Mary Klote: I am Mary Klote. I am one of the Deputy Chief Research and Development Officers within the Office of Research and Development. I am really excited today to talk about this cutting-edge topic. I am joined today by a number of our esteemed colleagues from our National Artificial Intelligence Institute. I am going to just stop for a second and let Gil, Christos and Michael go ahead and introduce themselves.

Gil Alterovitz: Hello everyone. My name is Gil Alterovitz. I am Director of the National Artificial Intelligence Institute. It is great to be here to talk to all of you about this exciting work. I am looking forward to talking about that. I will pass it back. I think, Michael, you may be on mute.

Michael Kim: Hi, sorry about that. Hi, my name is Michael Kim. I am Chief of Staff at the National Artificial Intelligence Institute. I report to Dr. Alterovitz. I am a physician and clinical Pharm Rx, radiology, neurology background. I have worked in different research and operational things. I look forward to this panel. I am really excited.

Christos Makridis: Hello everybody. It is an honor to be here. My name is Christos. I have been serving Gil and Michael. My background is in economics and engineering. Like everybody else here, I am really excited and honored by the opportunity to share what we have learned and the conversation that lies ahead.

Mary Klote: Thanks everybody. We have some other panelists that are going to join toward the end of the call. We will introduce them as they take on some of the questions. Just a note for our audience, this is going to be the first of several sessions that we are going to sponsor on artificial intelligence, research, and the IRB. The information that we are presenting in this session is not ORD policy at this point. We are just having a talk about AI. What will come in the future will be discussions about forming guidance around the use of AI, how we are going to implement some of the trustworthy AI documents that have recently been released. This topic today is really just intended to introduce you to some of the issues that are related to AI and research, and specifically for IRB review. We will get to those initial questions. In future sessions, we will also talk about the use of AI and things that do not go to the IRB. There are lots of things that are being done in quality improvement and operations. That are lots of things that are research not involving human subjects where people are using de-identified data or synthetic data. Those will be in future sessions.

As Parker mentioned at the beginning of this, we are not going to have a live Q&A from the audience. Again, we have 90 minutes today for a really big topic and some pre-determined questions to get to the heart of this matter for all of you. Future sessions will have that open Q&A, but we wanted to just level-set at this meeting today.

To really get things started, when we talk about artificial intelligence in our daily lives, I am not sure that all of us might appreciate some of the artificial intelligence that is affecting us every day. They are things like my smart watch which tells me when to stand up. Right? It suggests when I should stand up. The fact that when I am typing something in Word, it starts to complete the sentence for me. Right? Things like that are little AI things that have already been added into our lives pretty seamlessly at this point. We almost do not know that somebody in the background is programming these things and introducing them to us. A lot of them are really great time savers and great things to help us in our lives. There are some challenges, and we are going to talk about them. Even for Mother’s Day, I went on ChatGPT, and I wrote my mom a Mother’s Day poem. I had ChatGPT write her a Mother’s Day poem in an Irish brogue using her name. It is things like that that are really fun to do.

Dr. Ramoni has challenged everybody on the staff in ORD to try to use an artificial intelligence tool, whether it is going onto Open AI, or if you have downloaded one of the programs and are paying for one of the services. Try to begin to use some form of AI to help you in time saving. I used it one day to help me write an outline for a Human Subjects Protection talk I was going to give related to the history of Native American research and some of the things that have happened to Native Americans. It brought up resources that frankly I would not have considered myself. I learned something from doing the outline in that way.

We also want to talk about the fact that we have more than 346 studies right now going on in the Department of Veterans Affairs. These are just the research projects that are listed in VAIRRS. I am not talking about all the operational work or other things happening. We have 346 studies that when you went to VAIRRS, and you put in the terms “artificial intelligence” “machine learning” or “natural language processing” pop up in a VAIRRS search. That is really what we are going to focus on today, and particularly those studies that end up in front of the institutional review boards.

Those are the words that I used when I did my search of how many studies are going on at VA right now. What I would like to turn to Gil and ask is, can you define for our audience what we are talking about? What are the right words we should be using when we reference artificial intelligence?

Michael Kim: You are on mute.

Gil Alterovitz: Yes, I was looking for the unmute button. Great. I am having a few screens here to be able to share with you that when you think about artificial intelligence, there are a number of definitions out there. In some ways, it is lucky that the federal government has a definition that is commonly used. That is referred to as the National Defense Authorization Act, which comes out each year. The fiscal year 2019, there is a definition there that is often used in a number of the different executive orders. I can certainly go through parts of that definition, but you can look it up also online. Essentially, it defines it in terms of characteristics. I will read a little bit of it, and then we will continue.

The term artificial intelligence includes the following. You see they are kind of defining it by some features that it has, and not necessarily through other means. For example, number one, any artificial system that performs tasks under varying in unpredictable circumstances without significant human oversight or that can learn from experience and improve performance when exposed to data sets.

Then there are four of these kinds of statements. This was just one of them. I think the thing that is in common is they are all about essentially trying to mimic or emulate in some way human cognition, whether it be taking information in, processing it, and then relaying a summary of that information or some prediction based on that in a way that we traditionally tend to associate with human thinking. That is kind of the commonality there.

One of the things to keep in mind in AI, or at least the AI that we are especially carefully looking at, is that some of the new approaches can be thought of as a type of black box. You do not know exactly why it came to its reasoning. There are not necessarily specific rules in there that you can go through and decide, does this one make sense in this application? Does this other one make sense? Rather, there is this emergent behavior. You have outputs from this system that you may not be able to predict given just slight variations in the input that you give to the system.

In traditional approaches, you may say if you have greater than 100 heart rate you have tachycardia, 120, or whatever it is that you set as your threshold. You can kind of define that. Of course, it is going to be different for fetal heart rate, so there can be exceptions there. You can establish these rules that people are often used to in clinical settings. It is a lot fuzzier when you get to these AI systems because small perturbations and small changes in input can lead to large changes in the output and its decision process. That means that you need to potentially set up guard rails to limit or define the world that the AI is looking at or the output of the world that it is able to communicate.

Mary Klote: Yes thanks. I know you have been heavily involved in the Trustworthy AI Initiative that the White House just signed off on. There is a break point between studying AI itself. When we are talking about research, you can either study the AI itself or you can use AI to do things clinically and whatever. Can you just give us a break point between how those two categories play out and maybe an example of each? Thanks.

Gil Alterovitz: Right. It is an interesting point. It is a solo point in some ways. There are a number of different guidances that come out. Right? There is the AI Executive Order that just came out. There is also a draft OMB guidance on AI that came out that kind of adds more specificity to what came out in the AI Executive Order. That executive order that came out actually refers to a past executive order, which is this other one on trustworthy AI. That one has guidance that interprets that. That is where this all comes from. It is from the guidance that was used to interpret the original executive order in trustworthy AI, which the current one references and adds more to, and which the new version of the OMB memo adds additional details to.

Let us go back to the past in terms of what that guidance around that original executive order was trying to define what counts as R&D as the use cases that are captured in its inventory and for what needs to be considered consistent. At that point there were nine principles around trustworthy artificial intelligence, which are outlined in that executive order. People were asking questions. How do we interpret this? There were three things outlined, basically. If you are doing research into AI itself, something that often you might see at the National Science Foundation. You might see it there, in industry SBIRs, or things like that where whoever created these different trial pots may be doing research. You see these things coming out into AI itself. That is improving natural language processing for improving language processing. That counts as part of that exemption based on that guidance.

The second type of R&D which is not considered part of that exemption in that interpretation that was released by OMB is R&D that is not about the AI itself. That is commonly what we see in the VA. We are not necessarily studying AI to make better AI, but the R&D is on a specific application where we might leverage AI in some way. That part is that component there.

There is another aspect, which is that regardless of where it gets categorized in that R&D spectrum between those two, they still believe that it is important to use these principles to inform the development. It just said in one case it is required. In another case it is more about informing. There is a special interest in cases that potentially could lead or that they are thinking potentially could lead to an operational use case. The thinking there is consider these items at the beginning, because if you wait until you are thinking about operations, you may have already trained the model on a biased data set. You may have already done some aspects in your studies that will be much harder to change when you go into operations, or they might have to redo.

Those are kind of the overlying steps to think about there. Each of these documents has many pages. The last one is over 100 pages depending on which printer you use. Essentially, there are a lot of these, but it really comes down to the fact that it is hard to predict the output of AI. In some cases, we may not be able to trust it. When I say trust, it is not necessarily only that it gives correct or incorrect answers. It may be that it gives biased answers. It may do something called hallucination, which almost think of it like a dream. If you have a dream, is it false? Is it not true? It is sort of a fantasy, but it is sometimes built on a piece of your reality. Right? It is either missing context or for whatever reason it is not really true that you can fly around or whatever it is that you may be dreaming about. It may be a thought or a plan for the future. It may not. These are all things that have to be considered when you think about artificial intelligence, because it is not as simple as in the past where we can analyze it and say okay. If I give you this data, I would expect this answer. We are in a different world now.

Mary Klote: Let me just make sure that I am clear on the three types. There is research on the AI itself. It is something like improving natural language processing. The second one was where you are not studying the AI itself, but you are leveraging the AI for a research study.

Gil Alterovitz: It can include tweaks of it. If you are customizing it for your research study, customizing it for – it is not like improving AI for AI in general. It is really made for that application area. Yes.

Mary Klote: Okay. I was trying to understand the third R&D, because you jumped to operational uses. Is the third R&D use when you use the AI for clinical decision making?

Gil Alterovitz: The third one is really an operational use case.

Mary Klote: Okay, it is operational.

Gil Alterovitz: It is not R&D.

Mary Klote: Okay.

Gil Alterovitz: There are two R&D ones. Within the first one into AI itself, it should be used to inform that work.

Mary Klote: I got it.

Gil Alterovitz: For the second one, it is required for that work. For the third one, the thought is with the second one that it might lead to operational use cases.

Mary Klote: I got it.

Gil Alterovitz: In the first case, if you are doing AI into AI itself and it has no operational potential, then it should be informing. It is not. In the last case, it is an operational use case. Those are required to be included from the design phase. Yes, those are required as part of the inventory. Inventory is done about once a year, although with the new executive order, there are thoughts it might be done earlier.

Mary Klote: Does the executive order take into account, or the guidance document from OMB take into account in that second category? Say you have a validated AI model that you want to use in a research study like a validated checklist you would use. You are not trying to validate the checklist in the study. You are just trying to use it as part of your study. If you are just using the AI, it has been validated, and it is trusted and whatever, would that have a lower concern than if you were trying something truly new and potentially customizing it? Is there that break in the second category?

Gil Alterovitz: The way it is defined is based on use cases rather than what you as a researcher want to do versus another one. If that use case has already been done before and shown to be trustworthy, then it is cleared essentially. If you have a variant on that use case, then we have to look at that variant in some ways.

Mary Klote: Interesting. Okay. All right, I think we are going to move to Christos. You recently published. Thanks very much, Gil. That was very helpful. I am sure we have more questions for you. Christos, you recently published a manuscript with questions that IRBs may want to ask researchers who are going to study something using AI. First of all, what led you? It sounds like you are an economist. What led you down that path?

Christos Makridis: Number one, thank you. It has been an honor to have you on the team with that manuscript. It was a number of co-authors to help to cross the finish line. Thank you for that. The incidence and how this kind of began was, we were just talking as a team. We are in AI, and we are evaluating a lot of different projects ourselves that involve the use of AI. We also realized that there is this gap between where a lot of research is in the broader community and then the projects that are being branded or called AI. There are a lot of similarities in these projects, so you think about what data they are using. How are they training their classifieds, et cetera? There are a lot of commonalities, but there are also some new risks that get introduced.

We thought about, for ourselves, what questions do we have to ask ourselves to make sure that we are building it with these principles in mind in the trustworthy AI principles that Gil just talked about. I think this was an early conversation that Gil and I were having. I think Gil said, what if we were just to create some basic standards that people could innovate on? We are not trying to say this is the supplemental module that should be used for the rest of history, but it is a place to start. Our aim was really to say, here is what we have learned around the sort of questions you have to ask yourself.

For example, describe how the data is being used to train and validate the AI system or the AI tool. How representative is the population at hand? That is a big issue. So many people talk about bias, and bias really is a divergence between predicted values, actual values, and understanding where is that discrepancy larger in the population. That begs the question, how representative is your sample for the population that you are trying to make inferences on? That is one example of a question.

We also ask the people that are undertaking the research to enumerate the different sources that they are going to be using. Then talk about the pros and cons of the different sources and the sort of data cleaning that needs to be involved. No data set is perfect. Maybe the only thing worse than having no data is having no good data, but being really transparent about where the gaps are in the potential data. Then just kind of a last thought to think about is around privacy security and how this underlying research is advancing the cause of veterans. How is it improving their well-being? That requires preserving privacy. It requires understanding the model and what is actually driving the key results. We look at the principles under trustworthy AI. You have exploitability, accessibility, and then obviously the security portion. All in all, this research was kind of an attempt that began from our own conversations around what questions we should be asking ourselves, and then hoping that it could be useful at an even greater scale.

Mary Klote: Yes. It really was eye-opening for me because I had not truly considered all of the things that should be asked. Part of it – we will get with Michael about this as we move into how prepared study teams are to answer these questions. Then how prepared are IRBs to understand these questions really? You touched on some of the questions. Just for those who do not have a copy of the manuscript, can you just go through what? You touched on some of them, but not all of the questions. Can you just for the audience’s sake?

Christos Makridis: Yes, I would be happy to. For everybody listening, it is an open access article, so you can download it and can read it verbatim. I love the way that the first question is worded. Basically, is there any use of AI? If not, you get to just pass go and not answer any of the other questions. If yes, then one example is describe how the data is being used to train and validate AI tools. How is it representative of the population that the algorithm is designed to impact? We also ask that the respondent describe the underlying population of interest in the sample that is being used to train it. Describe the data wrangling tools and analytical controls that would be used to actively mitigate the potential effects of bias and other misattributions of cause in or on the data. That point is actually really important.

In computer science literature, so many researchers are focused on just the predictive component of in sample prediction, out of sample prediction, and using cross validation. The question of causality is so essential to that especially for a clinician. It is because you have to diagnose what is the underlying structural factor that is affecting the patient. Describe plans to ensure that the data used to train the AI tool will be used to perform effective AI decision making as well as the metrics that will be used to evaluate effectiveness. It is not just we built an algorithm, and now turning it over you have to also protect the process. Also, list the different sources of data used to train and validate the AI tools and the way that the sample is constructed. i.e. are you using nationally representative sample weights, or do you actually have pretty much the full population, i.e. in the CDW? Is the AI algorithm intended to be used for commercial profit?

That also adds an additional layer of trying to understand the different stakeholders and the incentives that are at play. Are there any big data repositories that primarily store veteran data used to train the AI algorithm, for example the CDW? Then getting to the last couple of questions, describe plans to ensure that privacy and security of the veteran data are maintained during and after the research process, particularly through the application of AI and how it interacts with the existing guidance from an information system security officer. That part of not only during the analysis, but also afterwards, because you have to set up the proper infrastructure.

Describe any decisions or recommendations the AI tools would be making for human subjects, how these conclusions are reached, and limitations to them. The point being there is that if it is actually going to be used for decision-making, you have to have a lot of transparency. You have to have precautions. It is not just, hey, we are automating these decisions.

Then lastly, describe if research volunteers specifically being informed of the use of the tool through the informed consent process. Then a few minor questions are around will study participants be impacted by decisions made by the AI tools. How are human subjects actually being influenced by the use of AI? Sometimes it can be very subtle, i.e. there is some prediction that is being made to empower the clinician. Then the clinician is still the underlying person that is delivering it. Maybe in ten years there will be other cases where there is some sort of automation, but that will need to be scrutinized of course. With that, I think that is most of the questions.

Again, just to say, this is not meant to be the final version. It is just meant to create a minimum standard so that IRBs are armed with the right language and the right questions to be asking. Through that, I think a lot of IRBs might even realize that there might be a project that is going through that is not really AI. Somebody might be calling it AI, but it is not really AI. That can simplify the process and hopefully save a lot of headaches and a lot of time.

Mary Klote: I think that is where it gets back to our first question to Gil. How should our IRBs be defining AI? That is something that I think we really have to get out to the field and give them a lot of use cases to consider so that they are prepared to look for these things. Something else that you said, Christos, was about if you are using the whole CDW. In Human Subjects Protection, we have for many years had the topic of minimum necessary. You talk about how many records are you going to use? You should use the minimum number of records necessary to get the statistical significance that you need. Does that concept? I will ask this of all three of you. Does that concept go out the window when you are talking about trying to train a model with big data?

Christos Makridis: No, it is a fantastic question and one that I think internally we all have to grapple with. Where is that balance? What are the circumstances? What precautions are in place? There is certainly a tension between AI systems that require large data. When you think about how precise predictions can be when you are drilling down to specific groups and you are really trying to understand heterogeneity, the thinner the sample the bigger the stated error on that. Statisticians call this a power calculation. What is the sample size that is needed in order to achieve some P value less than 0.01?

If you are thinking about a power calculation for an average treatment effect, that might be one thing. Then if you are trying to think about power calculations for different subgroups and the interactions, that is why there is that tension. I do not think that there is an easy answer, but I certainly welcome it. This is something that maybe Gil could weigh in now or we could come back to. I will turn it back over to you, Dr. Klote.

Mary Klote: Okay great. Thanks. It is just something that always haunts me a little when I start thinking about using the whole CDW for any study.

Christos Makridis: Yes. I think that is a good thing. It should haunt us because we are stewards of that data, so that is a good thing. Yes.

Mary Klote: That is correct. That is right. I am going to turn now to Michael. Based on the checklist that was created and published in the paper, Michael, you have been out doing some pilot projects using the questions. Can you describe that pilot work that you have been doing for our audience?

Michael Kim: Yes great. Thank you so much. I appreciate all the comments so far. I feel that my value in NAII was particularly kind of translating high-level white paper framework concepts into how we meaningfully actually do something with this that is real for the field. I spent the vast majority of my career in the field. We would get these ten operation memos. We would get these things from different central offices. What do I do with this? I would have to help kind of translate that into meaningful actual things that the field can use. I know that we have logged that on the call.

From that lens, I thought of two things. What are the great lessons we can learn from this white paper and these concepts? How do we do something with it and learn from it knowing that we are not going to get it right in version 1.0, but at least we have a place to start? How do we do something by incorporating those HRO principles of sensitivity to operations, something driven by the field who actually do this work in deference to their expertise?

I took the concepts of the white paper and also, I wrote guidelines from the EO13960, White House, Bill of Rights, and these other things, and I converged them. I think our best use case is research. I belong in research. There have been decades of human subjects’ protection infrastructure. It is better to slightly modify something than create something new from the ether. The NAII is currently distributing four network centers in Long Beach, Tampa, Kansas City, and DC. That is a helpful model for our test bed environment, because we have the engagement from executive leadership to service chiefs to our research divisions. I approached our community saying, are you guys interested in actually developing a pilot here? We did.

I quickly learned this is a great white paper, but totally unusable for the field. We do yes and no checkboxes. It needs to fall in our ORD worksheets. We cannot force people to do it, but we are happy to test drive this out. We really kind of gave it to them. We will hear from our panelists of people who do this every day and get their input. How can we define this and make it valuable for the field? About a year and a half ago we started that journey, and now it is deployed at all four medical centers. It is at a scope here just for organizations’ interest, that initial successes from this IRB pilot which we will learn about, actually did concretely improve human subjects’ research. We have some evidence that it did.

We took this concept and said, how can we do it where there is even more risk in operations? It is a little bit more Wild West and the clear infrastructure that we have in research. We actually do a great job in research on protecting, but I think there is a lot more opportunity in operations. What can we learn from this? I do not want to steal their thunder, so I will let them tell their story. At a high level is that there was an industry sponsored study. It did go through review using this checklist at Long Beach. Actually, by using these thought-provoking questions, we identified a study that had multiple issues with it. It is felt to believe that these questions help identify those issues.

Our IRB cross functional teams are highly talented. They deal with these concepts of privacy and ethics on a daily basis. It is not to replace that subject. It is to help augment it. Right? It did get this approval, which is very rare in human subjects’ research. Actually, I could tell you offline, but it did actually pass through another EMC. It did cross my mind. If we were able to accelerate the deployment of this through the appropriate stakeholders and iterations through the central office leadership, we can make a difference. I am going to turn it back to you, or I can introduce the panelists. It is up to you.

Mary Klote: Please introduce the people that you brought with you today.

Michael Kim: Okay great. Wonderful. I have Isabel Junie Hildebrandt, who was my first at the very beginning of my journey at Long Beach where I am a field-based person in Long Beach. She was the HRPP Administrator there. She currently is a walk. She accepted and IRB position with UC San Francisco right now, but she still is collaborating with the NAII. I know she met you at the primer conference recently. Then Junie, did you want to?

Bradley Stein, he is ACOS [PH] or the Chair of the IRB. I am sorry, Chair of the R&D Committee at James Haley. We have Vikas Singh. I am sorry, I do not have all your bio sketches in front of me. He is at Kansas City, and I think he is our R&D lead there. We also have Bona Yoon, IRB Administrator at DC VA. Thank you for joining, guys.

Mary Klote: Great. Thanks to all of you for joining us today and helping us to understand how some of this has been operationalized. Let me just ask the first question. I think I am going back to you, Gil. What are some of the ways that experts in research and development can ensure that they are responsibly integrated AI into human subjects’ research? Make sure that they are maximizing veteran benefit from AI-related advancements without compromising any sort of ethical or privacy standard.

Gil Alterovitz: Right. Yes, that is a good question. It is a common one that we get. I think the first thing is to try to identify when you are going to be leveraging AI as soon as you can. If you wait until later, it is harder to take these steps. It is kind of like a study design. At the beginning, you think about your statistical analyses. You have the right sample size, power, and calculation. Right? Otherwise, you could set up, do the whole study, and then you have to re-do it. That is the first step.

We have actually created a trustworthy AI initial guide, kind of a quick version that we are looking to expand. There are a few questions there that get people thinking. We have been piloting, as I think we mentioned, around these AI IRB modules. It is not a required thing, as this was mentioned, but it is more getting people to ask the right questions. If you see a question there and you are not sure what it is, right then you know that might be something to explore more. If there is a question there, then you can explore that and have that almost as a little checklist to help get started. That is kind of, I think, the way to think about it.

Then you will actually do the study and leverage AI. It does not necessarily end there because for some studies if they end and they publish, that may be it. As data gets updated, people may leverage your model if you are releasing it as open source. The model may change. Right? Having ways to think about how it would be monitored over time once it is out there in the wild, if it is, is something that is also as important to think about as starting and thinking about it from the beginning before the study. Contrary to some other things where you buy a product, do your study, and you are done, this one you have to think about before you buy the product or make your study. Then there are also the after-effects and how they might influence things going forward.

Mary Klote: Great. Thanks very much. I am going to turn to Christos and ask the question about how we can try to ensure the external validity and reliability of AI predictive models where the impact of it going wrong could have disastrous and possibly fatal outcomes.

Christos Makridis: It is an important issue, especially within the VA. This question of representativeness and external validity is important, I think, in any sort of context, but especially in the Department of Veterans Affairs. I think there are a couple of things to say here. Number one is really understanding that when we talk about causality, at the core it is a statistical issue. There could be some other factor that is influencing the outcome of interest that is not observed. We can build a good predictive model. Then as Gil was just mentioning, as time elapses, if we are not understanding the root cause of the issues, but we just happen to pick up one factor that was a good predictor at a particular point in time. Then as time elapses or as the sample changes, then it becomes noisier and noisier. Depending on if power goes down, then we start having recommendations or predictions that lead to bad or potentially fatal outcomes.

How do we ensure around that? Number one is to really report these metrics of model fit holistically, transparently, and then regularly. Holistically means that you are not just focusing on one glimpse of the data. You might not just look at precision or the F1 score. You look at all these metrics in combination. A good example of this is when you are working with unbalanced data, let us say there is a population and only 1% of the population maybe has a particular illness. That is highly unbalanced. There are going to be certain metrics you look at that are going to make the model look overly reliable. You look at all the metrics together.

Number two is around reporting these metrics regularly as well and not hiding them. You might have different snapshots of the data where you do cross validation on five years or on two years, and then do it again. You are kind of updated. As Gil mentioned, there could be model drift. This was something that we saw when we started building some predictive models around Covid-19 mortality predictions. There was model drift, and we had to be extremely sensitive to that.

I guess a good way of summarizing this is to really understand the population. Understand the limitations of the data that you are working with. Then at the end of the day, maybe you put in a lot of hours – hundreds or thousands of hours – into building an AI tool that is just not good enough to actually go into the field. That is better to come away knowing that it is not good enough to go into the field and you hold on to it than to do something that ends up having disastrous consequences. We just have to really be honest with ourselves about it and understand the broader factors, the structural causes, and really delve into causality. Do not just say hey, I have a good R-square to a good AUROC, and I will call it a day. No, it is a lot more complicated than that.

Mary Klote: I think that is where oversight, including making sure that we have some sort of data safety management board for these AI projects. Just like we do for cancer trials when you look at the data, perhaps we need to have really well-trained people in the science of these models looking at the outputs of these. It is probably very hard for a researcher to look at a project that they have been working on so hard from an outside view. I think that would be very difficult. You want it to work. You want it to succeed, clearly. I think we will have to think about how we can help investigators be honest with themselves and the models they are creating. Thanks for that.

Vikas, you have used these supplemental IRB questions that were published. Can you talk about your experience with them and how they help you to evaluate projects?

Vikas Singh: Sure yes. Thanks, Dr. Klote. Yes, we use this checklist to study various research studies that came our way. Many of those research studies shed more light on the examples that you and Dr. Alterovitz used here in those kinds of scenarios. Those studies include human subject studies, industry-sponsored studies, investigator-initiated studies, and anyone QI/QA. The very first study that we reviewed was a study that had AI in its title and purported to use AI. That was at the very beginning that we got involved with the four centers or the whole group. That prompted us to ask a few questions to the sponsor. That led over the next couple of months to many amendments to the extent that the whole nature of the study was changed. There was no AI in the study.

Just to give you an extreme example, that is how our journey started. We used it. We found it very helpful in different kinds of studies too. Just to give the audience an example, there was one study that uses biometric data. It is voice recording in patients with heart failure and uses machine learning on them to predict their impending heart failure, to alert caregivers as well as the patient. Another study used the big data, the whole VA-wide data, and AI in a machine learning algorithm to predict in-hospital clinical deterioration in those patients.

There was an investigator-initiated study where they used machine learning to predict adenoma detection in colonoscopy. I know every VA is different. At our VA, the IRB also looks at QI/QA study. We looked at future QI/QA studies too, one of them using QI using FDA cleared AI automation image analysis through the VA’s mortality slides. Just to give you an idea, all those studies are very different studies. We found the tool to be very useful. It is effective. I found it useful. It is result-driven and purposeful.

During this whole process I learned a lot. When I look at the studies now, I have this handy tool, the HSE [PH] checklist that I can take a look at and ask the right questions. It not only helps the person who is reviewing it but also the investigator. They could take a look at this checklist and fill out all of the information beforehand so that the process is smoother, rather than 500 back and forth with the investigator leading them to missing a deadline.

Mary Klote: Great thanks. Yes. My fear is not asking the right questions now that I have the checklist. My fear is I will not understand the answers when they give them to me or what the answers mean when they give them to me. That is where I think having the centers to help guide the IRBs and maybe even service consultants to the Institutional Review Boards or the R&D committees to help them interpret the answers that are being given by the investigators. Thanks very much. I am going to turn to Junie and ask about potential risks that get associated with the AI-driven healthcare solutions. What sort of measures can we or have you taken to ensure that there is transparency, accountability, and traceability in the AI R&D process?

Junie Hildebrandt: Thank you, Dr. Klote. We have referred in this conversation to the checklist and the taking of the concepts that were written or developed in the paper that Christos has shared and turning them into a usable checklist that we can share with investigators. It can also be shared with sponsors so that we are all speaking the same language. By being able to speak the same language, that allows us to have these conversations about traceability, transparency, risks such as bias in the creation of the AI algorithms, as well in the data that is being used then to further train and verify. Really, having this supplement and having informed consent language – I think Bona might talk about it a little bit more – that can explain terms in language that our subjects and our participants can understand. This is as well as our community members on our IRBs, our non-scientist members, and our non-AI scientist members can understand. That is one of the goals of what we are trying to do.

Part of this whole process that NAII is putting together includes having AI Oversight Committees at each. Right now, it is at the four sites. We have these committees made up of various different departments throughout medical centers that come together to discuss AI coming into the medical centers from different routes. When these studies are coming into research and development, they can then call on the AI Oversight Committees and say, can we please have a subject matter expert -- I know Long Beach already has one assigned – that can come and comment on these studies? Michael started to put it in place that there is a framework to help with the AI portion of this and the understandability that can be disseminated to the entire IRB.

The concept that you brought up, Dr. Klote, of a DSMB for overseeing these types of studies and these processes, I wrote that down and light bulbs started going off. As we have been talking about this, you see that there are long-term effects or long-term changes that could be happening besides having just an annual review for something that is a full committee review. What if we did have something like a required DSMB check-in even for studies that are expedited and may not be required to have full committee review under the reviewed common rule? That is a terrific idea. I think that is something that will help mitigate some of these risks as we are keeping an eye on what is happening in the R&D realm at our institutions. Thank you.

Mary Klote: Part of my job and part of Don’s job as the IRB Network Director is to think about the national implications. I get four sites. It is great that you four sites have these things. What do we do for everybody else? Can we set up a central subcommittee that places that do not have their own board or do not have enough projects to justify having their own board could come to and have their studies looked at so that they feel good about it? How do we put something like that together on a more national scale? What do we require? If we put something in policy, it is then required. We much prefer to pilot something like a DSMB for these types of projects to make sure it works, come up with sort of a best practice, who should be on it before we put anything out there and say you have to have it.

Let me just do one more follow-up question to you, Junie. It is a question about any additional resources. As you stood up this group and as your IRB looks at these, maybe Vikas you can answer this too. As your IRB has looked at these studies, what sort of training? Is there external training or training that you have found that has been useful for your IRB members about AI?

Junie Hildebrandt: There has not been any formal training or anything that they have asked for. Vikas, you might have a better view on this right now. There are city modules for AI research. That might be something we want to consider. That was a discussion happening at PRIM&R. People were asking, what other training is there? This came up. A lot of people are training on their own, and that might be an actual additional resource that we could consider developing. We have developed a checklist. We have developed some patient-facing material. We have developed informed consent language. That is something we have thought about, and it has come up in the AI Oversight Committees too of how to disseminate AI. What is AI research, and what are the ethical implications to our members, to staff, as well as to patients? Vikas?

Vikas Singh: I agree with Junie with what you said that there is no formal training yet. We all learned as we went along, worked on this checklist, and rolled it out at all our centers. We used PowerPoints, articles, and all those things. As part of the implementation, we took this idea to our R&D committee, IRB committee, and human subjects committee. We used the slide decks that we have. We said, okay, this is what machine AI is. These are the various components of AI touching on human subjects for research. These are the components that you need to be aware of. It was very well received.

These committees include lay members, non-scientific members, administrators, and even privacy officers and information security officers. I was amazed to hear that even the privacy officer and information security officer expressed appreciation about any of this knowledge here. There is a need for knowledge creation as well as sharing across the field. Yes, that can make it succeed or not succeed.

Mary Klote: Okay great. Thank you very much. Michael put in the chat, and I am not sure if everyone can see it, but the work force and training is a key pillar for the agency under the new executive order that did come out. We will look forward to seeing what that is and figuring out how we come up with training specifically for our IRBs, but also for our research and development committees. As I said in the beginning, a lot of our projects are not ever going to go to an IRB. Vikas, you said at your institution everything comes to the IRB for a look. At many institutions, they have gotten away from especially quality improvement projects going to their IRBs. Even their exempt projects are not necessarily going, and certainly not their research not involving human subjects’ projects. Those now fall under the research and development committee. We have to do similar training for our research and development committees on this topic.

I am going to move onto the next question. This is for Bona at the DC VA. How do you see the ethical considerations in research using AI or researching on AI being integrated into your existing structures and processes for IRB review and approval?

Bona Yoon: Hi everyone. Thanks, Dr. Klote. To build on what Dr. Kim was speaking to, research has this process and structure already in place. We currently have an existing initial reviewer checklist tool for the IRB which addresses all requirements for IRB review and also the IRB consent checklist and the consent template. We use them because it is sanctioned and blessed by ORD, meaning that these tools ensure that we are following regulations for human subjects’ protections, components of required consent language, and the review of research. IRB would address those three pillars of the Belmont Principal Respect Inhibitions Injustice. The AI IRB supplement is important to use in conjunction with existing processes to enhance and ensure that AI is used responsibly to answer research questions. As an IRB administrator, I think about processes a lot. This IRB supplement really addresses AI specific elements, which are unique. This tool prompts reviewers and researchers to think about AI technology in that perspective, how to discern the different types of AI, and the terms and definitions used in the AI sphere, how this influences how we approach risks and benefits and the conduct of the study itself. Something new and different can be scary for research participants. What are the social implications such as equity considerations and the demographic? Who is going to benefit versus who it is tested on? Will the AI reduce cost rather than improve participant patient health?

The risks about the technology not functioning accurately, the bias, and exposing PHI and PII, the layering of risks due to software of the device, identity theft led by metric identifiers, and the implications about future use data and biospecimens in AI research. That also got me thinking about the DSMB as you spoke to, Dr. Klote. Ultimately, the IRB and R&D are charged with putting safeguards into place, recommending mechanisms to monitor the study data, and how to cross-check the data that is generated by the AI. It is great that we have our subject matter experts like the PO and ISO to touch on when we have specific questions.

The IRB also thinks about AI literacy for patient-facing information. We look to make sure the consent makes sense. Dr. Kim has also developed a tool called a model card, which is sort of like a brochure to supplement the consent document. This tool is to help participants understand AI technology and to disseminate complex AI research info to the lay individual with easy text, pictures, and tables providing that greater visual salience. It is really important when you are trying to convey a very complex topic.

Clearly explaining how their data will be applied when the context of AI outlined the risks and benefits are, I think, really critical too. In the IRB office, we think about how IRB is going to review this. Luckily, as Junie mentioned, we have the AI oversight committees we are going to work with jointly to review this because they have the subject matter experts. Then we can also have the IRB committee members use this checklist to look at research within the AI sphere. Then down the line, as Dr. Klote spoke to, as we have these continued discussions about AI research, it is how VAIRRS would be operationalized to collect AI elements and data collections. It is how that is going to be collected so that you can look at it across the board and see how AI studies are being conducted across the VA. Essentially, I think that is pretty much all I have to add.

Mary Klote: That is great. I do think we have the infrastructure in research. We have a process that can be applied to new things that come in. It is just trying to make sure that the education and training is there to apply those processes appropriately, and not fool ourselves that just because we have the process in place – like having these questions, if you do not understand the answers or the implications of the answers, you are not going to be protecting anybody just by asking the questions or checking checkboxes on a checklist. That is not going to help things.

I think we just have to be very vigilant in the human subject’s protection space to make sure that we are in that role as trusted advisor to the research team and helping them to make the right decisions about their studies. Thanks for that, Bona. Brad, I am going to turn to you.

Don Workman: I am going to stop you for a second. I really liked what you said that we have the PO and ISO review for areas of specialization. We are used to bringing in consultants when, for instance, we were talking about a different kind of cancer or some unique psychological issue. What are your thoughts about the possibility of a review process that might be similar to what we currently have as PO and ISO?

Bona Yoon: Dr. Workman, were those questions addressed to me? I could not quite hear you.

Don Workman: I am sorry. I was just opening that up to Molly or to the group.

Mary Klote: Don, if you are talking about adding like we have to have an information security review. We have to have a privacy review. If you check the box that you are doing an AI-type study, should you have to go through some form of special committee review like you do for a safety review if you are doing a lab study or you are using a laboratory as part of a study? Is that the question you are asking, Don? Should we have an extra layer of review, at least initially, until we all get very comfortable with AI?

Don Workman: Yes. We are obviously not setting policy, but just thinking about how that process is done. It strikes me as something that most IRBs would not have somebody with that kind of IT knowledge. That might be a useful consideration. It was just to think about whether there is a process that we could develop down the road that might allow for that.

Mary Klote: Yes. I am not convinced that every information security officer or privacy officer is going to be completely versed in artificial intelligence and the impacts of AI on either the information security or the privacy aspects. I think we probably also have some work to do with our colleagues in privacy and the Office of Research Reviews to make sure we are getting that out. This is as well as pulling in our colleagues from the National Center for Healthcare Ethics to make sure that they become part of this process and help us with the ethical implications of some of these tools that we are planning to use in research studies.

I am going to pivot because we are at 4:07 here on the East Coast. I am going to pivot to Brad and ask the question of, what strategies can be employed to foster a better understanding and collaboration between the AI technologists and our clinical researchers? This is to make sure that we have ethical and effective AI applications in our healthcare settings.

Bradley Stein: Yes, thank you. Really, what you are talking about are two different groups that speak different languages. You have your computer programmers that are creating the AI. They are not researchers. They are not used to human-centered research. They are really developing the AI and then trying to get it through a research application, which they have no experience with. Then on the other side of it, you have the end users, the clinicians, and the healthcare professionals. They speak a whole different language. In an ideal world, you would want somebody to bridge that gap. It is somebody that speaks both languages that can basically translate and help work with both sides.

The problem is that those people are very, very few and far between. We have to lean on other mechanisms. For the NAII centers like us, we have our Artificial Intelligence Oversight Committees. We have to have a whole committee with various levels of degree of specialties to come up as a group to try to make sure that we understand what the computer guy is talking about, understand what the AI is actually trying to accomplish, and think about what the end result is going to be. This is along with making sure that everything is safe and trustworthy.

We have talked about this throughout this webinar about how everything has to be trustworthy. The people that are actually reviewing it really do not have the experience. It is really going to have to be a group effort and really learn through experiences. Help with these model cars that we have established, and also with the AI checklist that we have implemented.

As far as the other sites that are not fortunate enough to be part of the NAII center that have one or two AI protocols coming through, again, most likely they are not going to have experts in the field at those sites. Maybe if they are lucky, they will have one to rely on, and that is kind of scary too. One person is going to be the expert for the whole center. That is where we come into play. Right? We are out here with the webinars trying to educate everybody in the research development committee world in the VA that work here. You can contact us, the leaders in R&D, for us, the people that are doing the pilots and are on the panel. We can help with that group effort. It does not just have to be my Tampa VA, and it is just with me. We can consult outside. With that collaboration, we will be able to create lattice work and help benefit everybody.

Mary Klote: Great. That is the concept. It is sort of the enterprise model that we are going to. Right? We establish these centers of excellence. We staff them in a way that they can support the workload of everyone so that we do not have to recreate this infrastructure at 110 facilities. We cannot afford to do that. Initially, having that expertise that we can tap into and get training from for those facilities, it is mostly just to identify the projects that really need to have a more thorough review. I think that is probably really our first step. It is identifying the projects that could go sideways and potentially harm veterans, get the investigator, or the VA in some sort of trouble. Those are the ones that we have to figure out what those kind of use cases are and get everybody’s antennas up at their sites. Potentially even working with the NAII looking at the 346 studies that are currently approved, going through them, really looking, and even doing an after the fact review of some of them to make sure that we feel good about the studies that are currently going on.

I am going to pivot back to Vikas again. I am going to ask you about what have your IRB or R&D committee members – I do not know if you have used the checklist for your R&D committee. What have they said about the AI questions as you have introduced them?

Vikas Singh: Yes. During implementation, as I mentioned, we had to give them a little bit of orientation and background. What I learned during that orientation and background is that most of the people had less knowledge about AI. They all were hungry for more knowledge or more education on the AI front. They all were hearing about these days ChatGPT and Open AI. They hear about it. Once in a while, a question will come up during the IRB meeting on such tools.

They were very appreciative of all the information shared. They were hungry for more information. I can actually share a survey that Bona designed with all of our group members and shared it at our four centers. Can everyone see my screen? No, not yet?

Mary Klote: It is coming up now.

Vikas Singh: Okay. We designed this survey to get more feedback from the field about what you think about the current AI IRB \_\_\_\_\_ [01:08:28]. I know this is a call full of researchers, so please do not judge us on the small end. It is just four centers. The answers that we got were – here is the first question. What were the demographics? Most people work for IRB. A few of the members were R&D committee members. The AI oversight committee members are also very involved in this whole process, and the administrators. It is mostly IRB and AI oversight. We still have some responses pending, so I think it will level out.

We asked some very basic questions. How familiar are you with the terms deep learning, machine learning, NLP, unsupervised learning, and reinforced learning. All of these are used very, very frequently. The answers you can see are the majority of the respondents who are all part of the R&D committee or IRB say they are not familiar at all or slightly familiar. The problem that we have is that we will be passing these studies through these committees where the members – it is a small sample of a few centers. Still, they are bordering towards not familiar or lack of familiarity.

The next question is, how confident are you that you understand what artificial intelligence means to human subject research? Again, it is the same pattern of not confident and somewhat confident. We had a couple of people, so we had some subject matter experts who were there too who were very confident. These people can be our anchor people in that IRB or R&D and serve as subject matter experts to employ mentorship.

Have you used or heard of this attached AI checklist? It was an equal split. Half of them said yes. Half of them said no. We were kind of surprised by this because it was presented everywhere. Using the AI checklist, how confident are you in approving trustworthy AI protocol? Still, there is room for education, training, and using various modalities like this ORD webinar or like what Dr. Kim was mentioning with TMS webinar, facts on find pro tool kit, or something like that. We had to figure out how to disseminate that information.

These are some of the comments. These are also very revealing. Many people say, okay, we are going to use this tool for regulatory aspects, advocacy for human subjects’ rights, or protection. Again, this is protecting all human subjects, staff, and patients, compliance when it comes up, protection of human subjects. Take all frameworks like Bona was mentioning. Also, there is a desire to learn more about AI and its use in human research. We can review information, but we will need subject experts to feel more comfortable evaluating this aspect of the study. These are the things that came up earlier in the discussion. This is some of the data that we got.

The take home messages that we got is that everybody is excited about it. Everybody wants to do it, but everybody needs more knowledge. They all are expressing a desire to have some kind of support network, a peer-to-peer network, and subject matter experts who can help them.

Mary Klote: Great. Thank you.

Bradley Stein: Can I interject one thing if you do not mind?

Mary Klote: Please.

Bradley Stein: Of the four centers, in Tampa we have external IRBs. I was the only. I was a lone external IRB site, which represents a large portion of the VA sites. What I did is, I educated all of the research and development committee members. We went through the checklist together, and we voted on it to approve it. Then what we do is implement the checklist during our scientific review. After the privacy information security officer goes through their review, then it gets sent for the research and development committee members to do their scientific review. That is when we add the supplemental AI. When it goes to the external, we do not know what will happen. We do not know if they have their own checklist or if they have even seen AI before. We are totally out of control with that. This brings control back into our site. You can use it for external IRBs as well.

Mary Klote: Yes. It brings up an interesting point of the role of the R&D committee versus the IRB and makes sure that your affiliate IRB actually has the competence to do an ethical review of an AI type project. The R&D committee is not supposed to be doing the ethics piece or the human subjects protection piece necessarily. They are supposed to be looking at the institutional issues. If you do not have that confidence in your partner organization, of course the best thing would be to reach out to them and try to help them ensure that they have that expertise. That is something,

Don, you as the IRB Network Director will have to take into account as we look at all these programs across the country and how they would implement something like this. Whether it is, as Brad talks about, doing it pre-emptively before sending it out. We have a lot of institutions who send their things to their affiliate IRB first. Then it comes back for research and development committee review. Then you are doing sort of the scientific review then. You could get into a deadly loop with the IRB if you have the external process.

I think everyone has to really take a hard look at their process and make sure you are not re-doing an IRB review in the R&D committee. You have to do what you have to do right now, especially for these AI projects, as we are all sort of growing into understanding the complexities and the potential harm. Thank you very much for that comment, Brad. It is always interesting to me when we have the externals too, because they always throw a wrench into a lot of things we plan at the Central Office.

Michael, you put into the chat that one topic everybody should be cautious about right now. I do not know if you are referring to its use in general or its use specifically in research. It is with the large language model chat box, the things like ChatGPT. I am just wondering if you can expand on that.

Michael Kim: Yes. A lot of these large language models are not hosted on the Enterprise cloud systems. There are instances where you can move Open Source, like you take their code and bring it to VA Enterprise system where it will be technically secure. There is the very possibility of working with the AI affiliate or someone at the university. They have this great idea. Let us summarize a discharge note. Reduce burnout. What are the clinical implications? It is all this type of stuff. I have seen them. We talk about what are the ones to be concerned about as a general topic. This is the hottest thing right now, and I am sure that some of our VA medical centers are going to see some sort of version of a generative AI use case come through their IRB or R&D. Those are the ones that you have to really scrutinize. Really get your information security officer. Consult the NAII. You really have to look under the hood on that.

If you start putting our VA data into something that is not the VA into some commercial system outside, this is a massive privacy breach. Aside from clinical outcomes and other things that you want to be monitoring, I have seen a couple that have really kind of raised eyebrows. You would be like, stop. Stop.

Mary Klote: Sure. Sure absolutely. Thank you for that. That is a great warning, I think, to everybody on the call to be mindful of that. Even if you are just playing with these chat bots trying to learn about them, putting any sort of personal information into them could get you into trouble. I think that begs a question of, do we have a generative AI model that is available to us in the VA?

Michael Kim: There is a lot of interest in this because it is really telling two stories. Your executive order says we want to do more. We want to accelerate, but we also have to be incredibly careful. I know every day has been different. There is incredible interest all the way to the agency’s top on agency response to this order and how we are going to need, including workforce and training, as one key pillar. One is in infrastructure. Right now, IT and Opto are looking into getting a commercial approved system. Whether that is approved for research or just operations, they get into the devils of the details because they are not the same thing. They are looking for a sure Open AI commercial system that is allowed to be used on VA data, which is incredibly exciting.

There are some open languages where we take the model and bring it to the VA system. I have heard some small operational pilots. We can probably take this offline, and then if I need to, I will talk to you offline about what we can do for our research community so they can do meaningful research in this space but not worry about the security and privacy concerns. I do think this really is the future of medicine and where healthcare is going. We know that the future medicine starts in research. We are making sure we do not just say stop, but we are making the right investments and putting in the right safeguards. I am sorry I do not have more details than that.

Mary Klote: No, that is fine. I think we will just make it a commitment that if we find out there is something available to research, we certainly will get the word out to everybody about it so that people can begin to conduct studies or plan studies using something like that. This is as long as it is safe for our data. That always begs the question. People say, I am going to use de-identified data. In today’s world, it is getting very scary to say anything is truly de-identified. We have. If you take off the 14 HIPAA identifiers, if you do some statistical work on a sample, theoretically it is de-identified. When you put it into a commercial system and it starts getting matched with other commercial things, that is where I think we have the concern that someone somewhere will be able to re-identify those data. It is just scary because you do not want to. The last thing we want to do is cause harm to our veterans who have put their trust in us.

That actually brings us to the end of our talk, although I will ask one last question just because I think it is interesting. Gil, you talked about these AIs having a potential hallucination. I am just curious if you have an example of a hallucination. I think we all are familiar with Dave and 2001 Space Odyssey and how he went bad. Do you have an example of a hallucination that potentially has actually gone bad? Michael, you are on mute. You are still on mute.

Michael Kim: I am sorry. Can you hear my audio? Gil had to drop off a few minutes ago. For people who are not familiar with the term hallucination, it is the kind of term they use when you use a large language model like ChatGPT. One of the things that is most risky is that you can so authoritatively answer a question that the credibility and plausibility of it being real is really high. It so confidently gives you that answer.

There are many, many instances, and I can do a literature search to show it, that there are significant error rates with that. With that, depending on the intent of use, it can cause tremendous harm. We have been doing some stuff with other not necessarily research, but how can you use large language models to work with HR, to go through the over 20,000 pages of documents and guidelines to quickly find information? Even in those pilots we found that, wow, it sounded like the correct answer, but it was not the correct answer. You know? That is a real concern. The real risk of using this is in one of the most dangerous things in society -- healthcare.

I think this is a tremendous opportunity. We know there is a huge need for it. Our healthcare systems are under tremendous burden. Covid did not help anything. Our workforce needs the technology to make their lives more efficient and easier, but we have to be extremely cautious that we can make errors. I think that is where getting the guardrails right and striking the right balance. What is it being used for? What is the human loop? How do we develop those highly reliable systems so if errors do happen, we can capture them quickly?

In terms of any really buzzy classic story or anecdote, I do not have one at the back of my head. If I have one, I can send you a link.

Mary Klote: Okay, that is fine. I once asked it to find me some references for a talk I was giving, and it immediately pulled up these six references. I thought, okay great. Then I went to actually find the articles, and two of them did not even exist.

Michael Kim: There you go. There you go.

Mary Klote: They were totally made-up articles. I mean, they looked good. They sounded good, but I could not find them in PubMed. I could not find them anywhere, so it was really strange.

Michael Kim: Yeah.

Mary Klote: Anyway, it is 4:28 on the East Coast. I really just want to thank our panelists. I want to thank Don Workman for coordinating this as part of his IRB network and outreach, getting the NAII involved in this. Just a reminder to everyone, this is the beginning of a conversation. I apologize to those of you who have questions. We will have future sessions on this topic and open it up, but today we really just wanted to set the stage for future conversations that we are going to have about this checklist, about AI in general, about potential future committees, and how we are going to train our workforce to keep research in the lop on this and keep everybody safe. I truly appreciate your time today, and thanks for everyone who stayed on to participate. Have a great rest of your day.