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Rebecca Gleason: Hello. My name is Rebecca Gleason. On behalf of OptumLabs and OptumHealth Education, I would like to welcome you to today's activity, why do smart people make mistakes? The answers are worthy of a Nobel prize. Before we begin, I would like to review a few items, a questions and answer session will be held at the end of the presentation. Questions may be asked via the instant message box located at the bottom left-hand side of the webcast player. Upon conclusion of the webcast, the evaluation credit claim and certificate of attendance will become available. Visit OptumHealth Education.com for more information. In order to receive continuing education credits, these materials must be completed by no later than November 13th. Additional resources for today's presentation can be downloaded under the event resources tab on the webcast player. Also, please note that this presentation is being recorded and will be available on-demand around October 20th. I would now like to turn the program over to Dr. Jaime Morello.

Dr. Jaime Morello: Thank you, Rebecca. I'm privileged to introduce Dr. Cook to this presentation. He's actually so smart that he can talk about smart people. So, Dr. Cook is Senior Vice-President OptumLabs and Dr. Cook supports the development of enterprise strategy and healthcare services, design, and innovation, and operates across research clinical and venture divisions within OptumLabs to build and inform future directions in healthcare delivery. He helps lead organization efforts in diabetes and kidney disease. Previously, Dr. Cook served as Chief Clinical Officer for Jiahui Health Shanghai, China. He oversaw their development and integrated multi-site medical system in Shanghai, he was responsible for strategic planning, phasing, and standing up for clinical operations. He also directed innovation, technology development and investment strategy, and Pan-Pacific partnerships.

Prior to his role, Dr. Cook was professor of the Mayo clinic foundation while he practices anesthesiologist intensivist with an appointment in Mayo section of systems engineering. Dr. Cook focus on the application of systems engineering approaches to practice analysis and redesign. Dr. Cook work has included presentations on the World Economic Forum with NADJ catalyst at the national press club. His work has included exposure through the advisory board, the Wall Street Journal, the Harvard Business Review. Dr. Cook is on the Board of Directors of the National Kidney Foundation and the Rothman Institute at the university of California, San Francisco. Dr. Cook is a fellow of the American Heart Association and received a master of health and nutrition from the university of Minnesota. And now, Dr. Cook.

Dr. David J. Cook: Thank you Jaime. Jaime, it's a pleasure to have you as a partner in these activities. Why do smart people make mistakes? About 20 years ago, the Nobel prize in economics was won by Daniel Kahneman for insights into human thought and decision-making. And Kahneman really turned traditional economic theory on its head. In 24 years of OR and ICU practice, I saw many instances of lapses in judgment, frankly, many of which were my own. And when I read Kahneman's book a few years ago, it helped me wrap a mental framework around some of those lapses. And while I have no background in behavioral economics or psychology—so I'm not really talking about qualified talk about those subjects. The best I can do is offer an illustration of flip flaws and judgment. I'll be it from my sort of years in the operating rooms, in the ICU. And well, the examples I provide are specific to those practices. I think they have wider applicability in our professional lives.

So, what I'm going to do in this—what I'm going to do in this lecture is sort of introduce Kahneman's ideas about human decision-making and then connect them to medicine. We hear a lot about behavioral economics. What that is, is the study of the effects of psychological cognitive, emotional, cultural, and social factors on the decisions of individuals and of organizations. We're also going to talk about Kahneman's dual process theory, and I think you'll understand the applicability, what are heuristics and how they introduce potential cognitive biases. And we'll talk about de-biasing techniques that can at least be partially effective in reducing cognitive bias. But first we're going to start with three questions that came in Kahneman's book and we'll do those questions quickly. The first one is a bat and a ball cost, a dollar 10 cents. The bat costs \$1 more than the ball. How much does the ball cost? Second, it takes five machines, five minutes to make five widgets. How long would it take a hundred machines to make a hundred widgets?

Last question, in a lake there's a patch of Lily pads every day, the lake doubles in size, it takes 48 days to cover the entire lake. How long would it take to cover half the lake? So most people get these wrong. The majority of people that are presented to do these questions, unless they're given a great deal of time to think about them, get the majority of questions wrong. And this is what, Kahneman' really sought to understand. So he won the—he and his partner, won the Nobel prize in economics in 2002, by characterizing and demonstrating and experiment something they called Dual Process Theory. And that's captured in a book called Thinking Fast and Slow. I'd certainly recommend it. It's a little dense, but the reasoning won the Nobel prize was because the findings that are presented in that book really challenged the assumption of human rationality.

That up until that point had prevailed an economic theory. So by understanding that human being's huge number of their decisions are not rational, really up ended how economists think

about the behavior of people and organizations. And I think that this is certainly relevant to medicine and to healthcare and perhaps in some ways to our own lives. So what Kahneman identified was that something called dual process theory, and that generally thoughts arise from two different kinds of processes. First, he called System One. These are thoughts that arise from an implicit sort of automatic and unconscious level. And Kahneman in his studies in psychology identified that about 95% of our thinking is really arises out of these sorts of automated unconscious processes. These processes are sort of, we're not really aware of them. They're intuitive. They tend to be very fast. They're usually pretty accurate, because they may be based on sort of historical patterns of understanding they're extremely comfortable and they're relatively easily reinforced.

So system one, thinking most of what occupies our mental activity then there system two. And the best quote I've ever seen to exemplify system two theory comes from this man. Lincoln said, if he had six hours to chop down a tree, he would spend four hours sharpening the axe. So how does system two thinking differ from system one? System two thinking is an explicit controlled and conscious process. System one approaches tend to be very accurate. They're time consuming. They're deliberate. We're aware of them as they're occurring. And importantly they're easily overloaded and system two process is fatigue. They require patience. And in some ways, they're hard because they demand multiple inputs and assessment of what are frequently conflicting kinds of decisions. So system one, thinking fast, automatic, easy undemanding, very good for familiar practice routines driving a car to work can be used effectively when you're tired, when you're sick or when you're stressed.

And it really relies on impressions, intuitions, and feelings, but it's really susceptible to error. And the three examples that I gave you, people jump to decisions on the answers sort of based on the structure of the question and certain features of the questions that tend to lead them in the wrong direction. Again, system two thinking slow effortful, hard, useful for hard question relies on logic analysis and reflection it's draining, and it can override a lot of errors through careful thought it's necessary for novel decisions or routines. And it's impaired by fatigue, illness or stress. And importantly, all of us who are extremely busy in our work and our personal lives, Kahneman' observed that under conditions of high cognitive demand. Our thinking tends to break down and increasingly rely on system one. And this is the kind of challenges that we often face in medical practice.

Again, I spent 20 years practicing in ICUs at Mayo, just down the street in Rochester and in my ICU practice, this would be an extremely common if not weekly scenario, surgeon comes, walks into the room and says, "Start an antibiotic now. I want to go back to the operating room

tomorrow." And our patients are complicated. The one I described has his status post-cardiac surgery for a mitral valve repair. The patient is febrile. He's got an infiltrate. He's got diabetes, he's got a compromise. The injection fraction, he's got moderate renal insufficiency. The creatinine is working—is worsening. The patient is all a garlic but has pitting edema. The labs are screwed up or already giving diuretics and he's on immunosuppressants. So the answer which antibiotic to give and in what dose is really a system two problem. Solving this problem for these individuals could either take an hour or two with a reliance on, you know, getting an expert pharmacist help or, you know, if you're really busy and you want to start an antibiotic now.

You sort of go in your past experience and choose a solution or a pair of solutions for antibiotics that are generally effective for 70% of cases and that allows you to start the antibiotic now, but the costs may be, you know, Nephrotoxicity or worsening renal function. So there's just this continuous tension in many ways in our lives and in our practices between sort of demands for rapid decision-making and time taking thoughtful decisions. So system one uses something called the heuristics. And again, these are largely unconscious, but heuristics are any approach to problem-solving that employ practical methods, not guaranteed to be optimal, perfect logical or rational, but generally sufficient for reaching an immediate goal. And frankly, in 20 years of practice, you know, we see a lot of this, so why is it important? Well, before we go on, so heuristics consideration decisions are made with considerations of fewer cues because that simplifies them simplification of the weighting of those cues, examination of fewer alternatives, attributes, substitution saying this is something else answering easier question.

And if you think about your—even your, sort of busy lives in the decision-making in your work at UHC or Optum or UHG these kinds of considerations are relevant to sort of all of our approaches decision-making not just those we'd have to make in an operating room or in an ICU. So in medicine, why is this important? Well, because of medical errors the Institute of medicine report to err is human was published gosh, 20 years ago. And so it's out dated, but that report said that medical errors are linked to almost 34 million hospital admissions a year and cause probably upwards of a hundred thousand deaths a year. At that time, the Institute of medicine said medical errors were the eighth leading cause of death in the United States. A more recent report from Hopkins published probably seven years ago, said it might actually be the third leading cause of death in the United States.

If you really broadly ask the net about how you understand medical errors say, continuation of medications for months that might result in a fall, a hip fracture and eventual death. So, you know, it's a big problem and mental shortcuts are probably a significant contributor to that. So what are the kinds of mental shortcuts that are used? And I'm going to talk about, about five of

them, there's something called an availability heuristic, an optimism heuristic, a confirmation heuristic, a representative or representativeness heuristic, and then another, sort of shortcut in decision-making called fixation or anchoring, which is not exactly heuristic, but there's discussion. So the availability heuristic is that our thinking and our immediate responses are influenced by a recent or highly memorable event. Some event, you know, has a psychological impression on us either because of its visibility or its recentness, and this creates an unconscious equivalent because between something that comes to mind quickly and its probability.

And here's what I think is a great example. A long with this is the kind of thing we saw all the time in the operating room. You know, Dr. X yelled at me, so this is what I remember how to do something. Or there was this journal article last week. Well, neither Dr. X yelling at you or the journal article next week. The weighting of those factors may simply be irrelevant even though they have a high influence on your decision-making. So, here's another question and it feels like an absurd question. In the US which is more likely dying from an illegal immigrant terrorist attack or an asteroid striking from outer space. I used to do these questions in an electronic environment where people could click on the answers. The answer to this, is well not what most people would expect. So there was a study published by the national safety council a few years ago that looked at natural disasters and causes of death the lifetime odds of those happening and things like choking on food, bicycling accident, accidental gunshot, but they also evaluated the likelihood of being struck by an asteroid or being killed by illegal immigrant terrorists.

And frankly, even though it's a little surprising, the chance of in our lifetimes of dying from an asteroid are actually greater than those dying from being killed by an illegal immigrant terrorist. I provide this example because, the issue of terrorism is so prevalent in our media. It's so prevalent in our exposure in our daily lives. That the way we weight those kind—that kind of an assessment or that kind of decision really is not representative of what the risk is in the population. So next steps are availability, heuristic, other ones that we saw all the time in surgery in the ICU, not to pick on surgeons. Surgeon, could you please give this patient some Amiodarone? And I would say why? And the surgeon say, "Well, because my last patient had rapid atrial fibrillation in the operating room and we needed to cancel the case."

I mean, this reasoning is just fallacious, right? It's highly vivid, but what happened in the last patient really doesn't have bearing on this one other example that we would constantly sort of share and sort of try to beat out of residents, my last patient bled. So I'm going to do a type and cross arterial line and a central line, my last hiatal hernia, patient aspirated. So I'm going to manage the airway this way. My last epidural and aerial obese patient resulted in a wet tap. So I'm going to take this approach. My last patient with [inaudible] equal hydromorphone needed

Naloxone. So I'll do something different. So all of these represent sort of this vividness and availability of information that caused us to lead to relatively poor decision-makings and it's extremely common. The next heuristic is called an optimism heuristic, and this is when a strongly held preference for an outcome cloud, our assessment of reality.

And I'll give you an example, which I heard many, many, many times sort of in the middle of the night or late in the day. And that is, I think the bleeding will stop when we get to the ICU. There's actually probably nothing about transferring a patient from the operating room to the ICU that's going to stop bleeding. But there are these—there's sort of a hope that some change will occur and that things will be better. And this kind of thinking frequently gets incorporated into our lives. There's a related heuristic, which is a—was called the confirmation heuristic, which is when we preferentially seek or overweight confirmatory information or use selectively limited information to support a conclusion that we've already drawn. And again, here's another example from the ICU. You know, it's two o'clock in the morning, the patient's been in the operating room for 14 hours.

They arrived in the ICU couple of hours ago. I see a nurse calls and said, "The patient's getting worse. The pH is 7.19. And the mean arterial pressure is 62." And the doctor says, "Well, I think it's going to be okay. We gave less epinephrin this hour." So this is again a situation where a very select piece of information is being disproportionately weighted to confirm, a hypothesis and, you know, perhaps other sorts of, secondary gains that come from this kind of thinking. The next example of a heuristic comes out of a short report that came out in the anesthesiology literature. I apologize for the examples, but I think they're probably representative broadly. This case is a post-op day two, grab a five para four patient whose status post her third C-section on second day after section, she becomes acutely hypertensive and short of breath.

You know, that she's morbidly obese. She has two plus putting a DEMA and the nurse tells you she's refused her last three doses of subcutaneous heparin. She rapidly loses consciousness and progresses to pulseless cardiac arrest. What's the most likely diagnosis? The vast majority of anesthesiologists and ICU docs faced with this question choose pulmonary embolism, which is not the correct answer. And this represents what's been termed the representative or representativeness heuristic, which is basing a judgment or a decision on the basis of a similarity to a prototype that one's established in your mind. This scenario obese likely to DVT refused heparin. You know, all of those things are true. But there are several gaps in the thinking on this, here decision is made on assumptions because something looks like something you've seen before.

So it's kind of a subconscious pattern recognition, the strength of the match of that sort of intuitive pattern overrides the knowledge of probability. And in this case, neglect of base rate leads to a wrong conclusion. I don't know the numbers exactly, but in as somebody who's had three C-sections on a postoperative day two, the chance of hemorrhage causing hypotension shortness of breath and cardiac arrest is probably five to 10 fold higher as a base rate incidents than having a PE on postoperative day two. So base rate neglect is a frequent problem. The next kind of examples that we saw are, and I think these are representative in all of our professional lives is called fixation or anchoring and fixation or anchoring is really used broadly as a psychological tool to influence decision-making. It's why, sellers always want to set a price on a house at a certain level.

It's the way when information is first presented, marketers, try to anchor you to a certain point to influence your subsequent decisions. So this was an example where I met with a cardiac fellow in the morning. We're scheduled to have this patient for mitral valve surgery. The patient had been transferred in, from an overnight—from an outside hospital overnight, and the fellow cancelled the surgery, the morning of surgery. And he cancelled the surgery because the radiologist at the outside hospital, said that the patient had pneumonia. But in fact, the—what the x-ray shows is heart failure. The point is that the resident focused on a single piece of information. He fixated on that report, that an outside radiologist, some presumably senior to him had made. And didn't see beyond that. So we cancel cardiac surgery with patient with new infections, but you don't cancel surgery for heart failure in a patient with heart failure.

So the fixation or anchoring in cognitive fixation, it's really an insufficient adaptation from initial starting point. The initial starting point is resident reads, pneumonia and failure to consider the alternatives. So it's a form of sort of mental handcuff. I'll give you another example, that was really vivid with me. This is a patient who had a coronary artery bypass grafting, and at the end of the procedure, the chest gets closed. You know, with sternal wires and the oxygen saturation starts to fall really fast. And an oxygen saturation of 83 is, you know, potentially life threatening. The patient gets tachycardiac, the patient's blood pressure drops, you know, can oxygenate. So the resident in the room does all of the anesthesia things. They increased in sparring fraction of oxygen. They checked to make sure that the breathing circuit is intact. They checked the ventilator settings and the alarms, they check the circuit integrity, they checked the capita graphs, the flow curves, they recruit lungs, increase peep and ask the surgeon to reopen the chest.

Now, all of these things are logical, but what they represent is this person effectively knowing—doing what they knew how to do, and the situation in the case was the patient acutely developed a ventricular septal defect where all of a sudden, the blood from the left heart is overloading the

right, which caused right heart failure. All the resident had to do was push a button and turn on the echo machine to see this. But again, there's a certain myopia, that can develop in our work lives, where we fix on doing those things. We know how to do because we can execute on them well, rather than looking outside or thinking about problem solving in ways that are less familiar to us. So I think this is a quote from Kahneman, "When my present situation is in congruence with my past experience, I tend to persevere with what I know."

So how do we begin to fix cognitive bias to improve decision-making? First, it's really difficult to study and to document because these processes are internal, they're psychological, they're largely unconscious, they're decisions made on sort of emotional and visceral impressions, and their analysis can only occur retrospectively or externally. And trying to study bias in decision-making is really fraught with a Hawthorne effect, which is the act of studying that effectively changes the result. If you're studying someone's decision-making in all likelihood, they're going to take a different kind of approach than if you weren't studying it. So there's a variety of things that can be done. No single approach will work. Some of the interventions that are needed to reduce cognitive bias have to be bias specific, but in healthcare we're improving increasingly trying to identify external means of reducing bias and improving decision-making.

So external methods are changing a decision-making environment and internal methods to fix cognitive bias are improving our thought processes. The external strategies are pretty, pretty routine, although relatively poorly adopted. In the process of care, cognitively three Op system two, to think creatively and things like checklist, protocols, clinical decision support in many ways, reduce the cognitive load and allow systems two, to have to deal in some ways with less input. And although these things are effective, they're partially effective. Their adoption in healthcare is really still sub-optimal. I'll give an example of one of the things we did at Mayo. An anesthesia is complicated. I think it's got about, I don't know, can't read this diagram, but at least 35 parts. And, in anesthesia we routinely paralyze people and under surgery, they can't breathe and the anesthesia machine essentially is life support.

So if there's any defects in the system, you can get into trouble quick. So you can see basically about half of our pre-anesthesia checklist, the number of steps in this, it starts with step 10, and incorporating these kinds of checklists, making them mandatory and documenting them can significantly improve a patient's safety and reduce errors that come from shortcuts because you're busy or tired or stressed. Protocol based differential diagnosis is also important. These are the kinds of things that Ken Cohen is trying to do with Optimal Care sort of realizing and making real in our practices best evidence. So then I just throw this one up there. This is a protocol for shortness of breath. I circled there pulmonary embolism, you can see the number of

clinical causes of shortness of breath are numerous reaching towards pulmonary embolus. And the patient is at least a shortcut and probably irresponsible[?], but there are structured ways to approach these kinds of problems.

There are also other kinds of external strategies that don't occur actually at the point of care. And it's really important. And these things can, can really influence our lives, even if we're not directly in the practice of medicine. And these are external strategies where we get the inputs of our colleagues to get outside perspectives, things like case discussions in medicines or debriefing after meetings, and really importantly, creating a culture and environment where it's safe to ask questions of ourselves in each other's. There are also internal strategies to reduce bias. These are sometimes called metacognition or thinking about thinking, and that is being aware of your process of reasoning, literally forcing thought alternatives, considering the opposite articulating clearly the justification for your choice, rather than just assuming, because you practice in the ICU for 20 years, you knew what the answer is and forcing yourself to pause and ask questions.

What might I be missing? There's another form of internal de-biasing that is incredibly important, and that is awareness of your emotional and psychological state asking the question in when faced with a decision. Am I tired? Is this about my authority, my hasty, and my judgment. Do I simply want to go home and get this over with, am I listening? Am I distracted? And the application, you know, we're super busy, but the application of this combination of external de-biasing strategies and internal ones really can change and improve how we make decisions. The next thing I want to do is tell you a remarkable story about who I—a person who I think is a remarkable man. This is Thor Sundt, he's a close friend of mine and a former colleague at Mayo. For context.

He's a Harvard professor. He's the chair of cardiac surgery at Massachusetts general hospital and the recent former president of Society Of Thoracic Surgeons, which is the society for all cardiac surgeons in North America and cardiac surgeons have a reputation of being sort of ill-tempered and aggressive and impatient. Thor's mission though, is to really reduce medical errors and change the culture of healthcare that makes it easier to make better decisions. And I'm going to do the best I can to paraphrase a talk that I heard Thor give. So he walks into an auditorium where there are 400 people. Most of them physicians, some nurses, any pauses after his introduction. And he says, on a Christmas Eve, I made a man's wife, a widow.

It was evening a call came in for an emergency case and it was an aortic dissection. And he said, while I'd already been operating for 10 hours, and I knew it could an eight-hour case, it was Christmas Eve. I had elected to take the call. I didn't want to call my cert my colleagues in for

help. And frankly, Thor is the best aortic surgeon at Mayo. So what happened is in cardiac surgery, we stopped the heart and the lungs and the heart lung machine essentially provides all the circulation and oxygenation. And normally there's a whole lot of tubing that has to be connected and a lot of connections. And for a dissection case, there are several more than usual. So what Thor says is it was after midnight, he was tired, but he was very experienced and he wanted to get the case done.

So his team could go home. So he moved too fast, made a wrong connection and effectively killed his patient in front of an audience of 400. So then he asked what might have prevented this. So first realizing that he'd already been operating for 10 hours and asking for help from a colleague who hadn't been operating all day, it's a burden to ask somebody to help with your call on Christmas Eve, but that would have been a better judgment. He said stopping and using a checklist and a call-out for every connection. And what he really emphasized is empowering a team to call out a mistake. He said in the room is a surgical fellow surgical nurse and anesthesiologist, and a perfusionist and any one of them in theory might have identified the mistake, but there's this cultural hierarchy that the cardiac surgeon is the captain of the ship, or the committee chair is the captain of the ship.

And, he's been working to create a culture where people are empowered to identify mistakes, to question, to offer alternatives. And since taking over cardiac surgery leadership at MGH, Thor's really transformed the culture there. He's changed the lives of those that he's worked with. And I think probably made surgery at Massachusetts general hospital a better and safer place. So to recap, we told you what behavioral economics were. We've identified and defined sort of Kahneman's dual process theory. We've talked about heuristics availability, vividness, recentness, optimism, confirmation, representativeness, and fixation or anchoring. We've talked about some internal as well as some external de-biasing methods that I think are probably broadly applicable in our lives. That said, de-biasing in general is only modestly successful. System one is in default and Kahneman says because system one is intuitive and emotional and immediate being wrong actually feels just like being right until it was apparent that you're not. System two, even if we pride ourselves on it, readily breaks down the system one, be conscious of your physical and emotional situation of where your risk for that happening. Certainly decision-making environments can be changed and we may be able de-bias ourselves in each other, but it requires self-awareness, humility and leadership, I think that's it. Thank you.

Rebecca Gleason: Thank you, Dr. Cook. That was an excellent presentation. And I would now like to open up for questions from the audience. I do have a few here. The first one that came through

and I think they were referring to your heuristics list it, says, where would death from COVID fall on that list?

Dr. David J. Cook: So that, report was published, gosh, a number of years ago, I gave this lecture at Mayo, I think, five years ago. So COVID didn't even exist then. I'd have to, you know, refer that question to people that do population health, to understand what it's been in the past or what it's likely to be in the future.

Rebecca Gleason: Okay. The next question here is how can we better differentiate between an assumption we make about outcomes based on optimism and representation or representative heuristics versus correctly applying experience from outcomes in previous cases?

Dr. David J. Cook: You know, this is certainly an important problem in medicine and an important question. We rely on our experience. You know, physicians are lauded because they are able to make decisions, but the more that we can bring information and I hate to say apply data, but help before more, we can bring information to the point of decision-making to reduce the risk, to talk a moment just for a moment about clinical decision support, clinical decision support, kind of gets a bad rap. It's thought that, you know, AI or ML models are going to make decisions for clinicians and the clinicians' choice and decision-making is going to be replaced by algorithms that they don't understand. But probably what we're going to see over the course of the next several years is increasingly, as in sort of, as in the example with, you know, things like optimal care, increasingly we're going to see clinical decision support, not making a decision, but surfacing the information that's required to make the decision forms of data, to make a decision exist all over the place, whether it's in an electronic medical record or, you know, in your work at Optum or UHC, figuring out how to assemble those pieces of information together.

So they're more usable, and available make it easier for system two, to operate rather than having these sorts of, you know, Watson tools make specific recommendations to eliminate the provider. I hope that's helpful.

Rebecca Gleason: Thank you. The next question is, do you think that experience is what we need in order for us to decrease incorrect fixation anchoring? Are there better ways to recognize when we are doing this?

Dr. David J. Cook: Well, experience is fundamental. I mean, but at the same time experience should be a counterweight to anchoring. Experience tends to increase, as I showed in the example tends to increase fixation, right? Because, we tend to default to those forms of decision-making, and

kinds of decisions that we've made in the past. So, gosh, I always want an experienced physician, but I want an experienced physician or pharmacist or nurse that's supported by things like protocols and decision aids. I want my nurse supported by, you know, continuing education to be-participate in case reviews, to participate in debriefings. And those are things that are true of all of us. And frankly, you know, the most experienced provider in the room, there's a tendency to defer to them automatically, but just realize that there's—take it for what it's worth, but recognize that it also tends to be a trap. And certainly over here at OptumLabs, as we work on innovation, gosh, the stuff I hear from people every day that are 20 and 25 years younger than me, give me alternative ways of approaching problems and thinking about them that I just have never been able to get to given the fact that I've practiced medicine for 25 years. So, you know, there's a certain amount of humility in that and also a willingness to have that self-awareness.

Rebecca Gleason: Thank you. There's a question here are statistics a part of either or both systems?

Dr. David J. Cook: Statistics are—one could say that, you know, statistics are subconsciously applied in system one, but that's really not true. That's just a false justification. I'm glad you mentioned statistics because that's the sort of thing that comes out of our base rate and the recognition, you know, for the provider who wants to make a decision, whether we're going to treat this patient like pulmonary embolism or hemorrhage that base rate is a statistical sort of, way of understanding that understanding, you know, what are the—what is the likelihood of an adverse drug event in somebody who's prescribed a drug or the interaction between true drugs? These are largely, you know, while we have two statistics, don't apply to individuals, they apply to populations, but having that sort of information on our fingertips allows us to frame within a more narrow, context, how to make those decisions on top of those sorts of base rate and statistical understandings.

Rebecca Gleason: Thank you. Next question is how may we effectively apply a paced metacognition assessment under time sensitive procedures?

Dr. David J. Cook: It's super hard. I mean, to basically apply system two thinking when you're under tremendous stress or under short-term decision-making, it's certainly difficult and, you know, the best I can say, the situations that, you know, that I think of are so amazingly acute, that, you know, it might be, you know, please clamp the Aorta. I can't control the bleeding. You know, getting other people viewing the situation because looking at them from the outside may offer things, you know, practical example is, you know, having a nurse in the room in trauma triage simply be both recorder and an observer. Having somebody in a high importance meeting, sort of surveying and making sure that sort of understanding the sort of, emotional environment, and the expression of the people who were in the room, making sure that all people are heard.

These are kinds of, trying to provide an objectivity in time-sensitive or kind of emotionally charged situations, but identify an objective observer. Who's not a participant whenever possible. I'll give you another example of that. There's a really expensive technology in cardiac surgery called ECMO. And the average ECMO case cost about a million bucks and at least in its used worldwide about 50% of people die are put on ECMO, unless it's for like acute respiratory infections and another 25% leave the hospital disabled. I was at the Oxford, not Oxford whatever the other big English academic institution is. I was at their hospital and they implemented a process by which before a surgeon could be—could put a patient on ECMO. They got another surgeon to come in the room and make an assessment. They realized that a surgeon who had a dying patient was so wrapped into that case and would do everything and anything to make that patient get out of the operating room if even for a day or two, that, that emotional and state of physical exhaustion prevent objectivity. So they would require another surgeon to come in the room completely disconnected from that case as an observer to support that kind decision-making I hope that helps.

Rebecca Gleason: Thank you. The next question is, will additional use of systems two operations contribute to more accurate systems one operations?

Dr. David J. Cook: I don't know the answer to that. I suppose if you apply system two thinking long enough, you may eventually start to establish some sort of cognitive patterns that may lead to better system one, thinking I have—you'd have to ask Daniel Connor, that question. I'm not sure it's been tested and it's—if system two thinking includes sort of self-awareness, then that will sort of reduce reliance on system one.

Rebecca Gleason: Okay. Thank you. This question, how do you think AI artificial intelligence, assisting human decision-making would help us with bias perspective and errors?

Dr. David J. Cook: I think in time, AI and ML is going to be extraordinarily beneficial. Physicians are reticent, right now, those tools are relatively mature. Those physicians are reticent to adopt AI and ML unless they understand how those decisions are arrived at. There's both rule-based AI and there's Black Box AI positions providers don't like black box AI because they want to know what the basis was for the decisions. Frankly there's probably greater power in black box AI for very highly complex clinical scenarios. Where this will probably go is machine learning and AI will be able to identify and recognize patients that look like the one that's in front of the provider. I mean, a provider with 20 years' experience, you know, has experience with thousands of individuals, which is a lot. And they may have experience with hundreds of individuals that sort of

look like this person, but they can't draw in seconds on a database of 30 million people recognize who kind of looks like this and surface different probabilities for different treatment choices.

You know, if you give drug A there's 90% effectiveness, 30% side effects, you'd give drug B 40% effectiveness, 20% side effects. If you give drug C low effectiveness, but almost no side effects that kind of AI application will really help decision-making. Yeah, at the same time as UHG, you know, we have to be aware that because these kinds of systems learn from prior decisions they are—they do have the potential to introduce bias and we have to constantly survey these tools and assess them to make sure they're not actually accentuating bias in our decision-making. We got two minutes left. We need to jump to the—

Rebecca Gleason: Yes. One more have—well, we have—yeah. While we have time for one more question, if you don't mind, maybe you can get this, it says, how do we deal with the pressure of practicing defensive medicine? How can we get the medical community to reverse the time pressure placed on providers in the clinical setting, where there is increased pressure to see as more patients in less time?

Dr. David J. Cook: You know, that's a systemic issue. Providers need more time to make good decisions. We have to find ways to empower providers, you know, this is a personal opinion, not opinion position of OptumLabs. We need to empower pharmacists. We need to empower nurses. We need to figure out way, we need to empower patients. We need to distribute decision-making across the healthcare stack. And so providers can spend their times making the most important decision and we need to surface information to make those decisions easier.

Rebecca Gleason: Thank you very much. Those are great answers. Great questions. I'd like to wrap up now and just mentioned as reminder that we ask all individuals to please complete the post activity materials, which are now available in order to receive their continuing education credits. Please have these materials completed by no later than November 13th. And on behalf of OptumLabs and OptumHealth Education. I'd like to thank you, Dr. Cook for your participation. You can contact us at moreinfo@optimumhealtheducation.com with any questions. And finally, please know that you can join us for our next grand rounds on Wednesday, November 10th, with Dr. Robinson Beale. And the topic is the pandemic related transformation of behavioral healthcare delivery, 2022 and beyond. Thank you for joining us. And this concludes today's webcast.