



Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury (DCoE) Webinar Series

June 11, 2015, 1-2:30 p.m. (ET)

“Translational NeuroRehabilitation Outcomes: Research Trends and Person-Centered Care”

Good day and thank you for joining us today for the DCoE Traumatic Brain Injury June webinar, Translational Neurorehabilitation Outcomes: Research Trends, and Person-Centered Care.

My name is Major Pamela DiPatrizio, and I am the Chief of the Office of Education Outreach for the Defense and Veterans Brain Injury Center. I will be your moderator for today's webinar.

Before we begin, let's review some webinar details. If you experience technical difficulties, please visit www.dcoe.mil/webinars to access troubleshooting tips. Please feel free to identify yourself to other attendees via the Chat box, but refrain from marketing your organization or product. Today's presentation references and resources are available for download from the Files pod and will be archived in the Online Education section of the DVBI website.

All who wish to obtain Continuing Education credit or a Certificate of Attendance, and who meet eligibility requirements, must complete the online CE Evaluation. After the webinar, please visit: www.dcoe.cds.pesgce.com to complete the online Evaluation and download or print your CE Certificate or Certificate of Attendance. The evaluation will be open through Thursday, June 25, 2015.

Throughout the webinar, you are welcome to submit technical or content-related questions via the Questions and Answers pod located on the screen. All questions will be anonymous. Please do not submit technical or content-related questions via the Chat pod.

I will now move on to today's webinar, Translational Neurorehabilitation Outcomes: Research Trends, and Person-Centered Care. Trauma care and acute care have significantly improved the survival of and reduced disabilities in individuals who have sustained moderate to severe traumatic brain injuries. However, post-hospital care has been less well-defined or validated as an intervention of this population. Today's webinar addresses research which supports the neurological continuum of care, from the Neurological Intensive Care Unit through post-hospital care to return home.

Current research substantiates that post-hospital care leads to positive results and ultimately decreases disabilities in individuals with extensive injury. Statistical analysis, such as Rasch statistical technique, has the potential for determining the level of rehabilitation intervention. This technique reveals that instrumental activities of daily living tend to be the most difficult skills to rehabilitate and those to change last in skilled acquisition continuum. This analysis provides a method to facilitate person-centered care outcomes to those with fewer resources. This model can be adapted to person-centered therapy in the home.

At the conclusion of this webinar, participants will be able to: articulate how current research trends in post-hospital rehabilitation impact healthcare decisions; discuss outcomes prediction, measuring and monitoring, and cost utilization; incorporate the application of facility-based model to the home and community level for the individual with limited resources.

Dr. Horn serves as the National Deputy Director of Clinical Outcomes at NeuroRestorative, focusing on outcomes, translational research, and healthcare economics in post-hospital rehabilitation. His research interests include traumatic brain injury outcomes, rehabilitation outcomes, and normal pressure hydrocephalus. He has experienced an entire continuum of neurological care, from intensive care through post-hospital treatment.

He holds a Ph.D. in Clinical Psychology from St. Louis University. His intern and post-doctoral fellowship are from Duke University School of Medicine. Specializing in neuropsychology, medical psychology, and neurological rehabilitation, Dr. Horn's current academic appointment is with Florida State University, College of Medicine.

Thank you for joining us today, Dr. Horn.

Thank you, Major; I appreciate it. That was a great introduction.

Let's talk about translational neurorehabilitation outcomes. And let me make sure I can do this correctly; I think I can.

I'll just review the disclosures real quick. The views and opinions expressed in this presentation are those of the presenter, and do not represent the official policy of the Department of Defense and the United States Army or DVBIC. The NeuroRestorative Outcomes Team is myself, Dr. Frank Lewis, and Robert Russell. The three of us do a lot of data analysis and data outcomes research, and so we're the primary team for NeuroRestorative. And we will not be talking about any discussion of off-label investigations or anything of that nature. So let's get to it.

In the overview, as stated, we're going to be discussing the following things. First, we need to understand basic trends and statistics regarding various neurologic conditions for looking at post-hospital rehabilitation care. We're also going to be looking at the current research trends in post-hospital rehabilitation and how this impacts our health care decision making. We'd like to look at things like predictions, measuring, monitoring of outcomes, and cost utilization. And third is we want to look to see how we can apply the (inaudible) between the facility-based model to a home and community-based level of care so that those who have more limited resources can access a benefit from many of the things we talk about today.

For the first polling question – I always like to have some interaction – if you all would take a look. This first polling question is: Select the primary type of health care facility where you are currently in practice. And if everybody can take a look at that, and you'll see the results in just a moment.

[Pause for responses]

Based on the current results, and I think I can broadcast the results; or I think that Jeanne will actually do that. It looks like the majority of folks, about 41%, are working within the VA health care system; and about 22% are within military systems; about 20%, not applicable; and we have about 5% to 6% are in private practice; about 5% in academic or community-based hospital settings.

Okay, excellent, thank you for presenting that. It's always nice to know who is in the audience.

The next follow-up polling question: Select the predominant TBI severity level that you typically see in your practice or that you typically work with on a day-to-day basis. And even those who are currently doing research, if you would also take a look at that.

And it looks like the results are coming in pretty quick. It looks like about 75% to 80% are working with mild to moderate TBI, and about 20% are working with moderate to severe TBI. What's interesting about actually that poll is that when you're looking at the levels of severity of injuries, the levels of severity actually match exactly what you see in terms of how people are working with this population. For example, approximately 80% of most traumatic brain injuries that we see around the country actually fall

in the mild category; and the other 20% fall within the moderate to severe TBI category. So that's excellent.

And we'll go to the third polling question, if you all would take a look at this. Please indicate your role in the TBI rehabilitation and check whatever applies. And let's see what those results are. Again, we'll give it a moment.

[Pause for responses]

It looks like case managers may outpace everybody else. It looks like about 20% -- we can go ahead and post those results. I think they're primarily in. We've got a total of about 135 attendees; and about 20% are case managers; about 17% are within the behavioral health realm; approximately 13%, occupational therapists; approximately 13% are physical therapists; about 8% in speech and language pathologists; and about 13% are other types of rehabilitation providers. So that's fantastic, and so welcome to everybody. Hopefully, all of this will be applicable for all professions within the rehabilitation scope.

Let's get some perspective. I always like to start every lecture that I give with just some basic statistics, and I really enjoy using the Center for Disease Control because I think that they have some of the best data that's out there that is readily available. So let's talk a little bit about what we are actually seeing. This was based on current trends, so this data is actually updated. As you know, the CDC -- oftentimes they are sometimes a year or two behind in terms of their tabulation. But as of 2014, this is the data that they're currently reporting.

We know that those who are men between the ages of 15 to 24 are the highest rate of persons who are sustaining a traumatic brain injury across the country. And of course we know that is incorporating high school students as well as things like college students and just early adulthood. We know that is the biggest trend. We also know that most of the activities that people engage in during those years are really where a lot of that risk comes from. We know that males have a greater tendency to have traumatic brain injury, so it tends to be a 3 to 1 ratio. Or putting it simply, approximately 75% of those who acquire a traumatic brain injury are often male and about 25% being female.

We also know that the rates of traumatic brain injury begin to spike once again later in life. Typically, it's about age 65; that's when we begin to see that spike. And now with our aging population actually aging longer, that spike is actually shifting to between 65 to 70 now.

In 2010, the estimates were about 2.5 million persons would be sustaining a traumatic brain injury within the United States in one year. What we see now is that rate is about 2.7 million persons within the United States. Approximately 5.3 million -- and, again, I think the more recent data, which is just a few months old -- is now that about 5.5 million persons are living with residual disability from their particular injuries.

Approximately 10 million persons are estimated to be worldwide living with the residual effects of traumatic brain injury. So you can see this is, in fact, a major health crisis. And in the United States, this accounts for over \$60 billion that we spend per year in terms of not only going from the neuro ICU and working with the acute trauma, but in the private sector that will run about \$6,000 per day. But it also then runs through the entire rehabilitation continuum of care.

We know also that men have approximately twice the rate of death than women following a traumatic brain injury. Overall, however, we know that their rate of death following traumatic brain injury has substantially dropped over the past approximately 10 to 12 years.

Let's take a look at some of this additional data. One of the reasons why I like using this statistic, again coming from the CDC, is that this is an interesting trend. If you look at starting at around 2007, what you'll notice is that the data, as it relates to emergency room visits and total hospital visits, was relatively static from about 2001 all the way to 2007.

But you'll notice that there's been a steady increase in the number of people visiting the emergency rooms in hospital systems secondary to TBI. Part of that has to do with the latest information and really educating the public about what a traumatic brain injury is and taking it more seriously than saying, well, you'll be fine; just sit on the sidelines. And when the dizziness is done, then there's no big deal. Well, it is a big deal. And so what I think has been helpful is we've been getting the message out to make sure that people understand that this truly is a public health risk.

One of the things you'll notice in that green line is that those are the total number of deaths from traumatic brain injury, and you'll see that has been coming down substantially. I can tell you that when I first started in traumatic brain injury in 1989, a couple of the trends were very, very different. One is that most persons who sustained a traumatic brain injury were in the hospital for 6 to 12 months on average.

Second is that the death rates overall were tremendous; and part of that had to do with the fact that we had very poor safety systems and safety mechanisms, especially in vehicles. Now when you're essentially in a vehicle, you're in a cocoon of air; and you're also in a cocoon where you have braking systems. And the way the engine is designed is that everything is to move away from the person and the passenger that are within that cabin. So we are, in fact, seeing some of these wonderful effects from all of the safety guidelines and safety improvements, especially in vehicles.

The other thing I like to use is this statistic because it really shows you the different types or ways that people are actually sustaining a traumatic brain injury. What we know very clearly is motor vehicle and traffic accidents account for the greatest numbers, from essentially ages 5 to 14, and then again from 15 to 24. You begin to see a pretty significant drop-off by the time you hit age 25. For any of you who have either teenagers or you have young adults, you'll notice that your insurance rates go down substantially by the time your loved one hits about the age of 25; and that's because the statistics are very clear in showing that the number of auto wrecks actually goes down quite a bit.

The other thing that's also surprising is the number of head traumas that are sustained those who are zero to four. Part of this is, of course, we've been really advocating over the past 20-some years for car seats and making sure that those car seats are, in fact, in the right position. And if they're not, then you can have our little guys and girls who wind up getting hurt; and they shouldn't. When they're properly in a car seat then you can really minimize injury.

The second thing I wanted you to notice is really more in that kind of maroon color, and that is looking at falls. And you'll notice that even though little ones from zero to four have a tendency to fall a lot, they don't fall a lot and then hit their head; they typically fall on their butt. And so they're really not sustaining much in the way of an injury. However, you'll notice that by the time we hit the mid-40s through the early 60s, then the rate of falls begins to increase; and it exponentially increases as we hit 65 and older.

It is very common to see – and I can tell you coming from the hospital and systems where we used to see a lot of folks who were in their 60s, 70s, and 80s who obtained a traumatic brain injury after tripping and falling at home. Quite often the scenario was they would trip and fall; and two weeks later, they would wind up in the ICU because they would lose consciousness. The reason why it would take so long is because of subdural hematoma; and most persons will take several hours to days to sometimes weeks before it actually evolves enough to create that level of trauma that then causes impairment in positive function.

One of the things that we're also seeing – and we're going to talk about it in a little bit – is those folks who have dementia, whether they have Alzheimer's dementia or a frontal temporal dementia. And then what happens is that they slip and fall and now wind up with a subdural hematoma and essentially now have an acquired brain injury. So as our aging population continues to progress, we're going to have much more complicated medical concerns.

I wanted to tell you about a couple of cases because really these cases highlight a couple of things. First is that you're going to notice that one is secondary to an automobile accident, which is the most common. Approximately 32% of those who sustain a traumatic brain injury will sustain it from an auto wreck. Then

you have a fall; and then the last one is a pedestrian versus a motor vehicle or, in this case, pedestrian versus a truck. And, yes, it is a truck not a car.

Let me tell you about the gentleman who had an auto wreck. He had just turned 18; he had been 18 for a few months. He was in a jeep up North, and hit a patch of ice; it was in the wintertime. Needless to say, when he hit the patch of ice, the vehicle lost control even though it was a four-wheel drive. And the vehicle flipped several times, ejected him from the vehicle, and he wound up sustaining a severe traumatic brain injury at the age of 18 – a very common scenario.

Now, what was interesting about his particular care and case is that he went through all of the inpatient hospitalization including acute care, neuro ICU, stepped down, and then eventually matriculated through to the Inpatient Rehabilitation program. As he matriculated through the rehabilitation program after about two months, he actually had recovered substantially. And so the rehabilitation team felt that he could then go home. They actually discharged him to home; and, needless to say, the family – this is back now approximately 27 years ago – the family felt that they may have not really been educated enough to really understand the injury. And so they wound up taking him home, but then didn't really know what to do.

And back some 27 years ago, we really struggled with giving people the right information at the right time so that they could really understand how this all was progressing in steps and stages. And hopefully, that's one of the things you'll walk away with today. Needless to say, after he went through about the first two years of rehabilitation and realized that he wasn't progressing, he then started doing more and more things on his own, including things like physical exercise. He had already resumed driving. He'd also tried working in a number of different situations, and could hold jobs for anywhere from about three to six months.

However, the amazing thing is he was able to actually complete a bachelor's degree, and then he went on to complete a master's degree. And all of that was within about 12 years of sustaining the traumatic brain injury. I tell you about this story because, number one, this is an actual story.

Number two is that just because of having traumatic brain injury does not mean that it is a hopelessness – that, in fact, people do recover; they do improve. No different than if you think of yourself and think about how you are when you're in your early teens and then what were you like in your mid-20s; what were you like in your mid-30s, mid-40s, and so on. Chances are, you have been changing over time as you have been progressively aging.

Well, in traumatic brain injury you do the same thing. The difference is that the trajectory is what changes a bit. But if you're working with a good rehabilitation team, you can get people back on track.

The second person is a severe injury secondary to a fall. This is a gentleman who at the age of 18, when he graduated from high school – he was a baseball player – went on to work in the oil rigs out in Texas. And he was actually working on a rig out in the middle of the Gulf of Mexico. Unfortunately, working in an oil rig is extraordinarily dangerous. And so he got thrown from the platform that he was on and fell approximately 50 feet and landed in a series of pipes. And when he landed, he actually crushed the left side of his head and essentially damaged the entire left side from front to back. As a result of that, he actually then sustained a right hemiplegia, which is essentially a paralysis of the upper and lower extremity on the right side; and he developed a pretty significant aphasia.

By the time I had actually gotten to know this gentleman, he was about 22 years post-injury; and so we had a lot of rehabilitation to do. The amazing thing is that once he was able to be within a structured rehabilitation program, where the goal was to continue emphasizing improvement, he actually was able to get to the point of living on his own. He had never been able to get to the point of living on his own. He had never lived on his own after the injury occurred for over 20 years. We were actually able to get him to that point; and he still today lives in his own apartment. He is actually married and is able to hold a job on a part-time basis.

His injury was much more severe because of the language impairment and because of his right-sided weakness. But he was still able to compensate for that and still able to resume productivity.

The third is looking at a more recent injury, and this is a 25-year-old teen now who as at the corner intersection and had the green light or had the pedestrian light to say that she could cross. And as she began to cross the street -- again, she was in the right of way -- a vehicle, a truck, actually came by, lost control, and partially went up onto the curb. But needless to say, she was hit essentially head on. As a result of that, she sustained a severe TBI. She wound up in a coma for several days. She was able to actually come out of the coma and continue to progress within her rehabilitation program.

Now, to give you an example, the first gentleman that we referred to – this is a person who spent about three months between the hospital systems, followed by almost two years of doing in and out outpatient kinds of therapy. The young lady that I'm referring to, the 25-year-old, to give you an idea where this is at within the past three years, the rehabilitation course that she had was essentially three days in the neuro ICU. She had about a week on the acute stepdown. She spent approximately four weeks in inpatient rehabilitation, and then she spent approximately three months doing outpatient services.

And at that point in time, she was then discharged to living again on her own. It didn't mean that she was able to do that; but it simply meant that the way our healthcare system has shifted, the responsibility of care and cost is on the consumer; and so then you're kind of left to your own devices.

One of the things I wanted you to understand in all those examples is, number one, people do get better. And sometimes they need enough time to be able to get better, but it's also what we do. The second is that cost factor is always something that plays into how well a person is able to tackle resources.

Let's talk about one of the conditions that I think sometimes gets lost when we're looking at it from the health perspective; and that is, vascular disorders generally. And more specifically, this is looking at things like stroke, aneurisms, and essentially anything within the vascular health of the brain.

What we know very clearly, based on statistics, is approximately 800,000 persons suffer from a stroke in the United States per year. So you can see that number is substantially lower than what it is for traumatic brain injury, where we're looking at averages of approximately 2.5 million to 2.7 million versus these 800,000 persons. However, this is a significant leading cause of death. Approximately every four minutes, someone actually dies from a stroke. As our aging population continues to progress, we are going to have more and more stroke risk factors that we have to pay attention to. Preventative medicine is key in order to reduce the risk of stroke.

What we also know is that for those 800,000 persons, we are spending approximately \$34 billion in costs of care and looking at lost productivity. Now if you look at that, even if you double that number of 800,000 to 1.6 million persons, and you double the \$34 billion into \$68 billion, as you can see, we have twice the amount of traumatic brain injury; but the cost differential is really considerable.

Now let's talk a little bit more about vascular disorders. One of the things that we know is that approximately 49% of Americans have at least one of three risk factors. The four big risk factors are in orange; and they are hypertension, diabetes, high cholesterol, and tobacco use. If you have all four of those risk factors, you are at a substantial risk of having a stroke. If you have three out of the four, you continue to bring that risk down. And if you have none out of the four, then your risk is no more than a statistical probability.

When you look also, we know very clearly that those who have had a stroke often have had a prior stroke. So essentially one in four persons who sustain or have a stroke have already had one prior. When I used to work on a stroke unit, one of the things that we used to educate our folks with was saying that if you have a stroke, your greatest risk of having that second stroke is within 12 months of that first stroke. Again, these are things that are preventable; but these are substantial health issues, and these are substantial costs to our health system.

Two quick cases in relation to vascular disorders – the first is an individual, who was 44 at the time, had two aneurysms rupture simultaneously. One was within the left frontal lobe; the second was within the left temporal lobe. So approximately 25% of her brain was disrupted within seconds, and she wound up being attended and wound up being taken to the ICU. We were actually unclear whether or not she would actually survive.

She also had a secondary condition known as vasospasms. Vasospasm is a condition where after you have had something like an aneurysms or vascular abnormality, what happens is your blood pressure rapidly rises and falls; and it will do it repeatedly. And when it does that, it actually creates what's called a perfusion effect, which means that it substantially changes the total perfusion in the brain of blood distribution.

So essentially after you have the have the first injury, which is the aneurysm actually basically exploding, then the second injury is that the blood pressure, until it gets controlled, is causing this continuous blood pressure fluctuation, which then causes a change in flow. That then causes a more diffuse injury.

In this particular case, this person was a high-level respiratory therapist who worked in the ICU. And after her aneurysm, she was unable to return to her job because of the intensity of the job and also because of the hours that she had to put in. She had a two-year degree; but approximately 10 years after her brain injury, she was able to then actually finish her bachelor's degree. She used that as a way to rehabilitate herself once the rehabilitation team was no longer coordinating her care.

The second case is a 56-year-old; and this, again, is a very common phenomenon. She had a spontaneous hemorrhage – well, spontaneous in the sense of, yes, it happened and it was not expected to happen; however, she was on aspirin secondary to a heart condition. And what happened was after her heart stabilized and she remained on aspirin therapy, unfortunately then she hemorrhaged in the brain. The hemorrhage that she had was within what is called the left middle cerebral artery, and so it's a very large artery that accounts for 80% of the territory on the left side of the brain.

Needless to say, it caused substantial impairment; and one of the impairments that it caused was a deficit in being able to understand and to speak language. For those speech therapists who are out there, of course this is aphasia. And so it had a substantial impact and caused significant disruption in her life for over two years. She is now back to living independently. She is doing very well. She drives; she cooks; she cleans; she manages herself in her own home and, again, does very well.

If you spoke with her, it would take you about 15 minutes to really detect her language impairment at this point; that's how mild it has become. By her third year of recovery is when language actually started to spontaneously and rapidly improve, to the point where her fluency was much more at her baseline. So again, the goal here is that she didn't stop doing rehabilitation just because she was out of the hospital. The whole idea was after three and four years of continuous treatment, she was able to show improvement.

One of the things, of course, that we're all facing at some point in time is looking at things like our degenerative conditions. In particular, everybody is aware of Alzheimer's disease and many of the other dementias. There is also Parkinson's disease, with and without dementia as well.

We now that these degenerative diseases are rapidly rising. The number of degenerative diseases is in excess of 3 million to 5 million; so we are looking at this as being also a major health threat. One of the things that we've been seeing in the literature in the past two years is that there are things that we can do to help preventatively keep our brain under good control and helping our brain to have good brain health. Part of it is diet, part of it is exercise, and part of it is cognitive skills – things like reading every day, things like looking at the newspaper every day, things like social interaction. And we're going to talk about one of the major studies that came out in 2015.

We know that in dementia syndromes, we're looking at the population as being 65 and older. And we are estimating that in 2030 those 65 and older will account for almost 20% of the entire population. So that

means we have a substantial health threat in terms of how our system of care is going to handle all of these different kinds of cognitive disabilities.

We know that dementia increases the health care costs per person by about \$4,000 per person per year, so it's a major health risk and cost. We know that there are reversible dementias, such as vitamin deficiencies, such as thyroid dysfunctions. It's called idiopathic normal pressure hydrocephalus, which you saw; but it's one of my areas of current research. I've been running a research program for about 12 years in hydrocephalus, mainly trying to understand what this disease is about and what we can do about it. Hydrocephalus accounts for approximately 9% of the dementias; that also includes the vitamin deficiency and thyroid dysfunction.

And of course we have the degenerative types. Approximately 75% of individuals with dementia have Alzheimer's-type dementia; the other 25% are spread throughout frontotemporal dementias, Parkinson's, vascular dementias, mild cognitive impairment – and, yes, you do see depression on that slide. One of the things that we know from that neurocognitive literature is that depression can actually be one of the precursors to developing dementia over time, especially if depression is not well-controlled or has not been appropriately treated in the earlier stages of life. So we know that depression has a pretty significant impact on the brain and brain health.

I want to talk just briefly about brain tumors because brain tumors often get overlooked because they're not nearly as extensive as what we see in traumatic brain injury or these degenerative diseases. At the current state, we are looking at approximately 70,000 new tumors being diagnosed per year. Now, I can tell you that my first involvement in brain tumor was 22 years ago; and I used to work for a brain tumor clinic when I was at Duke. And we would see, obviously, all brain tumors – primary, secondary, and otherwise. And at that point in time, we were looking at a diagnosis of about 20,000 to 23,000 per year. So in about a 20-year period of time, we've increased to almost tripling that; or actually we have tripled that number in terms of new diagnoses. About 14,000 persons actually die from the complications of brain tumor or the brain tumor itself per year.

Approximately 20 to 22 years ago, brain tumor prognosis for those that were malignant fell between three and six months. Now the rate of survival following the diagnosis of the brain tumor is highly variable, secondary to not only the condition but also where is it located in the brain? Is it a primary, secondary, or non-malignant tumor; and, overall, what is their response to treatment? Not everyone responds to chemotherapy; not everyone responds to radiation therapy.

Let me talk about some common elements here. All the conditions that have been mentioned are located in the brain and can coexist; so, yes, you can have dementia and you can have traumatic brain injury. You can have a stroke and you can have a tumor, as an example. All of these conditions range from mild and not necessarily impairing, to mild with functional impairment, to then being severe and requiring 24-hour care and assistance. Any of these conditions and disorders can afflict anyone at any time. All the conditions have short-term, and many have long-term effects that may lead to a lifetime of challenges – brain injury included, TBI, but also includes all the other conditions and then some that we've already talked about.

Costs are substantially rising; and in the United States, we have a spending problem. And one of our spending problems is this. Currently, we spend approximately 17.9% of our gross domestic product on healthcare. To give you an example of other systems around the world -- and this includes other countries where they have a nationalized healthcare system -- they are at max spending between 9% and 11% of their GDP. So our GDP expenditure is much higher than what you see in other parts of the world. Now, some would say, okay, well, the caveat is that we also have a lot of people who live here. The answer is, yes, that's true; but these percentages are based on how you correct out the (inaudible) population as well.

One of the things that I think we need to do better – and our research clearly can demonstrate this – is that it's not necessarily an issue of money. What it is, is that we need to spend it wisely; and we need to spend it at the right time, for the right reasons, for the right conditional disorder.

Let's talk about treatment and levels of care. This is a little bit of a review; and so what I want to do though is paint the big picture. In Part A, you're looking at acute care; and of course, acute care is hospitalization. Within the hospitalization you're looking at things like neuro ICU, you're looking at the acute care stepdown process; and then you're looking at transition to Step No. 2, which is the rehabilitation center. All of this is within the umbrella of the hospital system; all of this is considered inpatient hospital care.

This whole process can take anywhere from a few days to sometimes upwards of three to even upwards of five months of care, depending upon the level of severity. If a person is at the severe level, then they may spend in the hospital setting anywhere between 6 days up to 12 days and then going to the rehabilitation center. A person may be in there for between two and four weeks; and then oftentimes, there are outpatient centers that are affiliated within those hospital-based rehabilitation programs.

The second part, however, is really accounting for approximately 80% to 90% of where the recovery occurs; and that is in what we call post-hospital care. And in post-hospital care, what we're looking at is post-hospital rehabilitation programs, such as neurorestorative. We're also looking at day treatment programs, where you're getting the coordination of more than two professional services – so things like combining OT/PT and speech, but doing it in a coordinated way where a person is in treatment for four to six hours approximately three days a week.

Then we have home and community programs, where therapy services actually come to you and come to you in your home, and then also work on generalization of skills. We also have outpatient centers that do what is called single-service design. And this is where we look at things like physical therapy only, occupational therapy only, or maybe it's two therapy services but no more than two. So it might be psychology and speech therapy, as an example.

And then, of course you have home – and home meaning no therapy services. And this is where families have to get pretty creative. And then, of course, there are many folks who wind up leaving hospital level of care and then have absolutely no follow-up services whatsoever; and their disability essentially remains unchanged through time.

Those are kind of the overall levels that we're looking at currently in our healthcare system. Sometimes I make the slide case do funny things, and then I forget that I do that – and then have to evaluate myself at the end of this.

Now let's talk about family and the support systems. The question that I sometimes asked is we're so used to in our healthcare systems having different levels of physicians. So I might see a neurosurgeon if I'm brought into the acute care center. I might see a neurologist when I'm on the stepdown unit. And then I may see a physical medicine doc when I'm going through my rehabilitation care. All of these folks are professionals within their medical professions; and so they're all physicians, but they all have specialists.

Well, in behavioral health and in psychology, there's actually specialization as well; but most people don't think about it that way. Let me kind of pose a question to you, and that is this: Within the brain injury system, one of the things that we find is that you can in fact have more than one mental health provider or behavioral health provider. And I'll give you an example.

At a residential level, what you often may see is that you may have a psychologist or a neuropsychologist working with a behavior specialist or a behavior analyst and maybe working with a counselor. And the idea is that each of those disciplines are coming at it from a different perspective, but all from the same goal – which is to improve outcomes and to get the person to be able to be home or to be more independent.

At an outpatient level, it is very common to have a neuropsychologist or a rehabilitation psychologist working with the individual patient, and having a clinical psychologist or counseling psychologist or social worker or licensed mental health counselor working with the family and working with the family and

sometimes with the patient at the same time. The trick is, you have to coordinate this care no different than you coordinate your medical care. And the idea here again is use what you need to use; don't be afraid if it's within technically the same discipline.

But in behavioral health, we sometimes forget about the fact that we can actually use specialists in a very different way. One of the things that I find that works very well in clinical practice is if I'm the neuropsychologist involved in the case, I will often do the evaluation and I'll often do the projection of outcome. And a different psychologist or counselor will then do the individual treatment, doing individual things like adjustment and helping the family to cope and to understand brain injury. And then I will sometimes come behind that and then work more with cognitive skill building, or I'll have an extender to work with cognitive building. There are many different options, many different ways to do it.

Let's talk about our outcomes in research. In 2013, this is really where everything began to change. And this was the first article that actually was published and literally was first. It came out at the beginning of January, so they really timed it very well. They did an excellent study, and this is the folks out of Pate Rehabilitation in Texas; and this is Hayden and her colleagues. And this is the first article that demonstrated, given a mixed sample, they were able to demonstrate that people in fact did get better after three to six months by post-hospital care.

And what they were able to emphasize is that post-hospital care was in fact showing functional improvement that went well beyond what they were able to accomplish in the hospital. They were also able to demonstrate that earlier is better. So when they were able to get folks into this center quicker to that hospital discharge, then they had higher or better outcomes than those who were more delayed in receiving services once they were discharged from the hospital. They were also the first to say the length of time since injury was not a factor in preventing outcomes from occurring, meaning the length of time since injury did not deter having a positive outcome. And so it was a great way to actually get started in the year 2013.

Then of course we had more research that was happening, and this is really myself and my colleague Frank Lewis, where we really started to hammer away at -- what else can we find that so far we don't know? Well, these are a couple of the findings that we actually had.

The first is this. We had a large multicenter study that incorporated over the course of approximately 20 facilities. And what we were trying to understand is: What is the impetus of time? Because for those of us who had been in brain injury longer than 10 years, you would have then been trained at some point in time in your career that says, well, if you give people enough time; then they can recover. And so sometimes there is nothing that you need to do other than let them take the time. But in fact, our data actually demonstrated that's not the case. And here's what our data actually demonstrated.

It says that essentially if we can get somebody within that first six months -- so no different than Hayden and her colleagues -- then we can have the best outcome because we're still working with that very acute process. But what we also found is that once you cross over between that six to eight months, then what you do has everything to do with outcome. But the amount of time has nothing to do with whether a person improves or not.

Let me say that again. The dividing line was that six- to eight-month marker; and again, you have to think of it like statistics, where there's a margin of error. You can just say at six months; we say between six and eight months. And what we found is that after the eighth month of being in a rehabilitation program or just recovery in general and improvement in general, what we had found is that it's the key ingredient of what you do that makes a difference with how well you continue to improve from that point forward. The first six months of recovery is somewhat correlated with time, meaning earlier is always better in terms of getting you a better outcome.

What we also found is that active neurorehabilitation, active neurobehaviorally intensive and supportive rehabilitation groups all made positive changes resulting in reduced disability and reduced need for supervision. And, folks, this is where your costs are. So we can help to start reducing costs in taking care

of folks with neurologic injuries long-term and short-term if we can reduce your disability and if we can reduce your need for supervisor.

The other surprising finding that we found in 2013 was age did not impact whether or not you would improve. Again, let me say it. Age did not impact whether or not you would improve and result in less disability. We used to think years ago that if you were older, then I'm not sure that we want to spend the time on the rehabilitation; but, in fact, that is not true.

Two other things that we found is that in our national sample, we found that we had a depression rate at any point in the time of recovery of 34%; and we had an anxiety rate of approximately 30% at any point in time in the recovery. One of the recommendations then out of that paper was that you have to treat mood disorders and anxiety disorders in order to improve outcome.

We've also done subsequent studies looking at the effects of depression and anxiety, and have presented and published some of this, to where you can see that those who have depression and those who have anxiety in a structured therapeutic setting, a person is still going to improve. However, if you can't improve the level of depression or the level of anxiety, then you're going to substantially impact a person's outcome. It will substantially impact it to the point of may or may not be able to live independently and may need more supervision, not less, at the time of discharge.

So again, these are really important key findings that, first of all, you can count on about one-third of persons that you see at point in time in recovery are going to have depression and/or anxiety. Second is, you need to treat it. And third is, if you treat it effectively as part of the rehabilitation program, then you will see the person continue to show excellent improvement and excellent outcomes.

There are a couple of other articles – and you'll see this in the bibliography, so you can always refer back to that as well. One of the things that we found, and this was just an exciting study, was that Dr. Green and her colleagues out of Toronto, Canada, were the first to actually demonstrate on an MRI the difference between putting a person in an enriched program versus those who were in an unenriched program. So essentially, unenriched was those who were just kind of doing the normal thing, so whatever that may be; but there was no structure to it.

The enriched program is where they were purposely getting people to socialize, interact, have cognitive activity, have physical activity, and so on. And they were actually able to demonstrate differences in brain atrophy with those who were in the enrichment versus those who were in the non-enriched environment. Those in the enriched environment were able to reduce the amount of atrophy; atrophy is shrinkage of the brain. They were able to actually reduce that by staying more active. So it tells you the viability of the brain and the brain tissue. It's a wonderful thing to be able to actually see it on the scan.

This is a case study. This is a 27-year-old who was actively hallucinating and having delusions secondary to 10 years of TBI. The person had no psychiatric history prior; but after the injury, they had substantial psychiatric history and paranoia even at times. This is a person where we had to do multiple medication adjustments, and we continue today to do that. This is also a person that when she would actively hallucinate or actively had paranoia, then of course we had to have greater psychiatric involvement.

This is a case where it's a great example of how we involved physical medicine, psychiatry, psychology or neuropsychology, mental health counseling, and behavior analysis, and having the person in a behaviorally-structured program – all in order to help this person do better.

One of the things that was very clear in this person's profile before entering a structured program is that they were becoming more and more isolated at home. And as a result of that, the psychiatric component, the hallucinations and delusions, were actually increasing the more she became isolated. And so what we found is that the increased socialization actually helped to basically create kind of a countercheck so that the hallucinations were not quite so prominent. This is a person who sustained a severe bifrontal injury. Typically, when you have a bifrontal with bitemporal injury, this is where you're more likely to get significant psychiatric overlap.

Let's talk about levels of care. This is out of 2014, and this is where we really started to pull together the levels of care and understanding how to put together this continuum process. There are two articles that are referenced for you, and you can certainly take a look at that. One is actually coming out in June, this month; and we have not gotten the full reprints yet, but they are due to arrive any day. The second was actually published back in 2014, and it is available.

Number one is this; looking at Level I is really the neuro ICU. And the whole focus here is just simply life-saving techniques. And what you're trying to do at this level is to reduce second injury or secondary injury phenomenon. This is where you're reducing things like swelling, hemorrhaging; and you're stopping the neurochemical reaction that the brain undergoes when it's been traumatized.

Level II is where you then have the person eventually go to inpatient rehabilitation, which we've talked about. This is where family education and training begins. It doesn't end there. This is where we're really doing the things like mobility, strength, and safety, along with basic communication.

When we look at the continuum of care for Level III, this is where we talk about post-hospital care. And we're talking about things like active neurorehabilitation but in a residential setting. We're talking about neurobehavioral intense programming. We're looking at supportive living. We are also looking at day treatment, and we are looking home and community.

One of the questions that has come up, and I'll go ahead and answer it at this point, where I was explaining enrichment. This is Dr. Green and her colleagues. Enrichment was defined as keeping the person cognitively and physically active within a structured program. So people would come to their center; and they would focus on things like having the person be (inaudible) as a challenge, meeting, things like being in games, things like doing computerized cognitive assistance, and so on.

There's also a question about clarifying after six to eight months of post-injury recovery. So let me say that one again. What we found is that the dividing line is that six to eight months. If you are able to get in to a rehabilitation program after the hospital and within that first six months of recovery, then you have the best scenario for having the greatest positive outcome – meaning less disability. After eight months, a person will continue to improve; but it has to be based on what you do –meaning the kinds of therapy that would involve them, the kinds of day programming, or the kinds of stimulation that you're involved in. And at that point in time, you then have to continue to do therapy over the long haul.

Okay, let's continue on; and I'll answer a few more questions in just a second. When we're talking about the continuum of care with Level III, remember, this is accounting for about 80% to 90% of where a person is actually going to do their rehabilitation. This, unfortunately, is where we actually don't spend as much in the way of money for programming. Instead, we've put it all in the front end; but we really need to be looking at it throughout the entire continuum of care.

One of the things that has been estimated is when you look at long-term care in order to do life care planning for a moderate to severe injury, in some cases you may be looking at costs that could be anywhere from, say, \$9 million to \$10 million, upwards of \$12-million-plus for the lifetime of care over approximately a 30- to 35-year period. The issue is if we know what the basic cost is going to run, then let's look at how we can distribute that cost over that 30-year period, as opposed to always putting everything up front and then having nothing on the back end.

One of the things that we're currently doing is we're studying aging effects. And one of the things I think that we're going to find is that the more supports we put into place with aging – and, again, we've been doing this; we have three centers around the country where we're currently collecting data – then I think what we're going to see is that aging in fact will be better, meaning that we can reduce the effects of disability, if we continue help the person to age appropriately, meaning we manage medical care and we help the person to be managing medical care. We help the person to maintain medication compliance. And we keep them cognitively and physically active.

Let's talk a little bit about the continuum of care. I think overall this is probably the best one, which is rehabilitation is just simply not a quick process. And when you're talking about neurology and neurologic injury, remember, this is the most complicated portion of your body; and so why would we expect for this to actually occur quickly? We wouldn't.

Let's talk about measuring the post-hospital brain injury programs. There is a question, and I did want to go ahead and reference this question; it's a great question. Someone is asking about alcohol and marijuana effects. Well, kind of an interesting thing – and for those of you who are in the military system, you all will either know this or you'll know it now -- is that military in particular has been doing a lot of research on substance abuse and looking at the effects of substances over time, especially in traumatic brain injury.

One of the things that we know in traumatic brain injury is that oftentimes substances are involved in the actual trauma itself, and there's a very high probability that a person had a substance abuse problem, or at least substance abuse, prior to the injury. So we then have to look at what is that going to do in post-hospital care. Where, here are a couple of trends.

The first is this; the projection is that in about one to two years of the time of the trauma, then you expect that if a person had a substantial substance abuse history, then they could have the potential of returning to that level of baseline by the end of one to two years of recovery and improvement. Number two is that if you know that a person has had a significant substance abuse history, you have to preventatively and proactively begin to look at that as being part of the recovery process because you don't want to miss anything; and you certainly want to help the person because you don't want the brain to become any more impaired as a result.

One of the things that we know is that alcohol over a long-term use will demonstrate substantial permanent cognitive decline over a 10- to 20- to 30-year period. Marijuana hasn't had that same data. Marijuana may be impairing at the time, but marijuana may not necessarily provide long-term effects; so some of the jury is still out. If you all are aware of substance abuse, then you'll also be aware of the fact that the synthetic marijuana is a different story.

Synthetic marijuana is a laced system, where there are multiple chemistries that are placed into the leaves. And what happens then is that when a person goes to get high, they're actually getting high because of the toxins that are actually in the leaves themselves. This can lead to death; it can lead to hallucinations, delusions, psychotic disorders, mood disorders, and of course substantial disruption in terms of what happens to a person in recovery.

One of the things that we do is we look at having specialty or specialized programs, where you're looking at the combination of treatment for substance abuse at the same time that you're then doing brain injury rehabilitation. And one of the things – I know I had a specialty program years ago. And myself and our physical medicine doc and my behavioral analyst and psychiatrist, we all came together to come up with a formula. And there are good medicines that are out there now that can help with substance abuse at the same time you're doing brain injury rehabilitation, and they don't cause an interaction effect to reduce the effectiveness of the brain injury rehabilitation.

One of the medicines that we actually like in substance abuse and brain injury is the use of naltrexone. Naltrexone was designed for primary substance abuse, but it also has a pretty substantial inhibitory effect within the brain system and, in particular, within the frontal lobe system of the brain. And so when we're talking about substance abuse following TBI, we're often talking about impulsivity control as well. So there's kind of a separate lecture that can certainly be discussed at a later time, or I can be contacted at a later time. But I did want to make sure that I eclipsed those couple of ideas.

Let's talk about measurement. One of the things that we know in the post-hospital world is that we use the Mayo-Portland. The Mayo-Portland Adaptability Inventory, Version 4, has been out now for many years. Jim Malec and Muriel Lezak were the original creators of the Mayo-Portland. And this is a post-hospital

rehabilitation method of assessing functional capacity and functional disability at the time of admission to a post-hospital center of care.

You can use this on an outpatient basis; you can use this in a day treatment program; you can use this in a residential program. Even as an individual practitioner, you can use it because it demonstrates what the functional capacity is based on the long-term effects of brain injury.

In the post-hospital world, we use it to measure acquired brain injury; so you can look at the level of severity of injury. You can also use it to measure and modify performance and create a performance improvement plan. It is a standardized measure that accrediting bodies use, such as Carf Accreditation, which is one of the major accrediting bodies around the world for rehabilitation facilities. We also use it in long-term studies where we're looking at the effects of age. It measures 29 different ideas or aspects of functional outcomes of disability.

We also find the Mayo-Portland is incredibly helpful for payer sources – insurance companies, government agencies, private payers – because it helps them understand how we self-evaluate a person's overall rehabilitation program. We also find it is one of the only measures that is actually endorsed by the Brain Injury Association of America. They, in fact, just released a white paper about three months ago -- Frank Lewis is one of the originators of that white paper -- and looking at using the Mayo-Portland as being the accepted standard for post-hospital care.

We also use it as a measure of advocacy. So what we've been doing is taking this measure, taking this massive database, and being able to demonstrate people do, in fact, get better. They may get better after years of being in improvement and recovery. So it is a very widespread measure. Also the Mayo-Portland has now been adapted, if I remember correctly, into – gosh, I know it's more than 10 languages; and it is being used around the world. Our colleagues in England – let's see -- Australia and New Zealand I know are using the Mayo-Portland, and it's beginning to gain widespread popularity.

With the Mayo-Portland, again, it's the fourth revision. There are 29 items, and it ranges in score from zero to 4. More importantly, I want you to remember this. It breaks it down into three subscales. The first is the Ability Index, the second is the Adjustment Index, and the third is Participation Index. Now, putting this more simply, the Ability Index is looking at sensory, motor, and cognitive and communication skills. The Adjustment Index is looking at things like mood, interpersonal actions, family interactions or what we call neurobehavioral syndrome. And the third is Participation, which putting it simply – and the OTs, PTs, and speech therapists will love this – is that it's really measuring your instrumental activities of daily living – so things like social contact, initiation, money management, and so on.

But this really gives you a very broad measure and helps to break it down into subcomponents so that you can see how a person may be managing over time.

One of the things that we also use it for is it tells us if our therapeutic interventions are working or if, in fact, we're actually helping to maintain a person in terms of their level of support and care. To give you an example, one individual has asked about the program (inaudible) and about other cognitive programs that are out there. Well, one of the things that we have been doing in different centers around the country, is we do have different people using (inaudible) as well as other cognitive skill building programs. And so we actually have the capacity to be able to see if that, in fact, is helping to improve the person's level of disability on the Mayo-Portland. So we have a series of studies that we're anticipating over the next two to five years to be able to answer some of these questions.

The level of disabilities is designed like this. Levels 0 and 1 mean that – a zero means that there is no problem, there's no adaptive device, and there's no adaptability. A Level 1 means that you have a mild problem, but there's no interference with your activities. The best example of this is this. If I have a mood disorder and I take an antidepressant and I function just fine, then that would be considered a 1. It means that I have a problem, but it doesn't interfere; and I'm using some adaptation to help me to compensate.

No. 2 is now looking at level of disability where there's a functional impairment. And so 2, 3 and 4 are really where we get into the meat and potatoes of rehabilitation. A Level 2 means that you have a 5% to 24% level of interference; but 45% of the time, you adapt just fine. A Level 3 means 25% to 75% of the time you need assistance because there's a fair amount of interference; 24% of the time the person is able to adapt or less than 24%. And Level 4 is pretty obvious, and this is where a person really has significant interference 76% to 100% of the time. Rarely is the person actually able to adapt on their own.

When we look at these particular skills, I like to break it down for you just to make it a little bit easier. When we are looking at the physical components, we're looking at mobility, use of hands, vision, audition, dizziness, and motor speech as our examples. The other parts of communication include verbal communication and non-verbal communication. Verbal communication would be the expression of and the ability to comprehend. Non-verbal communication is the ability to understand thoughts, gestures, facial expressions, or non-language kinds of behaviors that tell you what a person may be thinking, feeling, or how they're interacting.

In motor speech, of course for our speech therapists, we're looking at articulation, phonation, and rate of speech. Dysarthria is one of the more common terms that often will use. Of significance in the research currently in 2015, and we haven't finished this project yet but what we're seeing so far is that vision and audition are highly important because if you have impairment in one of those two areas, they are considered quite an impact – meaning that it has a substantial impact on your rehabilitation ability. Thankfully, however, those are low-probability kinds of impairment. Again, vision and audition do have a significant impact; but thankfully, does not happen very often.

When we're looking at the cognitive skills, we're looking attention/concentration, memory; we're looking fund of information; we're looking at novel problem solving and visual/spatial skills. One of the things to keep in mind about the fund of information is this; the greater the level of severity of impairment, the greater the impairment of funded information. This is not only widely known in the neuropsych literature, but it's also widely known across the rehabilitation literature.

Fund of information is your ability to pick up information through time – so things like knowing who the President is; things like knowing that George Washington was our first President in the United States; things like school-based performance; but also things that happen in the course of time and is an ongoing knowledge base. That's what fund of information is really measuring. The greater the severity of injury, then you have a harder time accessing that information as an example.

One of the things that we find as well is one of the predictive skills with novel problem solving – those who have greater disability in novel problem solving have greater disability of being able to live on their own or with minimum structuring support.

When we're talking about adjustments, I like to refer to it as behavioral impairments because we know that any changes in things like anxiety and depression, unless you had it before the injury, we know that you're going to have an incidence of after injury at some point in time. So to me, neurobehavioral syndrome is actually, I think of a better characteristic because we know that this is all coming from the neurology of the brain.

When we're also looking at irritability, anger, and aggression, we know that this is one of the leading predictive variables that tell us if a person falls within a neurobehavioral syndrome, where a person may then need a specialized behavioral intense program. So we actually have a way, we have an algorithm, that we can use components of the Mayo-Portland to tell us if the person falls into a neurobehavioral syndrome or not; and then we can define mild, moderate, and severe based on a neurobehavioral syndrome which then tells us where the person should be placed, which then gives you the appropriate mechanism of rehabilitation.

Pain and headache is pretty self-explanatory. Fatigue is also self-explanatory – low energy, low drive. We also look at sensitivity to mild symptoms, which is kind of the focus on symptoms as opposed to focusing on recovering. Inappropriate social interaction is No. 2 in looking at neurobehavioral syndrome; the

greater the impairment, then the greater the problem. And impaired self-awareness is also No. 3 when it comes to neurobehavioral syndrome in addition to a couple of other symptoms.

When you're looking at family and significant relationship support, we all know that traumatic brain injury, and really neurologic injury at its best, can really cause a lot of stress and strain on the family. And as a result of that, we know that the family is highly impacted.

And then the last is instrumental activities of daily living. And I'm going to kind of go through this because I'm going to come back to this in a second. What we're looking at: initiation; social contact; leisure and rec; self-care; residence, meaning home skills or home care; transportation; employment or other employment, like volunteering or going to school; and then managing money.

So let's talk about some of the results, and you all can get a chance to see what's actually happening around the country. Some of the results I'm going to show you – what we're currently looking at is, this what we do. It's called a rationalysis; and the rationalysis helps us to know that when we're looking at each of these individual items – like mobility, use of hands and vision and so on – we know that each of those items is actually telling us something that is clinically significant; and it's not overlapping with the other items. I'll explain to you a little bit further in terms of how we then took the second phase of the rationalysis, which really helped us focus on rehabilitation outcomes.

In this particular analysis, what I wanted you to see is this. The blue represents active neurorehabilitation, and most of these folks are within six months to one year of injury. The red is supported rehabilitation. These folks have been injured typically greater than five years post injury, and they're more into a supported model. And then third is looking at -- I'm sorry; blue is neurobehavioral – my mistake; and green is neurorehabilitation or active neurorehabilitation.

On average, the neurobehavioral folks are between five and eight years post injury. The supported rehabilitation folks are greater than five years post injury. And active neurorehabilitation folks are within 6 months to 12 months of the time of injury.

One of the things that you'll notice right off the bat is that those who are in active neurorehabilitation have greater physical need. So you'll see that mobility, use of hands, and vision are all significantly higher than in supported rehabilitation and in the neurobehavioral program. However, when we look at things like audition, dizziness, and motor speech, you'll see that they actually are all relatively the same. There is a trend that indicates that the neurobehavioral folks have the least impairment when it comes to vision and audition, whereas supported living and active neurorehab have slightly higher. This also makes sense because if you're living in a support living environment or support rehabilitation environment, it means that you don't have full capacity to be able to live on your own, in which case you would expect that there may be some physical deficit.

When we look at cognitive needs, you'll see that the three groups actually hover pretty close to one another. However, you'll see that support rehabilitation actually has better communication skills, and you'll see that the neurobehavioral folks have more difficulties with novel problem solving. You'll see that neurorehabilitation and neurobehavioral folks are very similar in terms of their cognitive profile, however.

When we then look at those who have adjustment needs-- again, neurobehavioral syndrome -- one of the interesting things here is that you will see significant differences where the neurobehavioral folks are higher across all of these behavioral components. So that's where we are with that.

Instrumental activities of daily living – one of the things that we know very clearly is instrumental activities of daily living are very difficult to rehabilitate; and they take the longest amount of time to rehabilitate, to get a person to be more functional in the community-based setting.

This is the new research that's coming out, and one of the things you want to look at is this. Instrumental activities of daily living should really be our focus almost from the beginning in that we're using these other skills -- like physical skills, adjustment, neurobehavioral management, cognitive skills, and so on –

that we're constantly circling with those other skills in order to get instrumental activities of daily living to progress and to improve.

This is some of the results of the rationalysis. I'm not going to go through all of this, but this gives us an indication of where we should start in the rehabilitation process. And essentially, what it says is that if you're starting at Level I and you have impairment at Level I, then everything else below it is going to be substantially impaired. However, if you get to Level IX, then everything above it should already be either rehabilitated through remediation or through learning compensatory strategies.

Of course one of the things we want to know is: Does this work? The simple answer is, yes, it does. Since we have limited time, I'm going to go right to the fun stuff, which is this. Looking at a rehabilitation sample, you will notice that a person comes in at moderate to severe level of impairment. By the time they leave an inpatient neurorehabilitation center, they're at the mild to moderate level of impairment. They continue to progress at 3 months post-discharge; and then by 12 months post-discharge, they're kind of stabilizing at this level.

One of the things that we know in active neurorehabilitation is, we have best outcomes when you go active neurorehabilitation to a day treatment program to an outpatient center and then discharge out. We find that you can then get folks down here into the 30s, which is essentially they may have an impairment; but it's not functionally impairing the person on a day-to-day basis.

Those who are neurobehavioral, which is the toughest to rehabilitate, also show a very nice steady progress and improvement. However, those who have neurobehavioral conditions will take, on average, two or three times longer to rehabilitate than those with active neurorehabilitation without behavioral components.

Kids – we do have a whole pediatric program, and our kids are also showing improvement. However, by the time they're leaving us, they're between the ages of 14 and 19. And so what's happening is that they really still require more neurorehabilitation because they're still developing as young adults.

Supported rehabilitation – you won't see as much progress; but what you will see is that they continue to show improvement to the point where less supervision is required.

In day treatment, we see, again, a very nice trend down. These are all statistically significant going from admission to discharge. The nice thing is that even when you see a slight uptick at the end of 12 months, they're still holding the gains.

Overall what we know is that research indicates that time does not heal all wounds. We know that age is not a factor in recovery because all ages show progression and improvement. We know that guiding depression can have a substantial effect on recovery, and you're looking at about a 30% to 34% expected rate of where somebody may experience anxiety and depression at some point in time in recovery.

We know that treatment needs to be considered in relation to the goals and community integration – so looking at function. Even though the long-term injury greater than 20 years, it can still show improvement in stability with rehabilitation efforts.

Cognitive and physical exercise have been shown to improve health aging, and therefore have also been shown to improve in terms of neurologic sampling.

Let me talk real quick about applications to home, and then we'll wind it up for the day. Some home ideas – therapy needs to eventually apply to the home skills. Therapy can be performed in a variety of ways in and out of the home for carryover and behavioral skills. The more behaviorally-intense somebody is, the more you have to do therapy in the home and in the community.

Education with healthcare professionals is essential. And you can have intermittent professional services, and you can also have paraprofessional services to help to implement things like home programs. Of

course we all know when we work in acute care that we want try to train our families to be able to carryover some of these skills.

Some of the things to look at are cognitive skills. You also want to look at physical skill building, like riding, walking, moving in fun ways that are productive – of course based on PT and OT evaluation. We want to look at the development of leisure skills and hobbies because that's more likely to reduce them getting into things like substance abuse. And of course being involved in the community with things like going to a church, a synagogue, or participating in community activities.

The last polling question is: How will you apply the evidence-based research from today's presentation?

So go ahead and take a look at that real quick in the last minute or so, and let's see what folks are saying. And I'll give you all one minute; I can play my little Jeopardy song.

What we've found so far in the results is that the majority of folks say that they will consider using the information to improve services, either that they produce or that their facility delivers – about 53% said that. About 6% said they would consider a research question related to these findings; 34% said that they would consider including the information that they can now provide to patients and families. Excellent.

And let me just wind up with one or two more slides, and then we'll call it a day. We can go ahead and flip; there we go. I tell you, I love working (inaudible) because they're the technical guys.

Let's talk a little bit about advocacy real quick. Basically the idea here is this. Clinical programs work. Chronic disease requires long-term supports and care to reduce cost and the impact on the entire healthcare system. One of the things we know is that sports need to include a systems approach, so that way we can incorporate all aspects of care which then reduces our costs. We need to also have a flexible continuum because sometimes people do have to go backwards on occasion before they can then move forward again.

We also need to make sure that we're doing things that are based on evidence-based models of care. We don't want to do thing because we think that they'll work; we want to do things because they can work and because we've shown them to work. And prevention always needs to be part of the continuum process.

A couple of ideas exist. Let's make sure that we continue to do research and educate those around us, not only at the professional level but also at the advocacy level. It is not about what we think; it is about what we can show or demonstrate through the use of science and technology. It's about showing that disability does not mean lack of value.

And that's about it. I think I ended up right on time, which is probably a miracle in and of itself. I appreciate everybody's time today. I feel like I kind of hit you over the head --no pun intended – with a lot of information. But hopefully, you'll be able to take this information now and be able to use it. We continue to produce research. And so, again, everybody have an excellent day. And I appreciate everybody coming today.

Thank you, Dr. Horn, for your presentation. We greatly appreciate your expertise and knowledge.

If you have any questions for our presenter, please submit them now via the Question and Answer pod located on the screen.

Before we begin to address questions from the audience, I would like to say a few words about one of DVBIC's caregiver resources available for download at the DVBIC website. A Guide for Caregivers of Service Members and Veterans is a nearly 500-page resource for caregivers and service members and veterans with moderate to severe or penetrating TBI. The Guide was originally published in 2010 and is currently under revision as the result of a Congressional action.

The National Defense Authorization Act of 2007 mandated the development of a coordinated uniform and consistent training curriculum to be used in training family members in the provision of care and assistance to members and former members of the Armed Forces with traumatic brain injuries. DVBIC was selected to facilitate this project because of its nearly 20 years of service to active duty military, their beneficiaries, and veterans with traumatic brain injuries.

This comprehensive resource is broken down into the following five modules: Introduction to TBI, Understanding the Effects of TBI and What You Can Do to Help; Becoming a Family Caregiver for a Service Member/Veteran with TBI, Navigating Services and Benefits, and Caregiver's Companion. These resources can be downloaded at www.dvbic.dcoe.mil.

It is now time to answer questions from the audience. If you've not already done so, please submit your questions now via the Question and Answer pod; and we will respond to as many as possible.

Sir, the first question I have for you is kind of a long one: The Military Health Advisory Team felt that behavioral health outcomes were driven by three major classes of risk factors. The first one is combat-related events; second is the current operational tempo; and the third is other deployment-related outcomes. The model suggests that outcomes can be improved by reducing or eliminating these three categories of risk factors or by strengthening protective factors so that the service members are better able to cope when exposed to factors that put them at risk. Do you believe that fostering resilience and protective factors among service members will strengthen and improve their outcomes after sustaining a TBI?

Yes, the simple answer is absolutely because we know that resilience training preventatively can help on the back end in many different ways. Resilience training at the very basics allows you to be able to deal with things that are traumatic and unexpected, which essentially is traumatic brain injury.

Second is that resilience training helps you to then kind of center yourself so that when things seem out of control, then you have a way to be able to reconnect yourself and then be able to come up with a plan to then move forward. So I think resilience training is excellent for a variety of reasons.

Now, the caveat is this. Resilience training can't do anything for the actual level of injury or for the location negative the injury because, of course, traumatic brain injury is very individualistic simply because it's all based on where it happens, meaning what part of the brain and to what extent. But what I do find is that especially like psychological resilience, people who have already had that prior to their injury, they tend to have a better outcome because they can deal with the adversity, especially early on. And if their family has had some level of that resilience training, then they're able to basically go with the flow until they can see things actually settle down. Great question.

Thank you, sir. The next question I have is: Because TBI varies widely in terms of injury, recovery, and reintegration, does this pose a challenge to developing a conceptual model or a standardized approach to care?

It's a yes and a no. Putting it simply, it goes like this. We should always have a flexible approach to any model of care that we create. And the flexibility in the approach should be twofold. First, we should be able to adapt people up and down in the system. It is very common – and I can tell you in looking at every aspect of neurologic care in rehabilitation – that sometimes we do go backwards. And it might be in the first six months, or it might be five years down the road. And sometimes when you go backwards, it's actually the beginning of the stages to then bump a person to the next level of improvement. So the flexibility has to be up and down.

To give you an example of how we can create this model of care, I think that we can create a model of care that really will be all-encompassing. The reason being is right now our current database has 1,600 persons that have successfully completed all levels of rehabilitation programming. And so the bigger the numbers, the more we can capture those individual differences. But again, I think we have to look at the

accepted stage based on the data; and then we have flexibility based on what the individual needs are. Great question.

Thank you, sir. I have time for one more question: Do you feel TBI outcomes and recovery are influenced by the individual characteristics, social environments factors such as family support systems, and barriers to rehabilitation access?

Yes, yes, and yes. Putting it simply, it simply is absolutely we know that recovery is based on not only the medical components; but it's also based on bio and psychosocial aspects as well. We know that those who have excellent family support, where the family really tries to be involved and are doing the best that they can do, we know that those folks have better outcomes than individuals who go through TBI recovery with no family or very minimal support.

We also know that other variables, like social variables – things like substance abuse, things like education, academic performance, work performance – all of those things factor into how well a person can get through the process of improvement during the process of recovery in time. So, yes, it's multifaceted in terms of how it all kind of comes together. And that's why rehabilitation really does need to be comprehensive. It can't fall on one provider's shoulders because, as they always say, it takes a village to raise a child. And in this case, it takes a village to be able to rehabilitate folks successfully so they become productive once again.

Thank you, sir. Once again, sir, we would like to thank you for this excellent webinar on Translational Neurorehabilitation Outcomes: Research Trends, and Person-Centered Care. Today we heard about the basic trends and statistics regarding various neurological conditions and needs for post-hospital rehabilitation care. We learned about the current research trends in post-hospital rehabilitation and how this impacts our healthcare decisions, predictions, measuring and monitoring of outcomes, and cost utilization. We also learned how individuals can apply what is learned from the facility-based model to the home and community level for the individual with limited resources.

After the webinar, please visit www.dcoe.cds.pesgce.com to complete the Online CE Evaluation and download or print your CE Certificate or Certificate of Attendance. The online CE Evaluation will be open through Thursday, June 25, 2015. Thank you and have a great day.