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**Knowledge Translation Outcome Measurement**

Knowledge Translation in the Age of Complexity

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ANN OUTLAW: Welcome back, everyone. Our final presentation of the day is Knowledge Translation in the Age of Complexity, presented by Dr. Diane Finegood. Dr. Finegood is a professor at Simon Fraser University. Are you ready to begin?

DIANE FINEGOOD: I'm here. Thank you very much. You've all seen the title slide now. Let me begin by making the statement that living in the age of complexity, and this is an illustration from Yaneer Bar-Yam, and you notice there's no Y axis so the graph. But his argument is that complexity has been growing throughout civilization. That we've moved from very simple control structures with a single leader all the way to a very networked and complex environment and I think we can all imagine that in our own worlds today. He even argues a little bit, so, asking me to speak up. I will do my best. How's that? I hope that's good. He would argue that when the internet was developed we surpassed the time in which individual complexity was surpassed. So, keeping in mind that things complex, I think we want to talk about four basic key messages in this talk.

The first one is that complex systems are not the same as simple or complicated systems and this is a key frame that I want to begin with. We will then go to the idea that knowledge translation is a complex problem or being done in a complex system, so going to go from talking about systems to talking specifically about knowledge translation then talking about the fact that we don't have to panic if a problem is complex because there are solutions to complex problems but they're not the same solutions that we have to simple or complicated problems so I want to make that distinction and try to illustrate it for you. And then lastly, go back to KT and talk about knowledge translation as an integral component of many of these solutions that are appropriate for complex problems, so hopefully those messages will align with your own thinking and you'll feel comfortable.

So let's start with complex systems are not the same as complicated or simple. I like to start with a definition. Her definition is a set of things, people, cells, molecules or whatever interconnected in such a way that they produce their own pattern of behavior over time. So I think that's kind of an important concept. There are many different definitions of system and also many different definitions of systems thinking. I've picked one here that was an amalgamation of other definitions. So here we go. A systems thinking is a set of synergistic analytics skills used to improve the capability of identifying and understanding systems, predicting their behaviors, and devising modifications to them in order to produce a desired effect. I will say I've grayed down a little bit predicting their behaviors, because personally, I'm not sure you have to predict their behaviors and that's a very difficult thing to do in order to devise modifications to produce the desired effect.

It's a bit of a debate, I would say, in this field about the importance of actually predicting their behaviors, but I'll speak to solutions that actually don't necessarily require that that are appropriate for complex systems. So, let's talk about types of systems. I would say there's simple, complicates, and complex. We can think of a thermostat as a relatively simple system. There's a single feedback loop usually in a thermostat, so, you set a goal temperature, the temperature goes up, the thermostat comes on to cool the space down and vice versa and yes, these things can oscillate, et cetera, but it's a very simple both mechanical and feedback system.

I always like to use the example of an airplane as a complicated system, particularly an airplane that's sitting on the ground without a pilot in it or people in it so think of that as a huge mechanical system where there's many, many interconnected parts and moving parts but it's so mechanical in a sense, it's complicated to the extent to which you can't actually wrestle it to the ground and understand what are the factors that might cause a crash to the airplane? In other words, everything is fairly deterministic. There's not a lot of randomness until you put you the pilot in the game. We can try to eliminate randomness from pilot behavior but it's not always possible. Okay?

So, simple and complicated systems. Now, I always use this picture to describe a complex system. This is called the obesity system map. It was developed in the UK by the foresight office in the government science office. And although you can't really read the map, the important feature that you see in such a map is all the interdependencies between variables. And we'll look at this map in a little bit more detail later because there are some interesting sections on this map, things about food production and food consumption, physical activity, physical activity environments, immediate yeah, physiology, these are all variables on these maps but you can see many, many interdependencies so it's really good to recognize that that exists and then think about what the implications are for solutions to complex problems. So, if I go to the next slide we have, what I would say, it looks dichotomous in terms of characteristics, with simple or complicated on the left, complex on the right. So when you have a population that's relatively homogenous, your system is more likely to be more simple or complicated but when you have a heterogeneous system, it becomes more complex. So think of these not as dichotomies but sliders you if you will. These are the features that contribute to complexity.

That you have heterogeneous populations, that relationships are nonlinear. Don't just A to B and predict what happens. Stochastic means random. Dynamic versus static, I think is self-explanatory, and as I illustrated previously, lots of interdependencies. So, I've hopefully given you at least a basic idea about the difference between simple, complicated, and complex systems.

And maybe I should ask, are there questions at this stage as it relates to this part of the presentation? I'm trying to read all the chat boxes and I can't keep up. So, Joann, is there anything there that I should try to explain better?

ANN OUTLAW: No, we think you answered it. Kathleen asked early on in your presentation to explain a bit about the individual complexity so we can understand better what means in contrast to the focus of this presentation? So if you'd like to talk a little bit more on that, but I think you did touch on it.

DIANE FINEGOOD: Yeah, so I think individual complexity in that first slide was really just a thought experiment, if you will, about our capacity -- the complexity of people and their ability to deal with the complexity in their environment. I'm going to talk a little bit more about that in a few minutes. Actually, when we get to solutions, I'm going to say a little bit more about that idea so hang on to that question.

So, let's move on to knowledge translation is complex. Probably most of you recognize that from the work that you do, but let me just see if I can reiterate it in a few ways to you. I turn to, again, a definition for knowledge translation as, and this comes from the Canadian Institutes of Health Research, an organization I used to work for. Knowledge translation is defined as a dynamic and iterative process that includes synthesis, dissemination, exchange and ethically-sound application of knowledge and I've grayed out the rest of it because it was a contextual definition which speaks to Canadians and speaks to the mission originally of CIHR to be both about knowledge creation and knowledge translation, so that's why they spent time working on a definition.

And also, their original Vice President for knowledge translation, Ian Graham is an expert in this area and he developed this framework for integrated knowledge translation. I think he was one of the originals to really think about and articulate what we mean, and we do this in Canada, talk about integrated knowledge translation versus end-of-grant KT in that distinction, being, you're not necessarily trying to exchange knowledge with users during a process but once you're done. So, this tries to capture all the different features of knowledge translation, as per the definition and other things. I'm not a big fan of this, only in the sense that I think whenever it's kind of organized so neatly and tightly, you lose a little sense of the complexity. But, it's a helpful framework because it reminds us of the many domains that are relevant to the whole knowledge translation process and so it's all the way from knowledge creation, inquiry, synthesis, tools and products, and moving around the outside, you know, there are many features like tailoring interventions, monitoring use, et cetera that are all part of this framework for knowledge translation.

As I said, I wanted to convey the notion that knowledge translation is complex so I put up one of my favorite kind of frames here which is that there's actually more than a hundred different ways to say knowledge translation. This comes from a Wiki that was created to list all the different ways. I used to have a slide that said 50 different ways but I think we're up to a hundred now. And of course, if you dig into the list, you'll see that not everything overlaps 100 percent, but clearly all of these different sort of disciplinary domains or sets of jargon, depending on how you want to articulate it, have a relationship to each other and a relationship to knowledge translation. And for me, the fact that there's such a proliferation of ways to talk about it makes it actually a little bit difficult and makes it complex to have conversations and to advance the field forward. I think of complexity science in the same way. We all, there are many different sort of origins for people who think of themselves as systems thinkers and that makes it more difficult to discuss. So, a few years ago, I was involved in a project which wasn't published but this was part of the result where we tried to actually use key informant interviews. We broke it down to the it transition, you can see the pressure to publish leads to publications and that part of our system or rehabilitation and perceptions of rigor, et cetera. Some of this can use to collaborative-based search and use of research-based, et cetera. But we also kind of mapped out the practice-based research because the work we with were doing at the time where we felt not enough attention is given to the tacit knowledge that many practitioners have from their work so we were trying to think of ways to collect, share, and use tacit knowledge so this came out of that exercise. And if we put them together, again, the image is conveying to us that knowledge translation is complex. Where we sit in the system, whether it's in an academic environment or a practice-based environment, what our motivations are, all of those things interact to create a system where we get certain behaviors out of the system. So, hopefully, that helps you. Hopefully, I've convinced you with those few examples that knowledge translation is also complex. So, we've got the fact that systems, there are differences between simple, complicated, and complex systems, and also that knowledge translation is complex. So, what do we do? We really increased to think about the solutions to complex problems and remember, the take home message here is that in fact those solutions are different from the ones that we think about for simple or complicated problems. So, the common responses to complex problems are, retreat, despair, believing the problem is beyond hope, assigning blame, figuring out who is responsible, simple solutions, and occasionally, we will galvanize our collective response and invest significant resources.

 I've been using this slide for many years, and you know, at one point I was using that last point to be optimistic about tackling a problem like obesity because we were starting to pay more attention. I'm not sure yet whether we're there. But, anyway. So, these are the kinds of ways we typically respond to a complex problem. And I remember the first time I saw that big messy spaghetti diagram of obesity, the person who showed it to me wouldn't even give me a copy of the slide because the people who produced it were so worried that it would be used in this way, to say, well, throw up our hands and say, there's nothing we can do about this problem. But there are approaches. People have been talking about complex or wicked problems for quite a long time. So, the first take home message here is that you can't solve them with that reductionist paradigm that we're so used to. The information that we need to understand a problem depends on our idea for solving it, so that you can't reduce it to a set of causes and then use to that figure out what to do, necessarily.

The process of formulating the problem and of conceiving the solution are actually one in the same since every way we specify a problem, we're specifying a direction of potential treatment. And problem understanding and problem resolution are kind of common, so I'm arguing that you really have to think in a very different mind-set and this was written by Ridland Weber in 1973. So, if we come back to this obesity system map and we think back that problem definition and problem resolution are concomitant as the previous slide said, we might actually need to look in more detail what this map is actually trying to illustrate for us. So we did some work a number of years ago where I'll say we zoomed out on the map.

So, what you're seeing here are the seven different domains that affect the individual. The engine in the middle is the individual. And the thickness of the lines both around the circles and even more importantly around the thickness of the arrows between domains, they don't necessarily reflect the importance of that domain, but they reflect the number of underlying connections that were on that original map, articulated by the stakeholders who are speaking, who were producing the map. So, one of the really interesting arrows for me or the connection is between food production and food consumption.

 The thickest arrow on this map says that food production drives food consumption and even more interesting, there is no return on that connection. So, in other words the people who are involved in defining this system did not perceive that food consumption drove food production. Well, that tells me that there was pretty much nobody involved from the food industry in the production of this map. So, that's kind of trying to drive home the point that the problem definition depends on who is in the room. So, how we're defining the relationships in the system is also a function of who is in the room and their perceptions and the way they think, whether it's their perceptions are based on evidence or personal experience. So, it's really important to kind of keep that in mind when we think about it.

Means there's only ever -- you know, this is one formulation of a problem for which a different group of people who have a different formulation. The other interesting thing about this is that when we produce a map like this, we can actually use it to benefit in terms of how we think about the resolution of it. And I see that for some reason, this map is not the one that I thought was in my talk so what's missing from this map for whatever reason is, there were little areas, so, circles drawn around subsets of these variables that you're seeing here, so, there were, you know, different regions that were circled. And the point of it was to tell you the story that in the UK, they use the map for a cross-government or whole of government conversation. They got a whole bunch of different government departments in a room, and said, okay, so, which of these variables are relevant to the work that you do, be it in transportation, social development, whatever it was, regulation of media, all of those things are part of how we -- of what government does. And they're related to this map.

But the point being that this was a valuable tool for starting the conversation about how all of government could actually come together to tackle the problem. Okay? So, that's where I am trying to illustrate those ideas. Now, if we start to think about implementation, systems approaches to implementation, the first thing is it's probably helpful to divide up our conversation into three different domains. Are we using a systems approach to define the problem, which I think we do when there's a complex problem? Are we using it to implement a novel intervention in the environment, so are we taking principles of systems thinking and using them to design implementation or intervention strategies? And are we understanding the characteristics of complexity when we assess?

For example, I just came from a conference where I saw a really interesting talk where the speaker was advocating that not only do we develop our assessment systems when we think about what we're trying to achieve and what the outcomes are that we're trying to achieve, but at the same time, think about the potential unintended consequences in that circumstance, and make sure you make measurements to understand both intended and unintended consequences. So, our approach needs to be holistic and integrative. We need to focus on relationships, boundaries, context, actors, actions, outcomes, and we need to consider the power imbalances, heterogeneity.

So we need to consider those risks to complex systems and the things that make things complex and we try to approach the system and define the problem. One. Interesting pieces I heard recently -- and since this is about knowledge translation I wanted to bring this to you, was a lovely piece of work done by a masters student whose committee I sat on. And when she was looking at experiences of researchers doing integrated knowledge translation with funding from the Canadian Institute of Health Research she did key informant interviews and found that she could talk about the crossing the boundaries that exist in knowledge translation or integrated knowledge translation in this kind of two by two table.

So, boundaries as barriers. So, when we have boundaries that are barriers to our ability to do integrated knowledge translation and we look at that against the importance of challenging the boundary for a particular problem, we can see four different strategies of crossing those boundaries. When the boundaries are important, when the boundaries are large, barriers to iKT but they're not so important that we challenge it, then we can recognize and handle those boundaries. If neither important or big boundaries, it's still important to respect and clarify that they exist. As the boundaries become more important but maybe not so big, we can challenge and embrace them. But, if they're big boundaries and they're really important, it may be that we have to blur and integrate so that the boundaries no longer exist. I think this may be a useful frame for some of you as you think about the nature of knowledge translation in your work. There's other models that are helpful here. What I like about this model, the --

ANN OUTLAW: Excuse me, Diane?

DIANE FINEGOOD: Yes?

ANN OUTLAW: Before we move on, could you give an example of a boundary and integrated KT?

DIANE FINEGOOD: Sure. So I think a really obvious boundary in integrated KT would be the boundary between academic and people, members of the public, stakeholders who, you know, for example, patient-oriented research, which is a growing interest in Canada, I would say there are fairly big boundaries of communication, of culture, that exist between the academics that are working on these projects and the members of the public who would like to understand how to become more patient-centric. We want to work with them to become more patient centric. I think there's also pretty big boundaries between academics and practitioners and policy makers and government. But the key here is within the context of a particular problem to think about how big the boundary is and then whether it's an important boundary to challenge. The importance of challenging boundaries to whom.

I think that will depend on the nature of the project, actually, and how you're framing it and whether or not you think it's critical to actually challenge theming. So, that's not -- I don't think there's a generic answer to your question. I hope that's helpful. Okay, can I move on? Anything else? Yes? Okay.

So, I brought up the Cynefin model, which many people have seen before, but what I like about this visual of it is the reminder, which I've already said to you, simple, complicated and complex are different. We'll ignore chaotic for the moment. Not so critical to this talk, per se. But when you have a simple system, you can have a best practice. But when you have a complicated system, you may not be able to identify what the best practice is. You may have a good practice, or several good practices, and when you have a complex system, the practice is emergent because of the complexity.

So, I think this is an important reason why we have to think differently about simple, complicated and complex problems and about the work we need to do to assess progress in a system that may be simple, complicated, or complex. Okay? Unfortunately, though, we're hooked in in medicine in particular in many of our systems and policy makers are hooked into the evidence-based medicine paradigm, which suggests that evidence is hierarchical, and that the best evidence is through systematic reviews of multiple studies using, you know, critical appraisal, et cetera, et cetera. And that background information, expert opinion which can be rich in context is actually considered in evidence-based medicine the least valuable. So I tend to want to turn this thing on its head and suggest that we need new methods to rethink the way we think about evidence. In knowledge translation, because it's complex, I'm not so sure that this paradigm is helpful to us. It's a fairly reductionist paradigm.

ANN OUTLAW: One more question has come up. Excuse me for interrupting. So, is the implication of the Cynefin model that will evidence-based practice is possible only in a simple system?

DIANE FINEGOOD: Well, that's a great question and I'm not sure I want to take a hard stand on it. I would say it probably says that evidence-based medicine is good, and is best in a simple situation. It's probably not bad or reasonably good in complicated systems, but it's really problematic in complex systems where there is no sing the answer that's right or wrong. Because remember, randomized control trials try to give us a single answer for a large population about what is right and what is wrong and there is no definitive answer when you have a complex system. So, yeah, I think it's true. It is suggested that evidence-based medicine is not necessarily the best way to go when you have complexity. And there's lots of interesting data out there that kind of helps to support this. If you've ever looked up the percentage of our large -- the percentage of people helped by some of the larger Blockbuster drugs that have been shown to be efficacious on clinical trials, you know, often it's less than 50 percent of people that derive benefit. So, I think that creates a challenge for us. Okay?

ANN OUTLAW: Yes. Thank you.

DIANE FINEGOOD: Sure. Okay. So, I'm going to jump in, so, instead of something like an evidence-based medicine paradigm, which really tries to give us a homogeneous constant or fixed answer for a large population, I think we need different kinds of framework for complexity. One framework that we developed out of work done by Danella Meadows who wrote a lovely paper called Places to Intervene In a Complex System and if you just Google "Places to intervene" you'll come up with her original articulation which had about 12 steps, I believe. One version has nine, and another one has 12. And we started thinking about this frame which tells us that in a complex system, where we address the system in a hierarchy of, at the top, being the deeply held beliefs that drive the system, down to the bottom, the fiddley bits, the structural elements of the system, you get different both effectiveness and difficulty for trying to implement change there.

So, deeply held beliefs drive a system, and they're most difficult to change. Goals are an important component of where we're trying to push a system, and things like information flows, connect connectivity and trust are all important in the feedback and delays and structural elements. Again, we tend to do mostly structural elements and most randomly controls times are trying to tell us what we need to do in the structural element domain, because remember we're trying to hold everything constants except a couple of things and that's often a challenge. So this is a different frame which might be helpful as we start thinking about complexity and how to solve it. And here's just one illustration in how we've used that frame in looking at things that we might think, should be done together or not. So, there was a conference a number of years ago on making food systems healthy, green, fair, and affordable. And we looked at the content of a set of papers that were prepared for this conference ahead of time and divided the material in the papers by whether they were talking about making food systems healthy, green, fair, or affordable and then by the structure of this intervention-level framework that I just showed you. So what's the paradigm for an affordable food system? Well, the paradigm is that healthy food be affordable for everyone. Unfortunately, that's pretty much in contrast to the paradigm or the deeply held belief by those who are advocating for green food systems which suggests that food needs to be priced according to its full cost including environmental cost. So those two things are at odds. So this framework can be a very useful tool for just thinking through the system and the changes that we're trying to incur in a system at all levels of the system, from those deeply held beliefs down to the structural elements.

Now, I've been developing this slide for a number of years where I've been collecting from a variety of systems thinkers. What I'm trying to -- what I would say are sort of generic solutions to complex problems. So, for example, we are so used to, in health systems, a very accountable model where we want to attribute success or failure to a particular intervention individual cause. And we really need to shift that mind-set to one in which we're talking about adaptation. And we're actually looking for structures and measurements that enable us to adapt as opposed to be accountable. We want to support -- now, counter intuitive is the fact that individuals matter in complex systems. And what's actually quite important about individuals is that we think about whether within the system, we've matched their capacity to the complexity of their task. And I'm going to expand on this in a second. We also have a lot of other tools here and if you're reading the slide, you'll see stuff that's interconnected with knowledge translation and I'll come back to it when we talk about solutions to knowledge translation. But I just want to expand on this concept about capacity and complexity briefly because I think it's quite helpful.

And so, this, again, is a concept from Bar-Yam who argues, so intuitively, if you take an individual, be they the person struggling with their own body weight or the CEO of a food company, and you ask, are we matching their capacity to do their job, their abilities, not just their own intelligence, but the tools that they have at their disposal? So, the complexity of the tasks that they have at hand, so for an individual, it might be managing and reducing food intake, increasing physical activity. For the CEO of a food company, it might be making a profit in a world where people want to eat lots of sugar and fat but it's unhealthy so wanting to create and change the portfolio of the company to one being healthier but still wanting to make a profit.

So intuitively, it makes sense. Again, you'll notice the absence of actual measures here but intuitively it makes sense that if your capacity matches the complexity of your task, then you're likely to survive or succeed. If the complexity of the task is higher than your capacity, again, intuitively, one might fail. And I think conceptually this is a pretty interesting idea that we could use when we're thinking about interventions in complex systems, and I don't think we really have tapped into this. Maybe from the point of view of education and we think education increases capacity, but I'm not necessarily sure that's the case.

So, I think this concept is an important one and one we should be using for knowledge translation. Recognizing in knowledge translation, capacity and complexity are both relevant variables. The challenge, of course, is we don't know how to measure them or I don't believe that there are many measures out there that help us really get empirical data to prove that this idea works. And that's one of the things I've been arguing for over time now.

So, okay. So, complex systems are not the same as simple or complicated ones. Knowledge translation is complex. And hopefully, you see that there are ways we can go about solving complex problems that don't require us to work out causes of the problem but are based on thinking differently, using a different frame of thinking as we approach developing solutions. So, how does this apply to knowledge translation? Because really, KT's an integral component of many of the solutions that I talked about, so let's have a look at that. You know, that is I little bit arbitrary, but I thought the ones that are bolded here were all ideas that actually were relevant here, and that would be helpful approaches to -- or were about knowledge translation. But you could equally argue that some of the others are also about knowledge translation. So, if I go back to the definition of KT and I've underlined that there are these four pieces of it, synthesis, dissemination, exchange, and ethically-sound. How does a system help us in these four areas? For example, if we think about synthesis, we're used to thinking about synthesis for the most part as those Campbell and Cochrane reviews which use a very rigid protocol for synthesizing evidence from randomized control trials typically, and they use the pyramid but certainly the best evidence is for that. I heard a lovely story recently about a synthesis done by the Cochrane Collaboration about whether or not advertising of alcohol drives up consumption. And the conclusion the review had was that they couldn't answer the question because there was only one or two valid studies that met all of their criteria.

But, fundamentally, if you take all the literature and information that you have, it's kind of a -- it's silly to conclude that alcohol advertising doesn't drive consumption. They would argue it just drives market share, but it's very difficult to imagine that it doesn't drive up consumption. So, how can we get at a synthesis of different kinds of evidence and different information? And I think one of the ideas -- I just illustrated here the notion of system dynamics modeling. It's just an example for me to speak to the notion that modeling, both system dynamics and agent-based models and other techniques that are now growing in availability for people working on these kinds of problems, that these are different kinds of ways to synthesize a variety of information, be it data or people's perceptions or ideas about what variables are related to other variables and these are useful tools in really trying to understand a particular problem and to synthesize the information that comes from a variety of techniques.

And KT and networks are really important, this is just to illustrate the notion of social networks and how much they can play a role in knowledge translation given the nature of the individuals who might be part, how connected they are, and so this is an important tool, I think, for starting to understand knowledge translation in social networks. And then exchange. So, remember, synthesis, dissemination, exchange. These are all parts of knowledge translation. And I used some work from Trish Greenhall in which she speaks to the differences between simple, complex. Bottom up approaches, letting it happen is the way she frames it. Top-down approaches, making it happen. If you had a complex system, you could make that work.

Or in the middle, which she refers to as, help it happen. So you can see that there's different characteristics, if you're letting something happen, making something happen, or just trying to help it happen. If you're letting it happen, it just kind of emerges. If you want to make it happen, you can do that in a complicated system, it has to be planned and programmed and managed. But if you've got a complex system, techniques and approaches like negotiation, influence, enabling and there you see knowledge transfer becomes incredibly important, so, again, knowledge translation is embedded in the solutions to these problems. Sorry for the picture. It was to remind me to say, I'm not sure what they meant by ethically sound in the application of doing knowledge translation so I'm a little confused both in the meaning of this picture and the meaning of ethically sound. I think it's in the eye of the beholder here. I just threw that in to remind me to say that it is in the eye of the beholder. One thing I think is important and that I tie to the notion of ethically sound is the issue of trust, and building of trust. Some people, we could have an academic argument, it's not important, but I think trust is incredibly important and again, I don't know that we are good at measuring trust. Here's one study from a global health project that demonstrated through key informant interviews that there are important elements of developing trust like use of discretionary power when there's power imbalances. Perceived empathy by patients. This was a study of patients seeking help. The quality of medical care. The nature of the workplace collegiality. In that particular study these were elements to build trust and they concluded that trust reduces social complexity that's inherent between clients and providers. And understanding the supporting trust process is important.

I brought this to you because there aren't too many papers that try to measure trust but trust is really, I think quite important and I've used these definitions of trust, simple trust versus authentic trust versus the other side of the coin, cordial hypocrisy where you've got a front of good will that hides distrust and cynicism. Think about yourself, you not only have to figure out how to solve a problem but work with the people that you're not really sure you trust so, it adds to complexity. Knowledge translation influences what emerges. I really like this notion from Margaret Wheatley who talks about how you can go from networks to communities of practice to systems of influence. So, you know, you can't just create a system of influence out of a hat, so to speak. You need to go through these stages and take something like a network which typically is self-organized and based on self-interest through to a community of practice where still, you know, self-interest is important and self-organization is there, but you start to share knowledge and exchange information and as a result, begin to build trust. And then as the social media advances and more trust is built, a system can really become one that influences what happens because things can move quickly.

So, again, you can see very easily how knowledge translation is an integral component of trying to influence what emerges out of a complex system. There's lots of assessment considerations. I think I won't spend a lot of time on this, but there's a chapter, second edition coming out in this book on systems thinking and dissemination and implementation but again, there's lots of things about adaptation rather than retribution, improving rather than proving, so important to shift the way we kind of think about these things.

So, just to kind of draw us closer to the end here. Wicked problems, they're different from tame problems. And we need to really keep that in mind and we need to recognize that there's no definitive formulation of a wicked problem. They have no stopping rule. They're not true or false. But, good or bad. So, think, you know, as you've got a system that might be very complex, you can't, there's no one right answer. It may not lease you exactly where you want to go but the key is to move in a direction, move in a good direction or possibly a bad direction. As a result, there's no immediate task, and they're all essentially unique. I'm sure many of you have lots of examples. So, just to wrap up. I will come back to my key messages and reiterate that complex systems are not the same as simple or complicated systems. People, I constantly hear people use complex and complicated interchangeably and it's my usual passion to try to get them to recognize that's not the same. Maybe I'm being too academic and pushing the notion that we need to understand that distinction, but I'm pushing it because I really think that, A, we've got a lot of complex problems in this world and we need to make that distinction so people need to recognize we need to move in a different direction. Knowledge translation is clearly complex and solutions to complex problems since they're not the same as solutions to simple or complicated problems, suggest that knowledge translation, we need to be thinking about this differently and in fact it is an integral component to many solutions to complex problems. So I will stop there and look forward to the questions.

ANN OUTLAW: Thank you so much. That was a fascinating presentation, Diane. Natalie just asked, do you have an example of each type of system? Trying to understand how to determine if a problem is complex or complicated still.

DIANE FINEGOOD: Okay. So, yeah. I guess I can go back on the slides myself. I would go back to the beginning and I'm going to quickly flip back there and certainly first remind you -- let's come back to this. So think of relatively simple mechanical systems in your home, like a thermostat, your television works in a relatively simple fashion. It's predictable how it's going to work. You know, the quality of the device may affect the quality of its ability to control temperature in the case of a thermostat but it's pretty predictable. When you turn it on, it's going to do the job of trying to control the temperature in your home. Complicated systems have a lot more moving parts, usually. So, that's why I put an airplane here as a comparison. I think there was a time, for example, when healthcare was relatively complicated, somewhat less complex because we didn't have nearly the same number of approaches. We didn't have enough understanding to necessarily change things. Or the running of our hospitals was really quite -- was probably more complicated.

But, more importantly, as we get to a situation where the populations we're dealing with are quite variable, so, you know, you can't just tell a person who's a pre diabetic to lose weight because not everybody is going to respond to that kind of encouragement. We have to think about those individuals and all the different things that actually contribute to their current condition. You know, they're not all the same people. Some people are doing well. Some people are in denial. Some people want to change but don't have the knowledge to do it, so that's about heterogeneity. Nonlinearity is about, you know, a linear system would be if I change A, I can predict that B is going to double or something like that. If I change A by, you know, doubling it, B is going to double. That kind of a relationship that is quite predictable but in nonlinear systems you may not be able to predict the change because a small change in A leads to a small change in B, but a large change in A also leads to a small change in B. In other words, it's not as direct and straightforward.

Deterministic and Stochastic are about randomness and predictability. I like to use the example when we're talking about obesity about a study that was done a number of years ago where they wanted to see what the triggers were for people who had gained and lost weight. So they took a population of people, some who had documented weight gain over the last ten years and some who had documented weight loss over the last ten years and they interviewed them and asked them about the trigger for that weight gain and weight loss. And the interesting result was it was the same list that the people who gained weight and lost weight had. They were things like losing a spouse or getting married, those kinds of big life events, in some cases caused people to gain weight, in some cases caused people to lose weight. So that gives you a nondeterministic element of that relationship. Clearly, all the interdependencies, the feedback loops that exist in something like obesity from that map leads to adaptive behavior and self-organizing. So, if you tweak, you know, this map in, if we're thinking here and we're down in the lower right and we're going to do something to change the variable that's down in the lower right, not only is the not predictable what's going to happen in the upper left but many of these feedback loops can cause adaptation that result in, you know, an unpredictable result and one that may not achieve what you were actually trying to achieve.

So, I hope that is a better sort of articulation of the difference between simple, complicated, and complex. And most of the problems I think we're dealing with certainly at a societal level today are complex problems.

ANN OUTLAW: Definitely, thank you. Before we go to Patricia's question, I have a similar question that's come in that says, one might infer from your presentation that you're describing processes that will happen no matter what. Do you think planned KT is even possible? Or that the task of KT science is to understand how knowledge circulates in its exchange, whether or not one tries to influence that process?

DIANE FINEGOOD: No, so I would argue -- and I'm just trying to think of what picture illustrates it. I would argue that it -- so, that kind of makes it sounds like it's hopeless, but actually, KT is so integral to effecting change in a complex system because that knowledge exchange piece, albeit not always easy, especially when there's boundaries is a critical component to things like building trust and being able to do things. I'll go to my solutions slide because I think that one illustrates it the best. Sorry. It's a little hard to page through here, but we'll get there -- oh, there we go. I went too far. So, if we look at this list of solutions to complex problems, things like establishing networks and teams. That probably should say, cross disciplinary or transdisciplinary teams where you're bringing people who have different perspectives together to be able to work together so there may be some boundaries there that need to be crossed in knowledge translation between disciplinary areas that's really important but when you bring people together with different perspectives, you have a better chance of solving a problem -- or again, you shouldn't even really say solving. Of moving the system in the direction you want it to move. So, I think actually KT, the question made it sound like KT was hopeless and I would argue it's actually part of what gives me hope that if we get good at doing knowledge translation, we'll actually solve some of the, we'll build on these ideas of solutions and move us in the right direction.

ANN OUTLAW: Great. Speaking of those complex problems. Let's see. We were having trouble understanding wicked versus tame problems. Does that depend on the system in which the problem is observed or can you give us some examples?

DIANE FINEGOOD: Yeah, I can't remember where that slide was, but what I would say about wicked and tame is, they're really just another way to say simple or complicated and complex. So, wicked problems, think of them. And there are some academics that want to make distinctions between wicked and complex, but for your purposes all I'm really saying here is, wicked is the same as complex. Tame is really the

same as simple or complicated. And just think of it that way as interchangeable. I just use the language really for two reasons. Sometimes, people feel like the idea of wicked problems or like that framing of it, and that was how Riddle and Weber back in 73 actually framed it so calling upon their work and approach, I thought it was useful to use that language, but think of them as interchangeable.

ANN OUTLAW: Excellent. Thank you. And one final question before we move into the interactive discussion is, what does it mean to have tools for tracking implementation in a complex system?

DIANE FINEGOOD: Yeah, so what I would say there, and we didn't really talk about that very much here, is that there are numerous strategies for thinking about measurement that are more appropriate when you have a complex problem. So, the notion, for example, of shared measurement which comes out of the work of people who do collective impact is an idea that I think is extremely important. And there's a lovely report done by FSG associates on shared measurement where they engaged in, again, key informant interviews with a group of civil society organizations that are doing different kinds of interventions. And they talk about how important it is to create a kind of shared measurement platform where different people in the system, different levels in the system are able to see related data and rather than, again, with the mind-set of accountability and the selection of metrics that are about accountability, if you're selecting metrics that are more about adaptation and you're sharing those measurements and enabling more continuous improvement, I think you're moving in the right direction.

So, when I think about developing tools for measuring, making measurements and complex systems, my mind goes in that direction. I hope that sort of answers the question. I see that there's a question as it relates to big data. And, you know, that's a really interesting question, one that I'm not sure I'm yet equipped to answer, but I did have a fascinating conversation yesterday with the folks that are building a health type app which they want to be able to scale up individuals, they want to support individuals who are suffering from a particular condition. And we had a really interesting conversation about how one can learn using AI, artificial intelligence and other computational strategies to really understand the deeply held beliefs that drive people's behavior.

So I think that's going to be an emerging area that will quickly come on and maybe in some cases overwhelm us because there are many out there that have the facility to extract interesting observations about people and their potential behavior from things like purchases, etcetera.

Also, the potential exposure of metrics associated with personalized medicine. Yeah, so that, I think is also a pretty interesting business. And what I would say is, I might actually use the language precision medicine there because personalized medicine tends to feel like it's about genetics and genomics and really the biological measurements. But I think for precision medicine as opposed to personalized medicine, and again, I know it's one of those academic nuances, I think we need to be thinking broader than that kind of data. We need to think about, again, I'll say it again, the deeply held beliefs that drive people's behavior.

ANN OUTLAW: This has really been a fascinating talk. Thank you so much, Diane, for your presentation today. And I believe you'll be sticking around for the interactive discussion, which is just about to happen.