

PCAST Meeting – September 12, 2013

>> John Holdren: Well, let me start by welcoming to our bimonthly meeting of the President's Council of Advisors on Science and Technology, our members, our presenters, members of the wider Science and Technology community who have come to join us in our meeting here at the National Academy of Sciences headquarters and let me thank, as well, for their interest, the folks who are joining us for the webcast. We meet at a time of a great many compelling and challenging issues, not least of which is the relation between the budget challenges currently faced by the United States Government, the implications of that for the health of the Science and Technology enterprise for STEM education, specifically for the research and development budgets of the many agencies across the U.S. Government that support so much of the research and particularly the basic research that is so important to the future of our country.

There is a lot of work going on following up a number of the reports that PCAST made to the President in the first term in the first part of the second. The President's climate action plan, of course is moving ahead smartly with many efforts going on in parallel on the mitigation front, the preparedness front, the international front, the question of comprehensive immigration reform and its relation to the health of the Science and Technology enterprise is still on the table. We are tracking and we will have sessions later today looking at progress on implementing PCAST recommendations on natural capital and ecosystem services. And of course, we will be hearing this morning in the first part of the public session about the extraordinary work that's been going on implementing the President's management agenda for the second term and also hearing about the challenges and opportunities in the domain of anti-microbial resistance, but before I introduce our first set of speakers, let me ask my co-chair, Eric Lander, for his welcoming remarks.

>> Eric Lander: I will be very brief, simply, welcome PCAST and everyone here and everyone on the web. It has been an extraordinarily busy period still for PCAST and we'll be discussing some topics, at least one of which I think will be the basis for yet another activity that PCAST will take on, so I'll say nothing more and we'll jump right had into our agenda.

>> John Holdren: I will just say one more thing, since our previous meeting, one member of PCAST has been announced by the President as a recipient of the Presidential Medal of Freedom, Dr. Mario Molina. (applause)

>> John Holdren: I am not sure there is any major award left in the world that Mario has not corralled, but this is an enormous honor.

President's Management Agenda

>>John Holdren: Let me turn then to the first set of presentations on the President's management agenda. We are fortunate to be joined by Todd Park, who is Assistant to the President and the U.S. Chief Technology Officer and Steve VanRoekel, who is the United States Chief Information Officer and Administration of the Office of Electronic Government in the Office of Management and Budget. We could not have two people more centrally involved in the President's management agenda to tell us about it, more details of their bios are in the briefing books for the PCAST members. I won't take more of their time to read their bios.

Todd and Steve, thanks so much for being with us, the floor is yours.

>> Todd Park: Thank you, Dr. Holdren, and PCAST members for having us today. We're excited to talk about the President's management agenda. As you know, when the president took office in 2009, very tech-savvy candidate and Senator and President, he really brought the notion of bringing government into the 21st century and thinking about the implementation of technology, good processes, good people to transform government to better serve the American people and I think we have made good progress in the first term with integration of new technology, our work on open data and thanks to a lot of the work you did around these tables with the PCAST group, we've been able to implement and think about how we move the ball forward. The President wanted to stand on the shoulders of that good work and in July he assembled his cabinet to ask Government to take it a step above and he called on the cabinet members to join together to think about his second term and how shaping management in a well-run management agenda could lead to great benefit.

>> Steve VanRoekel: So since July, Todd and I and Sylvia Matthews Burwell, the head of the Office of Management and Budget along with other White House leaders have been hard at work getting ideas, gathering ideas, working through tough questions and tough problems to determine where should we focus and how should we do big things. And our key metric here is not only thinking about the plumbing of government, how are we driving better benefit there, how are we doing things that are noble and fillable out with the American citizen and tackling those challenges we want to tackle. The four key areas we've sort of thought about and the questions we've asked ourselves that led to this are areas that I'll highlight and Todd will go into more detail upon. First is effectiveness, how are we best serving American citizens, how are we delivering services in the 21st century way that changes the game in the way we think about government service.

The second is efficiency. In a flat or declining budget environment, how are we driving savings into government taking from the opex column to give to the capex column so we can fund investments and fund new things we do. The third is economy, which sort of sounds strange in the context of a management agenda, but if you think about process improvement or opening up government data or opening up government intellectual property, things that have been central to this group, you can actually move GDP and thinking about the economy. And the last is people, how do we attract, train, retain and optimize the workforce, the Federal government. These centers of gravity, if you will, are starting to coalesce into generating for us the big ideas that are feelable and knowable with the American citizens.

>> Todd Park: I'll just talk a bit more about each of the four areas. We want to build on remarkable work that has already happened and scale up amazing things that have been tried in different parts of the government, come up with new ideas to pursue and so just talk about briefly four examples to help illustrate what we're talking about there. So in the area of effectiveness, the area of better, faster, smarter service to the American people, leveraging technical innovation, a great emerging example of what FEMA has been doing to leverage technology innovation to improve disaster response and recovery. For example, when FEMA in the past was trying to figure out how to get housing assistance to folks, they had to rely on the ground inspection to look at homes. Now it is happening post-Sandy and Oklahoma, etcetera, FEMA is able to look at aerial images, all kinds of other data to much more rapidly make assessments

and get aid to folks who need it much faster, more expeditiously. In addition, in terms of registering for aid, post- Sandy 57 percent of folks who registered for aid post-Sandy were able to do that via mobile and internet apps and websites, which is both more efficient and more effective for everybody involved and even folks who actually had lost access to electricity and internet were helped by FEMA agents armed with iPads to would go around and instantaneously register them for aid. Smarter, better, faster government service at work and the kind of thing we want to scale. In the realm of efficiency, getting more bang for a government buck, a great emerging example here is work of my brother in arms, Steve VanRoekel with process called portfolio stat, which is the process for running across agencies where they look at the portfolio, and say where is duplication, opportunity for improvement, etcetera. One example of a result is USDA had 21 different e-mail systems and they have now actually moved to a single e-mail system in the Cloud which works better for everybody. You can send e-mail to everyone at USDA if you are the Secretary easily. It also costs a lot less and the fact, it identified 2.5 billion dollars of savings to date and there is much more on the way, just a tip of the iceberg.

In the zone of economy, like how government operations can better support economic growth, I think a great example here is the whole U.S. Government as a platform for innovation and there is an idea we've talked a lot with y'all about over the last couple years, an initiative that is growing, the open data initiative, the basically take data, text is paid for and weather, climate, education, science, health, public safety, finance, etcetera, and open that data up in machine readable form for free and easy access by everybody. So entrepreneurs can take that data and turn it into new innovation, new companies and jobs, like for example we talked about in the past, iTriage, company in Denver started by a couple of ER docs that uses data from U.S. Department of Health and Human Services, where all the doctors and hospitals are to build an app that helps you based on where you are and what is happening and you find the best local doctor for you, best local help for you and help book appointment with the provider. It has been downloaded over nine million times has saved lives and created over 100 great middle class jobs in Denver. Companies like Opower locally here in Virginia, leveraged a whole bunch of data about weather, about energy use patterns, energy appliance efficiency, etc, energy efficient appliances, to help power service that gives tips on how to save on electrical bill. It's literally saved American consumers hundreds of millions of dollars to date thus far in its young life and created hundreds of jobs. Open Data, we talk to y'all a lot about. Great example of turning government into a platform for innovation, economic growth and as, again. A key element of our emerging management agenda.

The final category, we've been doing a lot of talking with folks across government about management agenda, getting lots of ideas and thoughts and there is this emerging thread around people and culture being critical enabler of all of the above, all of the above. And so there is a lot of exciting potential here and again, one of many examples of action or another program that we talk with y'all about in the past that the Presidential innovation fellows program where we're bringing amazing innovators from the private sector, tech innovators to work with the best innovators inside government on game- changing projects like Open Data and other initiatives that can help generate huge benefit for the American people. So these are just a few examples, but I think the common denominator across all of them and really central focus for the management agenda, is it's all about results. It's all about results. What the President really wants to deliver is not set of processes or a set of documents or a set of interim deliverables, what he really wants the management agenda to produce actual improvement in the lives of American people. Government that delivers better, smarter, faster services to citizens and

businesses, one gets more bang for buck, one that actually helps spur growth in GDP and jobs as a direct result of management action and one that continually advances on the people and culture front to be better able to do all of the above to deliver to the American people. So it's very exciting to be working on it. The President could not be more excited about, is personally sponsoring it and that is just hugely valuable, obviously, as we press forward with agenda to make government better.

With that, I think we'd like to open up for questions.

>> John Holdren: Good. We will follow our usual process where PCAST members wanting to ask question or make a comment, raise their name tag. Let me ask the first question while others are organizing their thoughts. What would you characterize as the biggest obstacle to -- that you are encountering as you try to advance the President's management agenda in the various ways you talked about. What is the biggest challenge toward getting all this done?

>> Steve VanRoekel: There is really two that have risen to the top, one is there is embedded culture in government around the way I do things in the future is the way I've done things in the past and thinking about continuous improvement how do I change the game, you will often see this and I'm sure many of you see it in private sector lives or academia, if you want to improve a process or make a process electronic, they will just take the old process and try to make that process electronic versus rethink the process altogether. There is mentality and culture of the prescription I've done in the past is the way I do it in the future. The second is budget environment. In this current environment, where we've got the blunt instrument of sequestration and a lot of uncertainty for the future, it makes its really tough for people to think about, how do I invest, how do I do multi-year investments that can drive benefit well into the future. We're looking at and discussing as part of the management agenda, are there things we can do to get smarter about consolidating resources across agencies to do shared services and strategic sourcing where we buy once, use often across government. Things you can quickly find low hanging fruit to save resources and then drive that forward. If you break down the cultural walls and start to streamline the way you do budgeting, that creates a bow wake that people can ride within, I believe.

>> Todd Park: The other thing I would say, there are no shortage of truly amazing high impact ideas for how to make government better. And one of the pieces of advice that we found most valuable from veterans of government who have been through efforts over the years along the lines of improving government. The advice was prioritize, right. It's going to be very difficult because the ideas are also spectacular but you can't do all these things simultaneously. You can't do them all at once. And it's going to be critically important to basically pick, based on impact, the most important things to do, the things that will be of most benefit to the American people. And then double down and really focus on getting those things done. And so I think it's going to be a challenge because there are so many good ideas and so many opportunities for improvement, but prioritization and focus is going to be key, I think, to actually delivering the results that the President is really focused on us delivering.

John Holdren: Good. Craig Mundie.

Craig Mundie: Here is a question, actually, for both of you in different capacities. The use of advanced information is clearly at the heart of many of these things that you prioritize and the

open data initiative is also a way to try to get value out of the government's investments. We've sort of watched with you over the first term particularly how that has evolved and my view is sort of that data.gov is sort of in V2 now and I'm kind of curious if you have a view you can share with us about how you see the evolution of the open data initiative beyond the, I'll call it the entrepreneurial approach only as it has been, of necessity, in particular, Steve, what do you see happening within the OMB environment in your office in terms of breaking down the barriers for more and more aggressive adoption of these high scale facilities that are demonstrated in the public sector and sort of haven't yet found their way into deployment in the government. What are the barriers is the big question?

>> Todd Park: I'll take the first part of the question, which is that a big breakthrough on the open data front was earlier this year when the President issued his historic Open Data Executive Order. So what has been happening to date was very entrepreneurial, if you will, efforts inside the government, start of efforts inside the government, open data initiatives on health, energy, education, global development, that were liberating data, making it machine readable, putting it on data.gov doing data jams, datapaloozas to spur use, etc. What building on those efforts the President then did going forward to say, look going forward then you default. For all new data, all modernized data created going forward by the government shall be open and machine readable by default.

And on top of that, simultaneously, was issues of a very detailed set of guidelines and tools for how to actually do that, all of which was actually posted along with other tools on project open data a depository, which is iterating as agencies really implement the policy to develop tools that are most helpful to do this, and so this is really wonderful to actually move to open data being the new default. Obviously, you know, data that should be protected for the purposes of privacy and security will remain protected, you know, but the notion of the new default for data that can be openable, being open and for that default to be machine readable in open format is a big break through step. So there will be further action on that front. Furthermore, data.gov, is moving to a V-2. There is a new beta addition called Next Data.gov, that you should check out. Among many other things exciting, one of the most exciting things about it is something that's not obvious from looking at the screens, right, which is that data.gov to date had been a site, right, where data got posted on it manually, right? So essentially agencies submit spreadsheets with their metadata for each data listing and that gets entered in data.gov, what is happening as per executive order of policy every agency will be publishing in a JSON file an index of all their metadata, openly and data.gov, is going to leverage a C-Can back end and harvest that magically and have it materialize and frankly anyone else can harvest those files, as well. It is moving to a much more open, no pun intended meta framework for open data, which will just help turbocharge the ecosystem further, So great progress on multiple fronts to really get to the next level on open data.

>> Steve VanRoekel: If that sounds familiar, it should for you, we modeled it off your health IT report on the tech section of how to think about meta data, how to publish meta data connections back to sources and things we were doing there. The barriers we saw we tried to address as we came out with the executive order, the executive order and the policy Todd and I published at the time that orders government to take these new approaches, really tried to address some of the barriers and to think about how we would get through those barriers and the main barrier for us was just the intellectual capacity of the agencies of government to understand how do I architect data in a proper way, how do I while respecting privacy and

confidentiality and everything else, start to open my data in interoperable machine readable way. We as Todd mentioned created suite of tools that the public can contribute to that, will convert and help agencies walk through this stuff. We also created a special team within government that could be deployed to agencies to help them. It was the team that basically got the 300 to 400 APIs launched this last May that are continuing every day to go in and swoop in and help agencies unlock the potential there.

Then the presidential innovation fellows has been incredible lever for us, we have taken private sector people and it is in their DNA and dropped them into key areas where we want to see data open, energy, health, other things from there. The order helps us a lot. It basically says and we've got mechanisms to track including the formation of across agency priority goal, the something the President pays attention to and we bring up to the Secretaries and Dep Secretaries a series of metrics and deliverables that say any time you create a new system you have to build it in this way. Any time you greatly modify an existing system, build it in this way. And then we'll find targeted opportunities to say there is public value here, let's go in and just in a way that's not new or greatly modified open up that data. We're starting to see momentum. I think there is room in the scientific space, I think there is room in kind of the big data stuff that we do, you know, the work we've done in weather and other things have shown us the way there. There's still lots of potential and work yet to do for us, I think we're crawl, walk, run, getting into the walk phase a little bit.

>> John Holdren: Good. Maxine Savitz is next.

>> Maxine Savitz: You mentioned efficiency and that you save 2.5 billion dollars, we have budget constraints are there incentives to the agencies they are able to take the savings and use for programs or things like that or is there barrier becomes well, if I do this, it makes ultimate sense I'm going to lose this money, so --

>> That is definitely a cultural barrier, we see the ROI is not realized with the person who actually does the hard work to get the savings and luckily, you know, this is one of the places where fiscal pressure actually helps us in that there is a greater mind set if I drive savings I can get better service and get that out. The good story here, if you look at the President's fiscal year 14 budget, tech spending goes up a little bit, 78 basis points which is relatively flat year over year and adjusted for inflation, very flat. But that's -- it's telling us a narrative we're starting to win the mind share on now is the time to invest in technology when the going gets tough, it is time to invest. We're very much moving the allocation in a way across an organization that say as you realize savings, let's invest in those savings.

The budget guidance came out on the tech budget last year OMB said to agencies, you must cut 10% of your technology spending and I'm going to automatically give you back 5% to invest in these certain areas. It was on citizen facing services, direct employee productivity or cyber security were the three areas and then I asked agencies to give me additional 5% netting to 0 that said in those same categories what are your priority things you would do and then we could look at the President's priorities and adjust across government and so I think in the aggregate we are in pretty good shape from tech spending. Like I said, we're winning the mind share discussions with Congress and realizing the tech is really going from this very discretionary thing to this strategic thing and starting to see the benefits of that in the realized savings.

>> John Holdren: Good. Jim Gates, please.

>> Jim Gates: Good morning, thank you for your brief, always great to have you guys back. I was wondering about a slightly different question. Clearly data.gov, is aimed at the Federal government and you are pioneering best practices for economic and delivery of information from government to citizens, I was wondering, do you see any examples where your best practices are causing state governments to think about using some of these models?

>> Todd Park: Terrific question and yes we are. For example, more and more states like New York State are opening up their own open data portals and in fact, there is a new section on data.gov, that is for state and local data, where states and localities can voluntarily list their data and metadata about their data and have it really become a one stop shop for innovators and entrepreneurs to find data of all kinds, very useful There' an extraordinary amount of data that is useful to citizens at the state and local government level. We look forward to turbo charging that kind of work going forward.

>> Steve VanRoekel: And cities.data.gov, is the site. The other aspect is the power of data in vibrant democracies and we've been doing a lot of work internationally. Data.gov was created in an open source way and we worked directly with the Indian government to deploy data.gov, in their environment, which they're using to fight corruption and other things. And then many other countries are now coming onboard to implement our data.gov in their environments. For example, we now track stolen cars using open data across the Mexican and Canadian borders and Amber Alerts are quickly coming behind. We do that with Canada now and I'm meeting with all the North American tac leadership in the next month to continue the work we're doing there. We're getting into not only the open data aspects, but the transactional aspects, as well, much to the benefit of all of our citizens.

>> John Holdren: (Inaudible, off mic) --

>> Hi, I think you've talked a great deal about how technology is going to help achieve the agenda. I guess I was interested in any comments you might have on how the President's management agenda will affect the doing of science and technology, particularly that the government supports and runs?

Todd Park: That's a great question. One of the really interesting ideas is being worked on as part of the governance platform idea is the whole notion of looking at our R&D infrastructure and our R&D investments and seeing if there are really creative ways to accelerate and improve the rate of transfer of that technology and that knowhow into the marketplace. There are all kinds of terrific ideas that have been generated, as I'm sure you know, on this front. And it's something we're very excited about. So that's one area.

I think also one of the things being really emphasized by different folks participating in the process is the importance of people and culture, right, and how people and culture underlies the ability to do all of this. And so, the work that you've done and others have done on how do we actually continue to get more and more of the best and brightest folks to engage in government and work with government on issues like S&T. Those ideas are ones that folks are really thinking hard about as we think about how to actually continue to advance the ball on people and culture as key enablers, as key engines, that really drive progress on all these fronts. So I think that

emerging work is really exciting and there will be more of that soon.

John Holdren: Good. Well I see no more flags up, not that we've really exhausted the subject, but I think people know that the time for this session is coming to a close. I just want to offer Todd and Steven an opportunity if you have any closing words you would like share, this is the moment.

Todd Park: Well, we always love speaking with PCAST. We take every opportunity we can to come be with you. So open invitation to invite us back on this and other topics because we just love this group and we love the chance to interact with you both formally in these settings and informally as well. So thank you very much for the opportunity.

>> Steve VanRoekel: And I think as we go forward with the formation of the agenda I think Todd and I both believe this won't be just a 3-ring binder we publish and put out there and do a press release around it, but it will be a series of things we do from both deliverables, initiatives and culture changing things that we want to look at for the long term. I think there will be ample opportunities for this group to help us think through the tough problems and help us break a little china and inspire people.

John Holdren: Great. So we thank you both for the work that you're doing and we wish you well, you and your teams, as you push this agenda forward. Thanks for being with us. (applause)

Anti-microbial Resistance

John Holdren: Now we're going to shift the name tag at the front of the room and I will ask Dr. Tom Frieden to take the stage. I usually as folks know, do not recite parts of the -- of our speakers bios, but I am going to take the opportunity to say a word or two about Tom Frieden's remarkable leadership at the Centers for Disease Control and Prevention and his remarkable history. In the '90s, Tom Frieden led New York City's program that controlled tuberculosis and reduced multi drug resistant cases by 80%. He then worked in India for five years building a tuberculosis control program that has saved nearly three million lives. He became the commissioner of the New York City Health Department and served through much of the 2000s in that capacity getting all kinds of remarkable things done, including reducing teen smoking, very substantially, and getting artificial trans fats removed from restaurant food and I just think the country is very fortunate indeed to have Dr. Tom Frieden heading the CDC and I think we're fortunate to have him here to talk about one of the really big challenges in public health anti-microbial resistance. Tom, thank you for being with us, we look forward to hearing what you have to say.

>> Thomas Frieden: Thanks so much, thanks to John Holdren and the group. This is a wonderful group, I follow closely the work that you do and value your input and insight. I thought I could just take a few minutes to talk about anti-microbial resistance, and give you a sense of where CDC comes to this issue from. CDC as an organization works 24/7 to protect Americans from threats whether infectious, environmental or chronic or whether from this country or abroad or intentionally man-made or naturally occurring, We do that with a broad range of expertise in virtually all of the infectious diseases, as well as noninfectious diseases.

We have staff in every state in the U.S. and more than 60 countries and we help both states and

countries increase their capacity to find, stop and prevent health threats. Our strategic direction for the next few years really is to improve health security at home and abroad, ultimately we want to keep people safe, that is crucial part of the government's commitment to our people and the second is to better prevent the leading cause of illness injury disability and death for both of those things strengthening the collaboration between public health and clinical medicine is really important and in fact, that nexus between public health and clinical medicine is absolutely essential to this issue of drug resistance.

So as I think of it, we face a perfect storm of vulnerability. There is globalization of travel, of trade, of medications, so that no infectious disease is more than a plane ride away, much of our food, most of our medicines are produced abroad. We are an interconnected and evermore interconnected world and that is not going to change, it will only accelerate.

Then we have three trends, emerging infections like H7N9, resistant infection, which we'll talk about here and intentionally created infections, including potentially-resistant, intentionally-created infections. Now when I think about drug resistance, I often think about one particular patient. I was the director of tuberculosis control in New York City for about five years right after New York City had experienced a very large outbreak of multi- drug resistant tuberculosis and I would work on Tuesday mornings in the tuberculosis clinic to get a sense of what was really happening. And so I had a panel of patients that I cared for. One of them was a man from small community in Kerala, India, he had what we would now call extremely XDR drug resistant tuberculosis, resistant to all first-line drugs as well as other drugs. Over the course of about two years with intensive effort, we were able to get him cured. That required removing part of his lung, that required intra venous aminoglycoside antibiotic, polypeptide actually, antibiotics, capreomycin for well over a year which was administered to him by his wife, who happened to be a nurse. It required great deal of support.

It cost at that time, 20 years ago, more than \$100,000 to get him cured. It would cost three or four times that today. Years later, I happened to go to India, where I lived for five years helping the government of India set up good programs to treat tuberculosis and I helped his community in his district, his state set up a tuberculosis control program that would have prevented his case of drug resistant TB, for about \$10. So this incredible nexus globally where we're all responsible for preserving the antibiotics we've got so we can use them for patients who need them is crucially important. At CDC we think of four key strategies that will be all, every one of them essential to addressing drug resistance, prevention and CDC is the nation's prevention agency and we'll talk about that more tracking, which is crucially important to identify where problems are and intervene. Improving the use of antibiotic, stewardship and then finding new drugs and that's not so much us but we occasionally do things in discovery in vaccines and other areas that would generally be industry, NIH, academia, and other partners. I'll talk about the first three in some detail.

First, let me discuss what some of the leading challenges are in our effort to track and stop drug resistant infections. One of the challenges that we have is the -- well, to be frank, very poor state of practice in terms of anti-microbial prescribing. We estimate that about half of all of the antibiotics used among people in the U.S. are either unnecessary or inappropriate. So we're taking this precious resource and we're squandering it. In fact, we produced earlier this year an estimate of antibiotic use in the U.S. that I'll show you later that is a little bit stunning in terms of just how high a proportion of Americans get advanced antibiotics every

year. Stewardship is a real challenge and one of the many areas where we think better collaboration between public health and clinical medicine will be very important.

Next week by coincidence on the 17th, we'll be releasing our first ever report on anti-microbial resistance that will look systematically at the problem and suggest an outline of solutions. It will review the latest data we have on a series of organisms and it will talk about some of the particularly urgent threats that we're facing.

Now one of those urgent threats is CRE, or Carbapenem Resistant Enterobacteriaceae, and CRE is truly a nightmare bacteria, it is a type of organism that basically has transmissible resistance genetic components that can go not only within a species, but among species, so it can move from *Cladiella* to E- Coli, to *Pseudomonas* readily.

It can encode for resistance to essentially all known antibiotics and have a degree of lethality that is quite high, What we're seeing is outbreaks in particularly long-term care hospitals, but also nursing homes and hospitals and elsewhere. The key fact to remember is that even though this is a really bad problem, it's not too late to stop it. And structural, structured intervention that we have recommended called detect and protect can basically stop outbreaks and clusters of CRE and other drug resistant organisms. That doesn't mean we shouldn't keep doing the other things, but it does mean we have to scale up effective outbreak control and prevention.

Now when you look at more common infections, you see a depressingly common curve of an increasing proportion of, for example, salmonella resistant to ciprofloxacin fluoroquinolones, an increasing proportion of *Campylobacter* resistant to ciprofloxacin. This steady increase is depressingly common in the all too common organisms we face.

If we're not careful, we're going to end up in an era that could be referred to as the post-antibiotic era. We lived through pre-antibiotic era and the antibiotic era and if we are not careful we'll be in post-antibiotic era. In fact we are already there for some patients and some organisms. I think that is why there has been, appropriately, a lot of concern about drug resistance. Some of these infections are very common and if for example the genes that code for CRE get out into the community, they could be that urinary tract infections which are extremely common, would not be easily curable with oral antibiotics and the implications of that are really frightening.

So we know, though, it's not only in this country and not only for organisms that are common in this country, we've seen Artemisinin resistant malaria growing in southeast Asia. This is a very troubling problem because Artemisinins are our last line of defense against Malaria. We do not have other good antimalarials in the pipeline likely to be available in the next five to 10 years there is still far too much Artemisinin mono- therapy and poor quality Artemisinin out there. There is a lot that needs to be done on the stewardship part of Artemisinin resistance. Of course multi drug resistant tuberculosis as in the problem I mentioned earlier, the patient I mentioned earlier remains a global threat.

Now as I said we're sounding the alarm partly because it is not too late there is still a lot we can do to alter the trajectory of the increase in multi drug resistance, that is going to require carefully tracking what is happening, implementing programs like detect and protect,

identifying strategies that work to drive down resistant infections and then scaling those up through a collaboration between public health and healthcare, one of the examples of tracking is something called the National Healthcare Safety Network or NHSN.

NHSN has been operated by CDC for many years, a couple years ago the Center for Medicare and Medicaid services CMS determined that in order to get full reimbursement hospitals would need to participate in NHSN and remarkably now 100% are participating in NHSN. That is a good thing. It's a system that helps hospitals get a handle on what is happen in terms of infections within their walls and it helps them control those infections.

NHSN is adding anti-microbial resistance module so that we can track the kind of resistance pattern in each hospital and help hospitals do that and help across hospitals because often one hospital, even one hospital system may not be able to see an outbreak that is happening in hospitals across geographic areas. So that kind of tracking system is crucial if we're going to be able to protect, detect and protect against anti-microbial resistance.

Now there are a lot of ways we can actually prevent drug resistance and I think it is important not to throw up our hands and say it's hopeless because there is a lot that works.

Immunization is one thing. You know, each infection that doesn't happen is a potentially drug resistant infection that didn't happen. So take pneumococcal conjugate vaccine immunization. We've scaled that up nationally. We've drastically reduced pneumococcal disease and, although we were seeing some resistance now that is much less of a concern since we have many fewer infections with it. Infection control, and this is something I think gets some recognition, but probably insufficient. I did a study some time back when I was an epidemic intelligence officer in New York City, of multi-drug resistant tuberculosis in New York City and we collected cultures from every single culture positive patient in the city. We tested them in a standard laboratory and did what was, at that point, cutting edge science, which was restriction fragment length polymorphism analysis and DNA analysis of the organisms and what we found was that a very high proportion of cases were part of outbreaks. They had been invisible until we could do that type of genetic testing and realized that they were part of multiple different clusters. And when we analyzed where those clusters came from they were largely from hospitals. This makes sense because at hospitals you have sick people and you have susceptible people mixing together. And we were able to document that at least 6% of every single case of TB in New York City in April of 1991 originated from spread in a hospital. That's bad enough but when we looked at the multi-drug resistant cases of tuberculosis it was probably most of them came from spread within a hospital. So there is a lot that we can do by turning off the tap in terms of infection control protecting the food supply so we don't have spread of resistant organisms through our food. Antibiotic stewardship, which I'll talk more about in a moment and outbreak detection and control either through routine infection control or very specific efforts and we had a situation, for example in Florida where we had an outbreak of MDR TB. We worked closely with many institutions in the state there and they were to drastically reduce it. So outbreak detection and control is important. This is the data I mentioned earlier and it's almost unbelievable but it is actual data on prescriptions per thousand people in 2010 and what you see is that in the states that have the highest rates of prescriptions antibiotics are prescribed more than once a year to every person living in the area, on average. So there is really a massive overutilization of antibiotics. And a remarkable geographic variation, you see that there is more than a two-fold variation between one state and another in the amount of

antibiotics used. So we have a long way to go and a lot that we can do on antibiotic stewardship.

One of the additional areas where we can make a big difference is in facility based stewardship and one of the things that's been done is to work with individual facilities to put in antimicrobial stewardship programs. And this is really an emerging best practice. It can decrease resistance, it can decrease *Clostridium difficile*, which is an avoidable condition that both spreads in hospitals and results from antimicrobial use and it can improve patient outcomes, reduce costs, and it's not that complicated.

The three steps here ensure that every single order for antibiotics has specific indications why are you giving the antibiotic, dosages and duration. So you stop after a certain period of time. Be sure to get cultures before starting antibiotics. I have to say, I trained in a facility where you would have been raked over the coals if you had started a patient on antibiotics before getting cultures. And yet, that appears to have become fairly common practice in health care facilities in many parts of the US. Third take an antibiotic time out, basically reassess, don't just routinely continue but is it really necessary to continue the antibiotics. Again, that number overall, about half of all antibiotics used in this country are unnecessary or inappropriate. If you do that you can save a lot of money, that's what at least one study shows, and reduce hospital stays.

So, I think there are important areas where we can make progress but there are also areas where we're not making nearly as much progress as we could. We don't have systematic data on global trends in antimicrobial resistance. We don't even have a comprehensive picture on the situation in the US. There is limited state capacity in US to deal with this and state and local governments in the public health sector have lost 46,000 jobs in the past four years because of state and local cuts. Sequestration has added to those challenges, reducing staffing by probably about 2,000 more jobs at the state and local level because at CDC about two thirds of all dollars go out to the front lines of state and local governments to help them detect and respond and prevent.

We also are encouraged by some of the technological advances and what that might enable us to do. One of the most exciting new areas is advanced molecular detection, which combines cutting edge traditional epidemiology with genomic sequencing and bioinformatics to be able to figure out faster whether there is an outbreak, whether there is resistance, whether there is increasing virulence of organisms. And then to help us trace back. it's not magical, it's not going to put in a machine a specimen and get the answer out. You still need to talk to people, you still need to do the shoe leather work of epidemiology. When you put those things together we have a power of being able to find, stop and prevent outbreaks that we never had before. Unfortunately we don't really have the resources to do it at the scale that we need to do it now.

That study I mentioned before we cultured, or got sub cultures of, every patient in New York City with tuberculosis. We then sub cultured them over about eight weeks, we then did analysis in a room about this size. It took about three months. We then put what looked like photo micrographs on tables about the size of this table and compared hundreds of them by hand to try to figure out which were the related organisms. This was three weeks of my life, by the way, comparing those micrographs in a leaky roofed building that has thankfully been replaced at CDC

since.

But that work can now be done much better by this chip in three hours. So we have this amazing new technologies, which can sequence a genome of a microbe in a few hours with supercomputing capacity. Put that together and I think we, rightly, recognize the amazing potential that sequencing the human genome has had. But we've only begun to unlock the potential of sequencing the microbial genome and also thinking about the interactions between specific microbial genomes and specific human genomic patterns. So we have a lot more to do in this area and I think there is a lot of potential there.

Now, I want to end on a positive note because I do think there are, despite many problems, there are real reasons for optimism. That peak of this graph is the study that I just mentioned. April of 1991, it was the high point of tuberculosis in New York City and we rapidly implemented a program that basically followed the approach. It was prevention through effective treatment of patients so they didn't develop drug resistance. It was standardized care so patients got good treatment. It was monitoring to track every patient with drug resistance and make sure they were followed up. It was infection control to turn off the Broad Street pump-like tap of hospitals that were spreading multi drug resistant tuberculosis. It was stewardship and outbreak detection and control. And it was patient centered care and it was really the collaboration of clinical medicine and public health. And the result of that was an 80% reduction in drug resistance in just a couple of years and a drastic reduction in drug resistant tuberculosis.

And it's not just in tuberculosis that we've seen this. This slide is about *C. diff* infections, that's *Clostridium difficile*, which is an antimicrobial associated infection. Often an outbreak, an unrecognized outbreak, in hospitals. And what you can see is that in London where they were able to revise their guidelines and do adequate care and infection control they had a drastic reduction in antibiotic associated *C. diff* and *C. diff* overall. So there are many areas where we can make progress and have success at reducing resistant organisms.

These are just a few examples. It's going to take a lot of people working together to both understand what's happening with drug resistance, identify the strategies that work to prevent it and reverse it, and scale up those strategies. But I think the basic concept of prevention, tracking, outbreak detection and control, stewardship. These are basic concepts which don't require enormous new knowledge. They do require rigorous efforts to get implemented. And they do require some resources. For example, the National Healthcare Safety Network doesn't actually have the funding to track antimicrobial resistance yet. So that's an area where there are gaps. We don't yet have the funding to do the kind of work we'd like to do in advanced molecular detection. Nevertheless with every dollar that we have we can focus and figure out what works and work to prevent it. So thanks very much for having me here. I look forward to the conversation

>> John Holdren: Good. Well, thank you for that very rich presentation. Not surprisingly the first flag up is my distinguished co-chair, the genomicist and head of the Broad Institute, Eric Lander.

>> Eric Lander: Tom, thank you so much for a spectacular presentation and for your leadership going all the way back to New York City and the MDR TB. You know, you rightly say the basic strategies are very clear to make a big difference, tracking and stewardship. And that there are

amazing scientific opportunities right now, just in the past several years. Yet when we look at how we're doing in implementing these basic strategies, I'd probably say most hospitals have no clue what the distribution of drug resistant organisms is in the hospital. Many probably don't want to know. Most nursing homes probably really don't want to know.

I'm intrigued by this NHSN and this fact you dropped that CMS actually tied payments to the implementation of these NHSN guidelines or regulations or something. And I see in that some potential that have a kind of race to the top that one could ratchet up over time the standards that might be required. I would certainly expect extraordinary levels of surveillance are possible, given the molecular tools today. And I would expect that we ought to have hospitals that practice like you were trained with regard to stewardship. Tell us more about this NHSN and the tie to reimbursement that might set in motion that kind of a race to the top. And let me just note that this in the context of, as you well know but I should make clear, PCAST has discussed this topic and I think we are very interested in potentially proceeding with a PCAST study in this area to see how we may be of use, not just in the context of CDC, but in the whole range of questions you've talked about and broader interactions in agriculture. So it's a topic of great interest to the whole group. But anyway, let me toss you my question.

>> Thomas Frieden: So, I talked about the importance of collaboration between public health and clinical medicine and that plays out at the local level, at the state level, and at the federal level. And we have had, over the past several years, a just wonderful relationship with CMS that did not exist to the same extent before. So it really is a collaborative effort on a broad range of issues, including reducing nosocomially acquired infections, HAIs. And what we've seen is some real progress in that area. So, Methicillin-resistant Staphylococcus aureus is down by about half over the past decade. And that's with CDC recommendations implemented through things like checklists Peter Pronovost and others popularized and implemented. And that impact is really quite substantial and can make a big difference. NHSN is a program, a surveillance tool, that goes to each hospital, goes to the state governments, so they can do oversight, except in a few states where the states are not allowed to have that information because of state law, and then comes to us at CDC or comes to CDC at the same time. And it has tools the hospital to manage and understand their own infections and infectious conditions, well. It's something that we're constantly enhancing and working to make even better. We would like to make the data transfer, and Todd Park is a great partner on this and other issues, electronic to the greatest extent possible. That will improve both the sensitivity of the system and the consistency across the country. With varying electronic health records that's not so easy but we're steadily increasing the electronic data transfer in NHSN.

We're also recognizing that it's not enough to do just the hospitals. So we're extending this to dialysis facilities and now, essentially, all dialysis facilities in the country are signed up. You know, we looked at MRSA a couple of years ago and we found, somewhat to our surprise, that with the progress in reducing MRSA in intensive care units much, maybe even most, of the MRSA is now associated with dialysis facilities. So we kind of have to track infections where they are occurring. Nursing homes will be a real challenge. One of the enhancements in NHSN that we're working on now is to include antibiograms from the local hospitals. And, again, electronic transfer would really help with that. We are hampered by not having adequate resources to do that as rapidly as we would like. But there are best practices and we fund collaboratives in different parts of the country and we learn a lot with them on what works to drive down different types of health care associated infections. And that's been a real area of progress.

>> Eric Lander: And just to be very clear that I've got it, what exactly is the tie to CMS. What happens to my payments if I don't do what?

>> Thomas Frieden: If you don't participate in NHSN you get a little bit less money.

>> Eric Lander: If I don't participate, but does participation just mean I sign up but do I actually have to deliver my monitoring on my success within the network or do I just have to agree to have a membership card?

>> Thomas Frieden: So the approach that we've used in many areas is to first pay for reporting as prelude to payment for performance. At this point we're paying, or CMS is paying, for reporting, essentially. We are not penalizing if you report and we want to make sure that everyone believes the data enough that they will accept, yes, If I didn't do a good job by that data, it's not unjust for my reimbursement to have been affected by it.

>> Eric Lander: Thank you.

>> John Holdren: Mario Molina is next.

>> Mario Molina: Thank you. Thank you for your presentation. My question has to do with use or overuse of antibiotic livestock or animal agriculture, I understand there is something called the preservation of antibiotics for medical treatment act, is that an issue or is it still a problem?

>> So enormous quantity of antibiotic are used in agriculture and regulation of that really is both FDA and USDA. CDC by and large is not a regulatory agency. We have seen in various pathogens an increase in resistance with widespread use of antimicrobials.

No one objects to the use of to treat animals who have infections, the challenge is widespread use of subtherapeutic amounts of antibiotic as growth promoters in animals and that is an area where the FDA has recently proposed some action, various legislation pending. What I would say is -- we're looking primarily at CDC as the widespread inappropriate use of antibiotics among humans and recognize that many of our most resistant organisms come from that particular inappropriate use, but certainly the animal antibiotic issue is an important one that's been looked at carefully.

>> John Holdren: Thank you. Barbara Schaal.

>> Barbara Schaal: I had a similar question, I thought I could drill down a little bit more. It's very clear that and this is concerns the origin of new resistant varieties and it's very clear in a healthcare setting when you have lots of antibiotics being used you'll be selecting for recombinant or mutation that gives bacteria advantage and resistance. What I was curious about and there may not be data on this, how significant is the problem of transfer, for example, from an agriculture setting of those resistant genes into the healthcare setting? Likewise, is there any significant origin of genes for resistance that come directly from the soil? We know these resistant genes ultimately, many are from soil bacteria, the genes themselves are quite ancient and probably selected for it at a particular level. My question is

just in the origin of these things, how much of these are originated within hospitals, is there transfer from agriculture setting and is there any recruitment from soil organisms?

>>Thomas Frieden: I think for the most resistant organisms we are facing now, they are mostly man-made. You know, as we all know, bacteria are really efficient, right, doubling time is in the 10 to 15 minute range, their genomic plasticity is relatively high, so have a relatively high mutation rate and the likelihood of eventually selecting out resistant organisms, particularly if you don't use multiple antimicrobial agents at the same time is extremely high for nearly all organisms. So for many of them, it is just a matter of time between the discovery of antibiotic and the emergence of resistance if we are using that antibiotic against that organism. There is a great history of this, as you probably know, soil microbiology gave rise to streptomycin, one of the first effective tuberculosis drugs in the work of Seldon Waxman, who reasoned that unless there were things that killed the tuberculosis bacteria in the environment it would have taken over the whole environment, so it must be there and went about trying to find them with his graduate student and found streptomycin. There is this very important subtext that generally what exists in nature has some antidote in nature. A modern story along the same lines, our laboratory in Fort Collins, Colorado, which works on vector born disease, learned of Native American a traditional healer who was aware of a bark of a certain tree that was effective at repelling mosquitos and ticks. And over many years they were able to actually identify the chemical in the bark created it in the laboratory, test it, find it is actually more effective than DEET, it works for longer, it repels more effectively and the reason it occurs in the bark of treed is to protect the treed against insects. So there are antidotes in nature. That is now in the process of being commercialized with challenges in environmental stability, but completely nontoxic, in addition.

The challenge is that we have now accelerated the evolutionary process massively by this extensive use of antibiotics in humans and resistance doesn't have to be irreversible in a community, but unless there are specific actions taken, it will inexorably rise, that is primarily from the use in humans.

>> John Holdren: I'm going -- the teacher in me, noted the first sentence you said might possibly have been misunderstood by somebody on the web when you said for most resistant organisms it's man made. You're of course referring to the selection of our use of antibiotics is drawing out and eliciting and encouraging that resistance, the organisms themselves are not man-made, you didn't intend that, but since we have viewers all over watching on the web, I just wish to be really careful to make that point clear that was not what you meant by man- made.

>> Absolutely. What I meant specifically --

>> Eric Lander: We all knew what you meant, no question, the word man-made and dangerous organisms sometimes might be misunderstood by somebody and I thought I would jump in to do the correction right there in case -- it is the first year teacher in me, who is aware of the kinds of misunderstandings that can happen. Great answer.

>> Thank you.

>> John Holdren: Thank you, Eric, and we'll turn to Dan Schrag.

>> Daniel Schrag we heard about overuse of antibiotics in the healthcare system, overuse of antibiotics in agriculture and then of course the challenges of developing new antibiotics, both economic ones and scientific ones. But we still don't have a sense of how much each of these is actually contributing to the problem. What would it take? What science would it take to actually figure out the -- we understand they are all contributing in various ways, but how would we actually decide how much is due to which of these different factors and where to focus our attention? Right now it feels like we're trying to do everything without a lot of understanding of what's really driving it?

>> Thomas Frieden: The key is first to parse the problem. Resistance is a general problem, but it emanates in specific organisms by and large or even classes of organisms as in the case of CRE. So for each of those situations, the solution is going to be different. The analysis is going to be different and for all of them, I do think that rapid sequencing is going to be very important because we can learn enormous amount about where organisms are coming from, whether they are clustered, which parts of the genome are predicting different types of resistance, how to overcome resistance from that kind of microbial genomic sequencing, we are scratching the surface of that. If you take malaria, or TB or HIV, or enteric or respiratory infection, they have different driving factors. I think for all drug resistant organisms we've seen there that I just mentioned, it's the human widespread use in humans that is driving much of the increase for enterics and skin infections we've seen in some parts of the world, there do appear to be highly resistant organisms in the environment being picked up. Rather than think in undifferentiated way about resistance it's important to think about the resistance in individual organisms or classes of organisms where that is coming from and how to counter it and I do think there are commonalities in how to counter things in terms of prevention and outbreak control, detection and stewardship, but there are important differences.

>> John Holdren: I'm going to take advantage of a target of opportunity, even I see Chad Mirkin up, but in light of the last couple questions, before I call on Chad, I'm going to take advantage of an opportunity.

It happens we have in the room, as a speaker in the next session on a different topic, Dr. Ann Bartuska, Deputy Undersecretary for Research in Department of Agriculture and I thought it would be good if Ann, you would come to the table here and use this mic, and offer any thoughts you might have on the last couple of questions that touched on the relative roles of agriculture and human overuse of antibiotic.

>> Ann Bartuska: Thanks for giving me the chance. I really was delighted in fact by the line of questioning that just happened. Because I think it's touching on something we've been thinking about a lot at USDA, to look at this entire issue is like looking at an ecosystem, we talk a lot about farm to fork with regard to food. This is really a farm to fork issue. How would you look at the entire antimicrobial environment and looking at attributable fraction from each of the steps along the way and if I had to recommend a big research question that would involve many of us around the table, many agencies, as well as organizations that really would be as Dr. Frieden said, parsing it out. How do we take the entire system, break it down and understand the functionality of each component. Right now I think we are taking our best guess, but some is guessing and I think this is a real opportunity for us to be pursuing because there is clearly an interest in agriculture to be smart about how we use antimicrobial, and appropriate role for animal welfare, connecting to human health is one step that has to be done.

Again, thank you very much for that.

>> John Holdren: Thank you. I'm going to call on Chad Mirkin, but I've been handed a note we are in violation of fire restrictions in having people sitting and standing in front of the door and so the webcast is showing in room 118 next door. So if you are standing or sitting in front of the door and you can't find another place, please go next door to 118 and watch it on the web. Thank you very much, we don't want to be arrested for violating fire regulations. Chad Mirkin.

>> Chad Mirkin: You talked about stewardship, which is central to contributing to the solution of the problem. Over the last couple of decades, there's been tremendous set of advances in point of care medicine, point of care diagnostics in particular, which is I think central to this problem, in particularly the ability to look at genetic analyses at the point of care. Yet the transition of those technologies to hospitals and certainly nursing homes and doctor's offices has been exceedingly slow. The question is how do you or what government levers can you use to facilitate that, if that doesn't happen, I don't see a quick fix to this problem, at least at the prescribing medication level.

>> Thomas Frieden: Absolutely. We have growing capacity to do things like rapid strep tests, for example, in pediatric offices can avoid use of antibiotics unnecessarily for kids that don't have strep throat and treat kids who would have otherwise not have been treated. That is an example of something that has happened. I think what we're hoping will happen in the coming months and years is expansion of culture and dependent diagnostic technologies, sepsis. Huge, right? Absolutely. Where rapid test you can find out is someone infected or not, do they have a specific organism or not and that can help you decide whether or not to give an antibiotic or not.

I think there is both promise and some peril in some of the technologies, we've looked for example at rapid tests for Salmonella, Shigella, E. coli, which will roll out in the next few years. They are great. They mean doctors in offices will be able to do a rapid test to determine if it a patient has enteric infection and what the infection is, however, if a culture isn't obtained or we don't figure out how to do next generation sequencing to know from the specimen what the specific organism is in terms of resistance and outbreak characteristics we may miss outbreaks. It may be two steps forward, one step back, increase diagnosis but reduce recognition of outbreaks.

In terms of your other question, what can government do. The FDA has been working to facilitate advances in diagnosis, other parts of HHS, NIH, and Barta have invested in diagnostics. We have done work at CDC in diagnostics of infectious diseases and I see kind of bimodal approach, one is high-tech and one is point of care, lower-tech. In the high- tech, an example would be technology that we picked up when the Department of Defense stopped developing it, we developed further called tac technology, we can have a single panel, doesn't fit in my pocket like the other one or I would have brought it, which is really quite small and you can put up to six different samples from different patients and it can test for 24 different pathogens in one very small amount of the material. We use that about a year or two ago in Uganda, when there was a large outbreak and none of our experts could figure it out. It was puzzling, let's try this technology. They threw it in the machine and it was yellow fever, which we did not expect. That was able to lead to vaccination campaign and control measures. There is kind of high-tech multi

pathogen platform and then the low-tech, the example of which would be something like the lateral flow dip stick, which for example, in clinical trials now for one for plague in Uganda also. In 20 minutes from urine, sputum, urine, sputum or blood or serum, you can find out with high degree of specificity for \$1, whether it is plague or not. We have been using that in practice and resulting in rapid treatment and savings of lives. I do think there is potential there and FDA is taking steps to try to make the licensure of diagnostic tests easier, however, we also have a problem and there are diagnostic tests out there that don't perform terribly well. In the case of influenza, for example, we have done at CDC an assessment of the accuracy of the rapid influenza tests and on one hand, they are quite variable, a lot of tests on the market and a lot of variability in terms of accuracy year to year. Second we basically tell people, if you really think it is flu, doesn't matter what the test shows, you got to treat them, their test may be negative.

>> John Holdren: Thank you. Ed Penhoet.

<< Ed Penhoet: Thanks for your remarks, following up on your exhortation to in the future have better collaboration, if you will, between public health and healthcare delivery, there are as you know, some good examples New York would be one, San Francisco another, where the public health and the delivery system work reasonably well in concert to actually address community health as overall community. Do you have some thoughts yourself about how beyond the measures that you have just discussed what are best practices, how can this be moved forward in the future? What are your views about how to actually implement the concept of this collaboration or really interdependence between the public health and community and healthcare delivery system?

>> Thomas Frieden: I think this challenge and opportunity of having public health and healthcare work together is the most important challenge for public health to deal with in the next decade. I don't think there are quick answers, I don't think there are simple answers, but I think there are emerging answers. One of them is simple communication, there is often remarkable lack of communication at the state or local level between the two entities, getting them talking to each other and finding out what resources are available is important, that may sound simplistic, but it is actually quite important. Using data as a bridge is quite important. Often community health programs or public health programs have data that shed enormous light on to what is happening in the clinical system that will otherwise be invisible to clinical system and the other way around, there may be clinical data that sheds enormous light on what is happening in the public health system or community as a whole. Data is one area.

A second area is specific services that are provided, whether they are TB or STD services or services that are in the bridge between clinical and public health and the third is in the drivers of care, the things that determine the structure of care, like requiring or incentivising participation at HSN, training, standardized treatment protocol. One thing we found in many areas is that when you standardize treatment, you greatly improve it. Doesn't mean you take away clinical acumen, or decision making, but it means that occurs within a range of evidence-based practices and that is very important. Often public health can serve as honest broker and convener. If you think of things like the advisory committee for immunization practices which comes up with the vaccine schedule every doctor in America uses that is something that is done as collaboration between clinical medicine and public health and then that standardization greatly improves quality, the same is true for standardized treatment

regimen for tuberculosis and sexually transmitted infection and others. I think data services and the drivers of care are all areas where there can be effective work together and certainly in drug resistance unless we have that kind of collaboration we're not going to make big progress. On the topic of collaboration, I would be remiss if I didn't comment first to thank the Dr. Bartuska from the USDA, and to comment that over the last few years we've had I mentioned our rich collaboration with the CMS, but also had productive collaboration with both FDA and USDA, on the question of food-borne infection. It used to be they were kind of, we were in different worlds. Now every week our team gets together and we look at several dozen potential outbreaks that we're considering. And unless we work together like that, we would not be able to do what we've done.

We are able to say what the human illness is, FDA and USDA, look at tracking and source attribution and how widespread a product is and that collaboration has been very, very fruitful.

>> John Holdren: Good. The last intervention from PCAST will be Eric Lander.

>> Eric Lander: Again, thank you so much, Tom. Looking ahead to the work that PCAST is likely going to want to do, I just want to pick your brain on some of the questions we've been asking ourselves. The first is to go back to agriculture and maybe Dr. Bartuska, will want to weigh in on this question, as well, which is we've noted the use of sub-therapeutic doses of antibiotics to promote growth of farm animals. Do we have any idea why that works? Because if we understood how we were manipulating the microbiome of the farm animals, there might be other ways to do it that didn't threaten antibiotic stock piles. I don't know if there is research anywhere that's shedding light on that question, meaningful light.

>> John Holdren: We'll let Tom and Ann.

>> Anybody that has an answer.

>> Eric Lander: Another one to pick your brain on before we get into this. Do we know the answer to this?

>> Well, I'm an ecosystem ecologist, I don't know the answer, but we have an expert here, (inaudible), on our staff at office of the chief scientist who does know the answer.

>> Turn on your microphone.

>> And here we go, thank you. As a veterinarian, animal health is extremely important to me and also the prevention and protection of public health. And I would -- I'd make a couple comments. One, know that some of the drugs that we use that are considered antimicrobial, for growth promotion really work as toxidia stats, they prevent infections that can reduce productivity in animals and actually the ionophore group is large proportion of the drugs that are used for growth promotants. In USDA, we actually have considerable investment in looking at the gut microbiome and evaluate mechanism and ecology of these antimicrobials, and how they influence animal production. If folks are interested in specific detail, Dr. Bartuska, and I can --

>> John Holdren: Folks are interested and would love to see details.

>> Eric Lander: My second question and last question to wrap us up here, has to do with the need for new antibiotics. Even with the best stewardship efforts, it's likely that we are going to still need more antibiotics, we're not going to recover the situation where our current antibiotics are as efficacious as they used to be because we're not going to get resistance out of the system. Yet, we're getting a lot fewer new antibiotics each year. The approval rate used to be 2.5 per year, it is now 0.5 per year and there are at least two hypotheses as to why that is. One, the economic incentives for new antibiotics are not that great compared to new cancer drugs. The other, it is really scientifically hard to get new antibiotics and we're succeeding less well at finding compounds that hit new pathway, the problem could be overdetermined in both of those could be right, but I was curious if I could pick your brain, Tom, as to whether you think A, B, or both are serious issues there?

>>Thomas Frieden: I don't know. I just had this conversation with Tony Falchi, a few weeks ago, I think he would pretty much say what I just said about it. I sometimes think if you go back to the first antimicrobial, Paul Ehrlich's Salvarsan 606 for syphilis Erlich worked hard, it is called 606 because it was the 606th attempt he made to make a compound that worked against syphilis and it is hard for me to believe we don't have people working just as hard and just as smart today with much stronger tools. So the question really to restate it is is it that we picked all the low-hanging fruit or is it that we are just not working in the right way to get the results we need to get. In either case, we certainly agree we want to make that pipeline as efficient and effective and productive as possible for new antibiotics. I gave at the outset four key components of addressing resistance, the fourth was new antibiotics, but by the same token if get new aspect antibiotics and don't fix the first three, we will lose those just as quickly. We need all of the above approach here.

>> Eric Lander: Very good. Thank you very much, I think all of PCAST wants to thank you, back to John to close this session before break.

>> John Holdren: Well, again, my thanks to you, Tom, my thanks to our colleagues from the Department of agriculture who were able to add to our understanding of this issue. And we are now going to take a 15- minute break, we will resume here at 10:45. Eric Lander will be in the Chair, the President has called cabinet meeting for 11 and so with apologies to the next round of speakers, I have to go back to the White House for the cabinet meeting. So 10:45.

Sustaining Environmental Capital: Making it Happen

>> Eric Lander: Welcome everybody back from our break to continue this morning's session of PCAST. Dr. Holdren, as he mentioned, was -- had to step away because there is a cabinet meeting this morning and he is on route to that. So I'm going to Chair the next session. Sometime ago the PCAST issued a report on sustaining environmental capital. The United States has several important forms of capital and one of them is environmental capital, but it is one we don't often think about as a rich form of capital that this nation is blessed with and that requires prudent management and sustaining. We are extraordinarily lucky this morning to have a panel of four very distinguished individuals across the U.S. Government who are working in all different ways with regard to agencies working with regard to sustaining environmental capital. We have Ann Bartuska, Deputy Under Secretary for Research, Education and Economics at USDA. We've got Suzette Kimball, the Acting Director of the U.S. Geological Survey. We have Sally Ericsson,

Associate Director for Natural Resources Energy and Science at OMB and Kerri- Ann Jones Assistant Secretary of State for Oceans and International Environmental Scientific Affairs at the Department of State. That's quite a lineup, and it's appropriate because this is a question that cuts across so many different areas across the government. I appreciate the four of you being willing to coordinate your calendars and come to talk to PCAST about efforts that I know started before our report, but have been going forward in addition in light of some of the things we said in our report. The panel is extremely organized, we're starting with Ann, and working our way down the line. I'm going to turn over to highly organized panel and ask Ann to start.

>> Ann Bartuska: Thank you and it is really wonderful to be on this panel and to be able to talk about this particular issue and I have to thank our staffs that worked tirelessly through the weekend to make sure that we were organized so well to use your time the most valuable way we can and also to convey pretty complex story about what has been going on in response to the sustaining environmental capital report. And I'm going to go right to my first slide, which is essentially both the set of recommendations that came from the report, as well as the outline of our talk today. We're pretty much going to go down that list and talk about some of the key recommendations and what we're doing about them. I'm pleased to be here for multiple reasons, I am the USDA principal on CENRS, providing oversight for this process that, in itself is really important, it brings all the agencies to the table to talk about their role in addressing those recommendations and I think it's kept like many things in government, you want to structure around them to make sure they work and move forward. Being able to operate within CENRS has been a positive step. But we also have subcommittee on ecological system, called SES, at the agency level where the work is happening. They were the ones charged with taking these recommendations and to sort through what can be done by whom, how, basic timing on it and to give feedback to the CENRS on what was doable from the set of recommendations. I need to mention that within all that and predates the report, we had established within the subcommittee a task force on ecosystem services. The initial effort of that ecosystem services task force was to develop inventory, we did that several years ago, they were also trying to find a mission for themselves, what do they do with themselves now they are talking about ecosystems services and environmental capital. The PCAST report I think gave them something more concrete to be working toward, be thinking about how we work through with the system, through the agencies to really address those issues. So the first thing I'm going to start with and actually where I will spend most of my time is the first recommendation which was recommendation to establish a quadrennial ecosystem services trend called QuEST assessment. And one of the things that we talked about in looking at how we would go forward with that particular assessment, we all agree we need to do something like that, the idea of being able to track the services, to link them to environmental market while that is not on this list, USDA in particular we have environmental markets where we try to come up with valuing these services, needed the best data we could to determine where and what is how. So the quest was important thing to do, right at the start appropriate. However, this report came at the same time that we were entering a really difficult time economically. All of our budgets were going down and I'll speak for my own department, we are 20% less in research budget than three years ago. The question is if you want to do this, how do you do it when you have no new money to do it. We really started diving deeply in how could we use existing structure and processes in order to achieve the same outcome. Now there is an added benefit to that and as a long-time civil servant, member of USDA, one of the best things one can do in establishing something new in government is build it into what already exists then it has longevity, when you talk about something like status and trends, it's more effective to build it

into an existing structure than it is to create something brand-new. So the first thing and we -- the subcommittee recommended to CENRS they look at existing assessment structure and see are they suitable for this particular assessment? And they came back with us to best, which is biodiversity and ecosystem services trends assessment. So they have taken the idea of quadrennial and moved it into more a stream lined in the sense of using the existing governmental structures, existing processes to look at what biodiversity and ecosystem services trends looks like. The reason, it is a very important aspect of this whole process is that PCAST actually did something that was incredibly valuable to us in reducing redundancy in government. We found we actually had across the agency in CENRS, 98 different assessments. When you think about that, now each one of them was established for a really good purpose and probably for a set of stake holders and a set of mission or a particular mission or goal. But when we started thinking about, how do you build into assessment processes ecosystem services and biodiversity, getting information, being able to report regularly, it really made sense to use existing assessments. So if you look at the far -- to my -- to the far right existing assessment and monitoring programs that, became one of the focal points for the initial work of the subcommittee and of the best team. There are a couple assessments lent themselves very well to bringing in best variables and in particular I'll point to the USDA ones that I know the most. One is the RPA, Resource Planning Act Assessment established by Congress, required report every 10 years with five-year update. It is designed to report on trends dealing with natural resources. You have chapter on timber and chapter on water and recreation. So now you have a chapter on ecosystem services and environmental markets, building into existing system going on for more than 50 years a new variable and new approach. NRCS has a resource conservation act assessment, exactly the same thing on private land, what is the trajectory, current status and trajectory of key resource variables. Using that existing assessment then identifying what are those new ecosystem measures or metrics that could be built into that assessment, use existing structure and you develop it and roll it out. It allows us to establish a monitoring system built into existing systems, gives us regular reporting and it allows us I think to move more quickly and with some level of stability in moving this kind of process forward. So the model that I'm showing up here has really become then the work plan for the best team. After they have done inventory, identified where the assessments were, they are starting to look at how do they work together to start populating the boxes? What do you monitor? Where do you monitor it? How do you do that? How do you use existing systems? I know you heard about EcoINFORMA, you will hear more about this in a minute. But tools like that really allow us, across government, to utilize, get data in a system that we could be more proactive about. Then perhaps even more important for the doing of business, of government, the business of government, is not to leave it in a static assessment that is all about science, it is moving into practice. So I point to the far left box at the top, it says decisions and policy impacting natural resources. The true test, not just reporting these data, the true test will be can you use data to inform decision making and make decisions that really address the issues of concern. And I think that is the other part of what BEST team has been doing. How do you build a system that allows you to look at our processes and build this information into those systems? So just running down the list of some of the activities that have taken place, I already have been talking about building on and improving existing Federal activities and using what we have, again, 13 agencies, not easy to work across boundaries, but I think this group has been doing that and coming to a common basis. Being able to through this assessment process, identify the measures that are important we can now identify gaps. Very important aspect, going back to the RPA model, the Resource Planning Act model, we don't currently measure ecosystem services per se, but do measure things like water. Let's reshape and reframe that water metric and to how does that provide a service. Take

existing structure and you use it and build it into those activities. One of the things that is indicate pilot survey of the Federal assessment, being able to have that list, that check list, we've never done that inventory before. We now know what we have. Then another task looking at previous assessments and what have we learned from them in terms of stability, flexibility, their robustness in terms of the measures that you add and use that you can bring and also asking our stake holders, how valuable, what is it you need to be making decisions to be informing your own decision making? I think having that ongoing dialogue has been really important part of that whole process. Identifying stake holder needs I mentioned and series of workshops to do that. It is also then building into existing steps and the one I'd like to mention here is NEPA, for those who are familiar with National Environmental Policy Act, it is a wonderful tool. It is a much maligned tool, it is very wonderful. It forces us to have structured way of bringing data and information and science into a decision. So let's use NEPA, let's bring in ecosystem services into the process and use that as part of the environmental scan that we all do every time we apply NEPA. That is one of the tests. How do you build this into that system. Then finally, continue seeking collaboration and partnership with those who do have data and the systems and I have to mention two really important partners that right from the beginning, the Heinz Center, because state of the nation ecosystem reporting process, a big partner on this and Nicholas Institute and Nicholas School at Duke, both who have been working on environmental markets, ecosystem services and getting relevant data to help make decisions. However, moving forward, I've sort of eluded to the -- there. The idea of doing a couple pilot projects and really testing the robustness of the system, how would you use it? Two ways, one to bring this type of information to a specific natural resource decision, not something generic or conceptual, if we have something to do, let's see how it works and I think that is a real strong interest of the natural resource agencies to apply it and then also to how do we take these types of systems and use the data in a concrete way and we've frequently not used, we have ecosystem data, biodiversity data, we've used endangered species act data, but ecosystem services per se, have not been part of the framework. How do we bring that into the process? Getting a handle on the known methodologies, the definitions, etcetera, is important part of the standardization process, developing guide books and guidelines and tool kit for agencies, it is all well and good to have a bunch of stuff on paper, but you need the how to cookbook, how do I use this. For NEPA, how do I use this? Continue to expand partnership with other organizations and entities who can be part of this team. But also I think that the last point is filling in the gaps and that's where the Science and Technology piece is as we do this, we learn more about where the gaps are and how we can more effectively move forward. So that's the process that we've been pursuing under the now the best model that was quest. I think that might be the end. The last thing I want to reenforce that all of this has been done under the CENRS oversight and I can't really state enough how valuable that is to the agencies involved to have that structured approach. They ask the hard questions of our team to go back and do the work. Thank you.

>> Suzette Kimball: Thank you, we really appreciate the opportunity to be here and my first statement is going to be Ann's last statement, is that we really acknowledge the partnership that has evolved through the CENRS SES, the ability to not only understand, but to really know the activities going on within our partner organizations and that has been a huge help in moving forward on PCAST report and the recommendations. I think we all recognize as Ann mentioned, best use of taxpayer dollars to pay attention to our current investments and leverage those investments in the best way we can to ensure they are used effectively and we know the vast amount of data that have been collected and will be collected can make better use of that

existing knowledge to support the generation of essential new knowledge and to expand the use of informatics and that is what we will be talking about with EcoINFORMA. Research agencies have much to contribute and much to gain from improvement resulting from the recommendation PCAST report on sustaining environmental capital. These agencies continually need better information on how to sustain resources they are responsible for, water, energy, recreation, fish and wildlife, both from a conservation perspective as some agency missions have, but also in terms of how to manage consumptive use of those resources. The agencies also understand they need to know the implication any one of their actions on biodiversity and ecosystem services and how that affects the dependencies that the human environment has, as well. The Federal government already has a very major investment in research monitoring and assessments and we have an understanding in many different ways of America's rich natural heritage. The efforts were developed to meet a variety of specific mission needs, however, and they have done so admirably over the past 100 to 150 years. We're entering a new era of dealing with some very complex environmental issues. And in those complex environmental issues, there is going to be more and more of a need for those data sets to be able to be used interoperably. Many efforts have taken place Ann, eluded to department of agriculture forest services, resource planning act assessments and the forest inventory and analysis programs. These measures specific aspects of forest area and location, species, size, health of trees, total tree growth, mortality, removal by harvest, wood production and utilization rates for various products, as well as forest land ownership. Similarly, the Department of Interior has major investment in monitoring assessment for key mission areas, including protecting icons of America's heritage, managing one-5th of the land base of this country, including 35,000 miles of coast line and 1.76 billion acres of the outer continental shelf. The responsibility to conserve fish, wildlife in habitat and manage water supply for 30 million people also drives those mission requirements and the need for an appropriate way to intersect across multiple data sets. When we start talking about ecosystem services we're really talking about two aspects of the natural system. The production of goods and services and the economics associated with that production. So it is important to note that in addition to monitoring there is a very important role for basic science in order to understand those production functions, to understand the basic physical, chemical and biological processes that produce ecosystem services and drive the system. That fundamental understanding is going to be critical to robust assessment of environmental capital, taking reach of river is an example few don't know for instance how much water is flowing in the system, the relationship between groundwater and surface water or what the ecological requirement of the species living in the stream might be, it would be very difficult to accurately assess the value of those ecosystem services to society. And in that case, what do we mean by the ecosystem services? Not only water production, but things like protection of water quality, the functions that for instance coastal systems may have to function as nurseries for commercial fisheries, a whole host of different kinds of characteristics in which the intersection multiple data sets is going to be absolutely essential in order to understand the value of the service that a particular ecosystem provides in the human context. USGS, not only USGS, other research organizations are undertaking many scientific endeavors to understand and quantify these basic ecosystem processes. For instance, USGS has been working on development of groundwater and surface water models, understanding shoreline and other physical coastal processes. Understanding ecological flow and effect on aquatic species and habitats, the environmental conditions that increase the likelihood that biological threats like nonnative species or wildlife disease might occur and interaction of multiple stressors on fish and wildlife. Examining how exposure to contaminants can affect the immune system of fish rendering them more susceptible to disease. Four years ago USGS created our Center for Science and Decisions which was really an effort to be able to begin

to bring together these multiple aspects of basic ecosystem processes and address the economic and social value associated with those. So how do we do that? One of the most important ways is providing monitoring and developing the biodiversity inventory. We developed number of monitoring programs in support of the department of interior and other policy and decision makers. The efforts which include stream gauging, water equality, phrenology, land and land use change fish and wildlife distribution and abundance and assessments of mineral and energy resources are good starting points for the PCAST reports called to begin integrated comprehensive assessments of the condition of U.S. ecosystem. Predictions concerning trends in ecosystem change, the synthesis of research findings on how ecosystem structure and condition is linked to function that contribute to societally important ecosystem services. I think it is important to note that we are not the only ones who are doing this. So what is our approach? Well, one of those is developing the EcoINFORMA hubs, first of which we have online is BISON or Biodiversity Information Serving our Nation. I think it is important to note that this is not a USGS specific activity as you can see, from the slide, we have well over 100 million records, 60 distinct environmental layers that have been provided by over 265 sources, including nine Federal agencies and input from scientists and researchers in all 50 states. It represents data from over 750,000 individual citizen and professional scientists. I think this brings into focus the need for stake holder engagement, for a way for us all to interact in a way that preserves the integrity of the data sets, but allows for information to come from a variety of different kinds of sources. The PCAST report recognizes how important research monitoring and assessments are. It also recognized that it was critical to maximize financial savings by enabling the integration and utilization of current knowledge held by these many different agencies to inform decisions, while facilitating the gathering of new essential knowledge. EcoINFORMA is needed to ensure that we sustain environmental capital, that Federal agency data are relevant to biodiversity and ecosystems, as well as socio economic data required in support of ecosystem valuation and decision support. We need to ensure there are published and machine readable, interoperable format to facilitate research engagement by public, private, academic and other stake holders and to support policy and decision making at Federal, state and local levels. EcoINFORMA is national scale open access interoperable data system that aggregates databases and provide unified access to biodiversity and ecosystem services information. Currently EcoINFORMA has two hubs, BISON, we just mentioned and EnvireoAtlas for ecosystem services in beta testing at the moment through EPA. I think it is important to note as we move down the line that the identification of hubs and places to begin work could not have happened without the efforts that are undertaken in the best assessment format. We are as we go forward going to be reliant on those assessments to identify gaps. But these hubs, the two hubs are only the initial components of what will be visible on ecosystem.data.gov, they are linked, provide focused access, sophisticated tools and leadership for data standards and are available for use for specific communities. The hubs also should help navigate numerous impediment to data mobilization, such as minor formatting issue that prevent the overlaying combination of data. Also within the approach is the need to ensure that we've got extended web services, interoperability and matchability. When we talk about the 1.9 million occurrence record from USGS in monitoring programs in BISON such as international biological information system, multi-state aquatic resources information system, which is a fish database, NAQUA, our water quality data set, north American breeding bird atlas explorer, submerged aquatic plants and non indigenous aquatic species databases. You can see the wide variability of information needed to address key ecosystem issues of the day. So where do we go moving forward? I think we have much yet to do, although we have a good start in the two hubs that we've already started work on with EcoINFORMA. We do need to continue to develop blue prints for implementation, we need to make

sure we have mechanism to interact effectively with stake holders to address the most critical issues. I think we need to identify additional potential EcoINFORMA hubs, land cover is a good example as one that is closest to implementation, but I have to say as a coastal scientist myself marine scientist, I recently participated in a workgroup looking at ocean exploration needs for the future and the very issues that we're talking about today in terms of being able to connect collect and connect large data sets is an issue that came up over and over in that three day symposium. We also need to make sure we can expand the partnership to other agencies and to nongovernmental organizations and that connection outside of the Federal family is very important. It is also important to ensure that we have organizations that are willing to be the hones, the parents of these hubs, so that we can ensure their success and their perpetuation through time. With that, I appreciate the time and the opportunity to be able to speak with you all today and I turn it over to Sally.

>> Sally Ericsson: Thank you very much. I don't have slides, if I had slides, it would be numbers and wouldn't be pretty pictures. I appreciate the opportunity to come here and say a few words about what we've been doing to implement the PCAST report on environmental capital. When the report was in preparation, we had discussions about a project that I've been very interested in since the beginning and we have been working as Ann knows ecosystem services, she's been working longer than I have, since we got here at beginning of the administration, tried to align the agencies in what the strategies were and all the basics and this report is really helped focus our attention on how to implement environmental capital agenda and how to think about ecosystem services more robustly. I won't get into specifics that Ann and Sue covered. Since the report came out a couple years ago and you presented your recommendation to the President we worked hard to incorporate the support the recommendations in the President's budgets, even with overall funding constraints that you are all too familiar with. When the report came out around the time we were finishing the FY 13 budget preparation, even though it was late, we asked for additional funding for QuEST, EcoINFORMA and work on ecosystem services in the budget 2.5 million doesn't sound like a lot, but sends signal to agencies this is important line of work and as Ann was talking about, important to send the signal so it becomes part of the basic work that the agencies are doing on ecosystem services, kind of focus it. The funding in FY 13, we requested two million for USGS and half million dollars for USDA for evaluating USGS interior and partner data from the monitoring ecosystem restoration program to identify candidates for assessment of biodiversity and ecosystem services. Of course with sequestration and all the, what we request and what actually happens are often not aligned. But we didn't get the funding for that, but still sends an important message and the work has been going on without the additional funding. It's very important to highlight that not just interior and USDA, other agency focused on trying to make this, try to support activities without additional resources. Nevertheless, in 14, the 14 budget request the President's budget, we included four million for the work of 3 million for USGS and a million dollars in fish and wildlife service. We don't know how the appropriations will settle out, our expectation is without the additional resources, the agencies will continue to work within their base to advance efforts. Suzette was talking about the USGS sustaining environmental capital, 2 million dollars for collecting data on water and aquatic organisms, as well as building water ecosystem service evaluation standards to be used in EcoINFORMA. The USDA, we work on competitive research, we try to increase funding for competitive research grants, AFRI, and fish and wildlife in 14, we proposed services incorporating ecosystem valuations, supporting fish and wildlife work on incorporating valuation into regulatory programs and program reviews. The agencies are doing a lot of work on this all across the government. The army Corps does ecosystem evaluation, the fish they are doing

conservation banking. One of the things OMB can do is align all those and try to work with OSTP and the committee to try to align those efforts. So there is just some consistency and overall strategy. This year's pass back to agencies also included management guidance, which directed the agencies to provide us with inventory of all ecosystem service related activities and so we're going to work as we get that information from the agencies, we're going to work with the other offices in the White House to understand and better align activities across agencies so we have overall strategy to assist in moving the ecosystem services in decision making so the regulatory agencies, they are using the tools and budget decisions are made using the tools, we have to continue to work on. What the next steps are. We have been working closely with NSTC, and the ecosystem ecological committee and Ann and Sue discussed those what is happening in those committees. We are seeing our job right now is to kind of continue to kind of push the agenda and especially agencies where it is not as might not be as high priority as in some, so we share information, share data and have a more -- better common understanding of what's going on out there. I want to sort of close with one interesting issue that hasn't come up yet. In the Sandy task force report, there was a lot of discussion, we tried to work in Sandy task force report to align our response to the hurricane to the PCAST recommendations. Moving forward, agencies are going to work to develop consistent approach to valuing the benefit of green infrastructure, for example, which can include ecosystem services and develop tools and best practices for facilitating green infrastructure when making Federal investment decisions. It's an opportunity to think about how to respond to natural disaster in new way and using new set of tools and we've got the -- a lot of robust work on this to take advantage of. It's too early to talk about what is going to happen in the 15 budget, which will come out in February as we're negotiating right now what is happening in the 14 budget and dealing with end of the 15 -- 13 budget, but I think that it -- there is a strong commitment inside the administration for ecosystem services and work on what is in the agency base funding and also new initiatives we can highlight and also Ann points out this, work we've done inventory now in more robust way and we can see where there are gaps and where there are places to align programs much more effectively. Kerri-Ann Jones.

>> Kerri-Ann Jones: Good morning, everyone. As the last speaker, I'm going to give this a different look, I'm looking from the international dimension. So I appreciate being here again with PCAST because I spoke to PCAST a couple of years ago before the report as we were looking at things internationally and I'm happy to be here to give you an update and talk about how we are implementing the recommendations of the report on environmental capital. My bureau looks at how we advance national interest internationally and how we make sure we are participating in important international discussions on I think have been come to be called sort of global challenges. The issue of biodiversity, protection and conservation is something so far we heard the national perspective, but see this as global issue. How do we engage on that stage? Just as has been pointed out by my colleagues, the issue of how do you bring science into this discussion and how do you know what you're actually looking at and how do you value different resources, is a challenge internationally, as well as nationally. For a long time, the importance of bringing science into policy discussions has been a priority for our country, but a priority for everyone around the world, as well, and we certainly try to champion that perspective. So the discussion about how do you bring science into discussions about conservation and biodiversity policy has been on the international agenda since about 2005. It has been very active discussion and a lot of interest in how do you develop an organization that can work at that interface. In early 2009, the Obama administration felt it would be important for us to be a part of whatever international facility or organization developed at this

interface. So the State Department brought together a number of the technical agencies who look at this domestically, as well as representatives of scientific community to talk about what would we think would be the core principles in an organization should be established? Let me just tell you what those principles are because they really sum up all of the learning that you've heard from my colleagues. First is that any organization would need to build on existing initiatives and not be duplicative, build on assessment and work already out there. The entity would need to be very credible, products need to be credible, need to be independent and they would need to be peer reviewed. This is something that we really try to advocate internationally whenever we are talking about science and interaction with policy. We also put out as principle that whatever the organization did, it would need to set clear priorities and it would need to have a credible and transparent process. And very importantly, for this organization to be able to work between science and policy internationally with many different kinds of governments, it needed to make sure it was policy relevant and not policy prescriptive because as you would imagine on the international stage, there is always a concern that outside organization is going to come in and tell some country what to do and that is not the purpose. This is about getting the best possible advice. The last principle that we put on the table was related to capacity building. Because when you are working internationally, there is a range of capacities that countries bring to the table. Some have stronger scientific communities than others, some have more tools at their Beck and call than others and we felt capacity building needed to be integrated into the work but should not drive the work. So this would not be a development organization, it would really be a science organization recognizing importance of capacity building. So I'm happy to tell you that the proposed principles we put out there were very important in shaping the organization and they became a foundational part of what is now the International Platform on biodiversity and ecosystem services and it was officially established April 2012. The bad news is that we still have kind of a cumbersome acronym, IPBEZ, we tried, but that was one of the harder things to change, IPBEZ, established, but doesn't roll off the tongue easily. The purpose as I said to integrate scientific knowledge into policy decisions. On both biodiversity and ecosystem services. What it will do, it will pull together existing scientific information on biodiversity and ecosystem services and it will evaluate that information and it will synthesize it into overall assessments in formats that would be useful to policy makers. While that is easy to say, I'm sure you realize how difficult that is to do when you are trying to sort of deal with the whole range of countries that are now members of IPBEZ. In addition the organization will try to identify gaps and policy relevant tools, as well as methodologies and look at what steps could be very useful in capacity building in countries that are members that may be lacking in certain capabilities or resources. There are three groups established under this organization, one is the plenary group, that is where all of the members come together to make decisions and to govern the overall body, there are now 112 members of the organization. The second body of the organization is the multi disciplinary expert panel and that's where scientific experts come together to conduct open transparent discussions about the assessments of relevant scientific knowledge and information. And then there is secretariat which performs administrative functions. I'm pleased to note that my co-panelist Ann Bartuska has been selected to serve as the U.S. representative or actually the regional representative on the multi disciplinary expert panel. And they have already started to work hard on the first work plan for the organization. We expect that the first work plan to be approved or reviewed and discussed and eventually approved at the plenary in December. I just had a chance to talk to Ann briefly before we sat down today about some of the discussions that happened at the Mep, she mentioned that the importance of indigenous knowledge and how do you integrate that into your scientific work was called out and she also mentioned there were a

couple key assessments that were identified as possibly taking priority that would go forward and maybe in the discussion period we can talk about those more specifically. Let me just mention that following up on those principles I mentioned, there is an effort to draw on existing assessments and to catalog what is out there and sort of populate what we already know into this international system and so the U.S. has been able to contribute many assessments already to IPBEZ, and encouraging other countries to do that, as well. Now it isn't easy to establish such an international platform and it has been slow going. But I think all in all, we're pleased with the progress and I think that is exciting there is now another international body that is looking at this interface between science and policy. It's challenging, it can be bureaucratic, but I think that there are more and more models for this and each area needs to look at what is specific to that area of science and what is unique to how it interfaces with policy. And with IPBEZ what has been noticeable is that you need subregional, regional and larger assessments, so it works at a lot of different levels, particularly challenging, but there was a lot of attention paid to that as IPBEZ was being thought about and developed, so I'm optimistic that kind of broad view from the subregional up to the national and across region be able to be integrated. I would say that the innovation piece has not been missed in terms of how do you set up such an organization. And we clearly feel that the private sector has a very important role to play, especially many of the important information technology companies because there are new tools out there, not all countries have those tools, how do we make sure there are tools that can make it easier rather than having it be very difficult to start with, so we're trying to reach out to the private sector and see how this can be not just a broad-based science policy tool, but also one that draws on the latest innovations available so it can be very dynamic as it goes forward. So I think I'll stop there and for questions.

>> Eric Lander: Wow! Thank you all for just a tremendous joint presentation, very interesting and so well coordinated. We follow the practice of putting up our flags and our colleague Rosina Bierbaum has jumped in first. And I see other flags coming. So, Rosina, I'm hardly shocked, that Rosina plays such an essential role in our own work with environmental capital should jump in first.

>> Rosina Bierbaum: I have a lot of questions, but I'll only start with one. I'm sitting here looking at the four of you who I worked with in various capacities for 20 years and thinking my God, here just among us a century of thinking about environmental stuff.

>> Eric Lander: I don't know whether they're thrilled with that characterization. But, in any case...

>> Rosina Bierbaum: I'm glad the glass is half full after we've done all this. But you know, we really struggled in the process of putting this report together with what advice we could give you given all the moving pieces and hundreds of monitoring programs, 98 assessments, 39 ecosystem valuation things, 13 agencies, the partridge in the pear tree and suite of multi disciplinary problems. I'm shocked we got through the entire presentation without any detailed conversation that involved climate change as one of those multiple stresses and that if I get a chance for second question, that will be my prequel to it. So you know our thinking was that these six recommendations we made to you really did need as they are to infiltrate the thinking of the agencies and cross agencies. I think you're showing us very exciting movement on all the fronts and pilot projects and hubs, but we really did think one of the goals was to be able to try to put this all together and to say what can we say about this state of the nation's

ecosystem services in biodiversity, you know diagnostically. What is improving, what is not? Why? What can we do about it? What information do we need? Kind of in this holistic sense, which as of yet the pieces you are putting together can't quite do. That would be one question and related to that, we were asked quite bluntly what we thought the cost of our recommendations would be and we thought it would be in the tens of millions, not billions, tens of millions and as Sally is saying, you can send signals that things are important, but with no money it is very hard to make too much progress and maybe that links into Kerri-Ann Jones's comment about the potential role of the private sector to help amplify the activities that you're doing because there obviously is value in that. And then given that we are part of IPBEZ, admittedly a bad acronym, the U.S. will I think be looked to for leadership in trying to show what a national assessment could be in terms of helping other countries figure out how to do that. If there is a question in there, it's how do these many pieces come together to make something that we would call a true national assessment given limited resources, but given the fact we are part of IPBEZ and need to move forward on that front. What do you see as next steps in the most enabling activities that you need and that perhaps PCAST can help with?

>> Eric Lander: And when?

>> Rosina Bierbaum: And when?

>> Ann Bartuska: Let me take a crack at that. I think the team has already identified two important next tasks. One of them I mentioned, how do you take this type of data and put it into decision making? The other is how do we taking existing assessment and then looking at it specifically, will it do, can it do what you just said Rosina Bierbaum, can we use existing assessment process and address what is going on with biodiversity ecosystem services using data from USGS, using the data from EPA, the processes we have at USDA and really try that? I think government is slow, you have 13 agencies and I think it's taken this long to get all the pieces together and to think through strategically how we can do this work. But that is something that we really do see as the next step is that -- it may have been called a pilot, that may be a poor choice of words, from the sense of let's take existing assessment and ask the question, can we use that to address biodiversity ecosystem services trends? If not, what are the gaps? What are the problems in being able to do that? My guess is we will start with RPA, because it is the most robust right now out there. It has established staff, it is something that many agencies are already being used. We used fish and wildlife service on endanger species, EPA data for water quality and using that in more holistic way, I don't want to prejudge that, I think the BEST team is trying to nail down exactly how that would happen. I think that would be the logical approach. The chair.

>> Stef Davis: Hi.

>> Eric Lander: Come up to the table.

>> Stef Davis: Oh.

>> Stef Davis: Okay. Good morning, everyone, Stef Davis, Neocell Biotech. I was wondering at the state level any way the government can enhance --

>> Eric Lander: Are you associated with any of the speakers?

>> Stef Davis: I am one of the speakers, but I had a question if that is okay.

>> Eric Lander: Are you a public speaker later?

>> Stef Davis: One of the microbiology speakers, I had a question about -- is that allowed.

>> Eric Lander: We don't do it that way, we have opportunity for the council to be asking questions right now. I misunderstood you were -- I'm sorry, I thought you were jumping in to add something on behalf of the speakers. No, you are not, thank you. We have a short period. I think our next question the panel have further answer to Rosina's question?

>> Kerri-Ann Jones: I did. Quick one. Rosina Bierbaum raises point in international settings the U.S. is often looked to as leader and so I think that what we are doing is recognized as really sort of out there ground breaking, we are trying to integrate across the systems and when we were thinking about whether or not we would want to join such an organization, there was tremendous interest and outreach to get us to join because the scientific community and our industry is so strong and all of the tools. Having said that, I think it represents kind of challenge that we're seeing in a lot of areas where we have enormous amount of data in systems that start up in isolation. The integration process is far more complicated than anyone thought it would ever be and so I think it is somewhat dynamic in how we get to, so what do you need to answer this policy question. So I don't know if there is a point where you get there, but you just sort of have to keep refining the system. I think this is happening around the world and everyone is struggling with this integration question.

>> Eric Lander: Barbara, I have not forgotten Rosina has another question, but Barbara.

>> Barbara Schaal: I'm always happy to defer to my distinguished co-chair. Thank you all very much, that was really a terrific presentation and it is really encouraging to see how far this has moved forward. This is a question maybe initially for Ann, but has for Ann Bartuska, has broader aspects to it. One of the things we know agriculture has a very large imprint on the environment and particularly on ecosystem services. That was something that was pointed out in the sustaining environmental capital report. As part of that conversation, PCAST really wrestled with the concept of ecosystem services and monetizing ecosystem services. Some aspects of it, it is fairly straightforward, you could talk about saving agrochemical, saving the use of water, reducing the use of water, soil, conservation, but a lot of this has to do with a very strong component of being a public good and that becomes a little harder to monetize. And so one thing I am interested in is learning a little bit more about those kind of conversations given there has been such a real theme in this morning's presentation about valuing ecosystem services. In particular we also had another PCAST report in December of last year and that was looking at agriculture preparedness, preparedness for facing the challenges of the nation. And a strong theme of that report was research agenda. The importance of doing research in order to really make us prepared and to do a better job of not only just agricultural research in general, but I think ecosystem component to this. My question for all of you is did any clear research agenda emerge as you were working on the sustaining the environmental capital? And particularly for Ann Bartuska, there was, do you see any research agenda emerging or what is the current research agenda for valuing ecosystem services?

>> Ann Bartuska: A lot of different answers to that question. Or different parts. Actually the first that I'm going to respond to is taking off IPBEZ, and one of we are in the process now of identifying what are the assessments that will be proposed to the plenary and one of them is on valuing and valuation and what makes different from IPBEZ approach is that right now a lot of the documentation on on valuation is I think coming out of North America and Europe in general and we really need regionalize and subregionalize some tools. If accepted by the plenary, will be interesting international approach to valuation and valuing and how you do that. So I think that is definitely emerging aspect. From the USDA or U.S. Government perspective, I'm going to speak from USDA. We have the Office of Environmental Markets, which was established by the last farm bill, it puts very fine point on how you actually develop market and what you need de minimus to do that. So we've been working a lot on standards and guidelines, that is one thing you need, what do you do, what do you measure, what does that look like and how do you provide guidance to a market place? You need a regulatory hook and that is not necessarily in our lane, but it is out there. We have been doing quite a bit of socioeconomic research, through ERS in particular, as well as Office of the Economist to figure out how does that actually work and what would it look like. The nice thing is that USDA we have agencies like the NRCS, National Research Conservation Service that has money to put into projects to test this theory and so they have been invest nothing conservation practices for the innovation grants that actually are looking at how you apply standard and guideline for water and how would you establish one-off market to do that? We are learning from that, what are the tools and new things you need to do that, mostly in socioeconomic side, not on the ecosystem side and I think that is very important contribution. Then on the ecological service side, because EPA has done such a fantastic job over the years of helping quantify what is science behind that, we are already a step starting from a very strong place working across with USGS more recently and Carl Shapiro, I have to call out, just a wonderful force in this whole area. But it is really coming down to at the landscape scale how do you put these together and so in some ways we now have a confluence of multiple events. We have the establishment, the LTERs and established the LTARs research sites, so clearly putting landscape scale in ecosystem, how do you put the pieces together? We are very fortunate and I know you have neon representatives here, but that in itself is a driver for how do you put more effective sensor and monitor in place to be able to do that kind of work and so I think you see a lot of different pieces coming together. We do not really have an explicit research agenda in the sense that you can go to say here is ecosystem research agenda and here are the steps. We have built it in to several different agency processes, strategic planning, there is flavorites in the national climate -- USGRCP, strategic plan specifically informing decisions which is goal two, which how do you bring the science and the practice together, so I think it's popping up in multiple areas. I really believe that is the appropriate thing. You are looking at ecosystem, they are comprehensive and inclusive and you want to have a thread that brings the different pieces together. Is I guess I feel like we are pretty good place from that standpoint.

>> Eric Lander: We have only a couple moments left in this session, but my distinguished colleague Maxine Savitz gets the last question.

>> Ann Bartuska: We have a few more responses down here. Can we take the time?

>> Eric Lander: Not technically, but let's do it anyway if it is quick.

>> Suzette Kimball: I'll do it quickly, I think we'll have opportunity in a few minutes to have

additional discussion. But I want to say, one thing that is emerging, I think more systematic approach, USGS for instance has been known for specific discipline science based investigations and data collection efforts for specific scientific issues and it's really, we've always had this underpinning of socioeconomic valuation and the support that we provide to the department of interior bureau in that regard, but it has only been recently we've been able to pull that together under the auspice of science and decision center to have a systematic approach. One benefit of the PCAST report and where we're going with both best and ecoinforma and IPBEZ, I can't even say it, there is an opportunity to carry that system, to make it intrinsic and systematic across the agencies. I think that is going to be one of the measures of success is when it gets inculcated into the various departments in that systematic way and we're on track to do that. Especially within interior and part of that is because our secretary comes from, to government from an industry that is dependent on understanding of ecosystem services and valuation and so you'll hear more about that kind of a thing. But I think that is a trend that is going to carry us into ability to ensure success in these efforts.

>> Eric Lander: Maxine, keeping an eye on the time here. Last question.

>> Maxine Savitz: Thank you and following on Rosina's question for Kerri-Ann Jones, as you look at the international, we are taking a systematic approach, are you seeing common framework that is going to be accepted by everybody for the data and is there any reluctance of any of the people countries you have been dealing with to share the data they have or be part of this?

>> Kerri-Ann Jones: Thank you. I think it is a very good question, I think it is a little too early to tell. Everyone is excited about this new organization and they want to see how it's going to work and see how the information is going to inform their policy decisions. I mean, to touch on what Rosina, was going to, the stress from climate and the stress from sort of development as to how do you make decisions as to what is going to happen to certain landscape or certain areas, every country is facing that. So I think everyone is optimistic about getting there. We haven't gotten to the point yet where I think Data is being put on the table and there have been really a lot of discussions yet. We're just beginning to get into that. I can tell you from my experience that it does get sensitive sometimes when particular country may see that you're talking about an issue that is particularly sensitive to them and so it's all very positive right now and I think the good thing is you just sort of start doing this and you work through the problems as you get to them. But there is a lot of I think goodwill and good feelings about this now, excitement about a new organization. I think there will be areas where there is some reluctance about sharing data or whether or not the data will be compatible in ways that make it's easy to sort of go forward, but Ann, was just at the meeting, maybe you have more specifics.

>> Ann Bartuska: Only I think you are right, it is too early, but I will say that we have been talking about is there a minimum standard that all countries would ascribe to so you have minimum set of measures and metrics and then you would build from there. We are actually joked around having bronze, silver and gold standard that countries could adopt or region could adopt. You are addressing both developed and developing worlds, that might be fun.

>> Eric Lander: Well, we could go on and I knew that Rosina has another question, but she's going to have to find an opportunity to ask it after we're done with the session. Simply because the topic is so rich and the time is so short. So I'm going to apologize for having to

call this session to a close and thank our four speakers, both for their presentation, but really for extraordinary work going on at the agencies and coordination they have achieved, not just this morning, but across the agencies, it's very satisfying to PCAST when we do a report to see so much energy that goes in afterward. This is really where the work gets done. Thank you very much to our panel. (applause)

Public Comment

>> Eric Lander: So we now turn to the public comment session for today's PCAST meeting. And I'm going to turn it over to Vice Chair, Maxine Savitz, who is going to run the public comment session.

>> Maxine Savitz: Again, I appreciate all, we all appreciate the people who are coming to give us public comments, that's very important part. Just remind you of the ground rules, you have two minutes each and then 30 second warning, but we have many of you have given us written comments, we will have if it is more than the two minutes and some other people have also submitted written. We have three people to speak orally and then we have intern will present presentation one of the people. First speaker is Venkat Bommisetty, Associate Professor of South Dakota State University.

>> Maxine Savitz: We won't start the clock until you sit down and begin because there is a transition.

>> Maxine Savitz: Just take a seat right there.

>> Venkat Bommisetty: Members of the PCAST and ladies and gentlemen, thanks for the opportunity to speak here this morning. I travel here from South Dakota to share with you my experiences as a faculty researcher at a small research university and to share my experiences again as member professional societies to engage small research universities in policy making process and decision making process. I believe these institutions are an important and integral part of nation's economic enterprise that unique goal is because of their attention toward education and because of their attention towards additional and local problems. Having worked with small research university for a decade, I believe I know about how they work, how they different from a larger institute, like Yale or MIT. I also believe that they need support of PCAST and other agencies to strengthen their STEM pipeline. I specifically --

>> Maxine Savitz: 30 seconds.

>> Venkat Bommisetty: Focus on three strategies one is to provide port teaching access such as Maux and ADX with effect to access and more importantly make them available in formats that can care to need of small research enterprises. And second, to encourage more focused research programs such as team based programs and speed network gain to double up public- private partnerships in these universities by maybe visiting web and SBIR programs. And third is to increase entrepreneurship education for the guiders institutes. Now --

>> Venkat Bommisetty: Conclude with a quote from--

>> Maxine Savitz: Thank you very much. We have your -- glad you were able to tell us your three

major points and we have your written testimony. We will make use of.

>> Venkat Bommisetty: Thank you.

>> Maxine Savitz: Thank you. It will be posted on the web. Our next speaker is Stephanie Davis, CFO from Neocell Biotech Incorporated.

>> Stephanie Davis: Hi, thanks for this opportunity for letting me come to speak to you about reduce and discourage of anti- microbial resistance, I'm a cell biologist and life science professor. I've done research in this area. So these resistant bacteria, have caused a lot of problems in the hospitals and outside of the medical system. We need novel therapist to it fight these super strains of MDR gram negative, gram positive bacteria, gram-negative causing some of the most problem because of they tend to be resistant last resort antibiotics. So there are variety of new therapies that can be used to stop this resistance in quick and fast way, which really needs to be taken close look at and need funding as well as grant money, as well. We can screen for occurring antibiotics from the plant world, marine environment, examples are anti-microbial peptides, even frog skin has a variety of compounds that can fight some of these resistant bacteria. Manuca honey, which you can find at Whole Foods, has been found to hamper attachment of bacteria such as c. difficile, streptococci, synergism using anti-microbial agents combination therapy such as clavulanic acid, Penicillin, and other beta lactams fight negative bacteria. A unique therapy coming out of Russia and Georgia has been using bacteriophages, which are viruses that attack bacteria. Decoivalean bacteria are highly specific, they have been found to cure mrsa patients, eradicate polymicrobial biofilms research can quickly develop and characterize --

>> Maxine Savitz: 30 seconds.

>> Stephanie Davis: One other important thing that has come out recently, develop anti-microbial agents that also activate immune system and maintain low toxicity, bacteria kept alive, but the disease causing compounds can't leave the bacteria, the research synthetic anti-microbial peptide such as Klak, d-Klak Klak, they attack gram-negative rods, activity against these synthetic anti-microbial peptides have shown to have activity against biofilm and cause ultimately bacteria cell quickly, so my last comment is we need to standardize extraction of new compounds and synthesis process throughout the world to get effective quick results resolving of these new terror threat worse than a lot of terrorism right now, because the strains at the moment such as new CRVs can't be stopped.

>> Maxine Savitz: Thank you very much. Next speaker will be Alynda Rowan, External Affairs Director of UNAVCO.

>> Linda Rowan: Thank you for the opportunity to make public comment to PCAST. UNAVCO is nonprofit university governed consortium that facilitates geoscience research in education using geodysse. Geodysse is the study of the earth changing shape, gravity field and rotation over time. Geodetic research defines the terrestrial reference frame and quantifies changes in properties of earth's surface and subsurface, ice sheets and Glaciers, oceans and atmosphere. Geodysse broaders benefits include preparedness and mitigation of hazards and foundational support for space-based observations, navigation, communication, surveying, resource management and National Security. Permanent and temporary geodetic networks are being used to study

ecosystems. GPS instrument measure ground water changes, soil moisture, snow depth, precipitable water vapor in the atmosphere, sea level changes and even ocean wave height. Combining the GPS data with meteorological data provides information about the hydrological and atmospheric conditions that is essential for understanding weather, climate change, the water cycle and the critical soil zone on the land's surface. UNAVCO is a small facility with core support from NSF and additional support from NASA, NOAA and the USGS. Although we are small, our impact is global and we want PCAST to be aware of our role in the solid earth sciences, atmospheric sciences and ecosystem studies. We collaborate with other facilities including UCAR, NEON, and IRIS and with international efforts --

>> Maxine Savitz: 30 seconds.

>> Linda Rowan:: Including Copious and the group on earth observations. Beyond basic research, we play role in the President's initiatives regarding earth observations, big data and open data, climate change, hazard mitigation and STEM education. Thank you.

>> Maxine Savitz: Thank you. Is Gale Hanson here? Okay. From the Pugh charitable trust will be the last speaker.

>> Gale Hanson: Thank you. I'm here to talk about the use of antibiotics in food animal production resistance of antibiotics and my message today are this, that antibiotics are widely used and overused in industrial farming to the detriment of human health. The scientific literature shows subtherapeutic uses in food animals are most concerning agriculture contributors to antibiotic resistance and you have the opportunity to advise the president that antibiotic resistance is a public health problem requiring comprehensive Federal strategy to preserve use of antibiotics for disease, treatment and control only. Conventional farm incorporates low dose concentration of antibiotic such as penicillin and tetracyclines, and feed and water of healthy animals that have not been exposed to disease. Many national and international agencies, backed by four decades of science have stated the problem of the overuse of antibiotics in industrial farming is urgent public health issue. FDA recognizes in 1977, the 1980s, the National Reserch Council and the Institute of Medicine recognizes and this council touched on the public health threats in December 2012 report on agriculture. Antibiotics are given at low levels than they set up perfect environment for bacteria to develop and share resistance up to 95% of antibiotic resistance has been attributed to sharing genetic material among diverse bacteria. We produce 9 billion food animals in this country every year. Antibiotic resistance bacteria enter the environment when animal waste is spread on fields or fertilizer or runs off livestock and poultry farms as well as contamination of meat in the food supply. Antibiotic have a place for animal production. As a veterinarian I know antibiotic to treat animals that are sick is appropriate, but inappropriate use where there is no disease contrary to public health. Eliminating inappropriate uses will not compromise the safety of food. Over the counter use of antibiotics is not allowed in human medicine and should not be allowed in food animal production, should never be substitute for good animal health management. The Pugh Charitable Trust asks you to take up this health issue and advise the President on methods to curtail the widespread overuse of antibiotics on industrial farms. Every day we delay implementing antibiotic stewardship on policy to curtail over use of antibiotics in food production, the risks the American people increase. Thank you for the opportunity -

>> Maxine Savitz: Thank you, our chair Eric Lander wants to follow up.

>> Eric Lander: I just wanted ask, is this area in which the Pugh Charitable Trust is active in funding work?

>>Gale Hanson: Yes, we are.

>> Eric Lander: It would be great if you could share some of the work you have been funding and the activities of the trust.

>>Gale Hanson: I can do that.

>> Eric Lander: That would be great. Thank you. Okay. I believe that brings us to the end of today's public session of PCAST. I want to thank all the members of the council who have been very active and are in the midst of studies and about to begin a new set of studies. Thank our public speakers who have come from all over, including South Dakota, to come and speak to us today. I want to thank the people who have been here in the room and to everyone who is watching on the web. This concludes our session, we will be back in session, I believe in November. Thank you very much.