

>> Hello, everybody! Welcome to the final Return to Learn Fall 2014 Webinar in our Webinar series, Students Kindergarten through 12th grade with Concussion. Today, we will be hearing about supporting emotional and mental health of students with protracted concussion recovery. It's sponsored by the BrainSTEPS program. BrainSTEPS is a program for students who have acquired brain injuries in the State of Pennsylvania. It was created in 2007 by the Pennsylvania Department of Health, and is jointly funded by the Pennsylvania Department of Health and Pennsylvania Department of Education Bureau of Special Education via the PaTTAN training network. BrainSTEPS is implemented through the Brain Injury Association of Pennsylvania.

The Webinars in this concussion series were created to build the capacity of teachers working with students who return to the classroom following concussion. This series does not replace the official Pennsylvania BrainSTEPS Return to Learn Concussion Management Team Training. Attendance during this Webinar does not denote CMT formation or BrainSTEPS team membership. This Webinar is for educational purposes only. If your Pennsylvania school district is interested in forming a Concussion Management Team for academic and symptom management, please register your CMT at www.brainsteps.net, and online training information will be sent to you.

The BrainSTEPS Program in Pennsylvania currently has over 800 Return to Learn Concussion Management Teams that have formed in the past almost two years, so we would love to have every school in Pennsylvania equipped with a Return to Learn Concussion Management Team, and essentially their job is to manage student concussions for the initial four weeks prior to making a referral of that student's case to the local BrainSTEPS team, based out of the educational intermediate unit.

What we have in Pennsylvania is a unique layered statewide infrastructure for supporting students following concussion. When a student has a concussion, districts who have a Concussion Management Team monitor academics and symptoms for the initial weeks as the first layer of support, and then the BrainSTEPS support can begin at four weeks, and again, that would be through our 31 regional consulting BrainSTEPS teams that cover the State of Pennsylvania.

But BrainSTEPS isn't for just students who have concussions. Students who have concussions, of course, can definitely be referred to BrainSTEPS. We wait four weeks, because we know that the majority of students will recover; practically 90% will recover, usually, in about the four-week mark. Now, if a student has a history of prior concussions, a history of migraines, a history of learning, attention, emotional disabilities, or sleep disorders, then you can definitely make a BrainSTEPS referral sooner than four weeks, but that's just a guideline to go by. But BrainSTEPS also works with students who have not only new brain injuries that may occur, but also injuries that occur at any point in time, as long as that brain injury has occurred after birth of any severity, whether it's a stroke, a tumor, aneurysm, it could be from a car accident, a lightning strike, near drowning, even chemotherapy and radiation effects to the brain. For those types of injuries, we want to, hopefully, have a student referral made as soon as possible, the sooner the better for the more moderate to severe brain injuries.

Again, this is our final Webinar in our Fall Return to Learn series. We're really excited about this series, and the hope is that all of these are going to be archived and available online at the pattan.net Website,

and also the brainsteps.net Website. They will all be available sometime in January. They will be free, and you will have approximately eight hours of viewing, all different topics about concussion and students. And the hope is that this can really educate the educators who are not directly serving on their Return to Learn Concussion Management Teams for their district, but who do need to learn more about concussion, in order to help assist managing the education of these students.

Any questions that you submit today will be answered at the conclusion of today's Webinar.

I would like to now introduce our presenter, Dr. David Brent. Dr. Brent is currently Academic Chief, Child and Adolescent Psychiatry at Western Psychiatric Institute and Clinic, and Professor of Psychiatry, Pediatrics and Epidemiology, University of Pittsburg School of Medicine; and he holds an endowed chair in suicide studies. Dr. Brent cofounded and now directs Services for Teens at Risk, or STAR, a Commonwealth of Pennsylvania funded program for suicide prevention, education of professionals and the treatment of at-risk youth and their families. Dr. Brent is a member of the Institute of Medicine, and has been recognized for his research by the American Academy of Child and Adolescent Psychiatry, the American Psychiatric Association, the American Foundation for Suicide Prevention, and received the Ruane prize for Research in Child Psychiatry from NARSAD. His work is focused on the identification of risk factors for adolescent depression and suicidal behavior, and on the translation of those findings into actual clinical interventions. Along with many other colleagues, Dr. Brent helped to establish the role of cognitive therapy as a treatment for depressed adolescents, and developed guidelines for the management of treatment-resistant depression. Dr. Brent and his colleagues have endeavored to understand possible intermediate phenotypes for suicidal behavior, and mechanisms by which suicidal behavior is transmitted from parent to child.

So, Dr. Brent, you're on!

>> Well, Brenda, thank you very much for inviting me to do this. I think the organization that you work with is really fantastic. And hopefully, my voice will hold up, and not be too unpleasant to listen to.

So, what I'd like to talk about today are what prolonged recovery from concussion looks like, how common it is, what the risk factors are, and just the general presentation. And then having discussed that, then we'll talk about what is the evidence for best practice, in terms of rest and return to activities. And then, finally, to talk about the clinical management of prolonged recovery.

So, the post-concussion syndrome is a constellation of symptoms related to cognitive issues, such as difficulty with concentration. Somatic symptoms like dizziness, balance problems and emotional problems, like irritability or sadness, and sleep disturbance — and all these four sets of symptoms interact with one another, and so, it's very important to think about them holistically, rather than separately.

So, as Brenda was saying, the rate of prolonged recovery is about 10% in a series, say, from athletic participation. If you look in ER's, while you may see a more severe form of concussion, the rate of prolonged recovery is higher. And in general, the things that predict a prolonged recovery are, somebody that's had a loss of consciousness, a longer period of amnesia, and post-traumatic headache.

People that have overall higher initial severity of symptoms tend to take a longer time to recover. And then, there are also factors that are related to things that they may have – vulnerabilities they may have prior to the experience of the concussion; such as a previous history of migraine, or emotional or behavioral difficulties, impaired family functioning. A girl seems to be more vulnerable; we don't know whether this is just because they're more honest about disclosing symptoms, or whether it's a true difference. And kids in the adolescent age group seem to be more vulnerable than the younger kids, and then kids in the college age, perhaps because there's such rapid change going on in the brain during this period of time. And there also are neuroimaging findings that showed persistent difficulties in working memory and executive function that may not be clinically detectable, but it indicates if there is an ongoing process of this function.

So, this is a study that takes a look at kids seen in an emergency department, who either have a mild head injury, which would be a concussion, or have some other traumatic event, such as a broken leg. And what you can see here is that the group with the head injury, which is the darker curve, that they have a much slower recovery related than the individuals with the other types of injury, which supports the idea that this is a real syndrome. And as I was saying, the rate of recovery tends to be slower in older kids, compared to, say, kids under the age of six. And in addition, the number of previous concussions has an effect on the rate of recovery, so that kids who've had more than one concussion will show a slower recovery, and people that have had — it also is related to how recent the concussion is, so that if your concussion took place more than a year ago, then the second concussion, your recovery isn't any different. But if it's been one year, then your recovery is much slower.

And then finally, there does seem to be a dose response, so that if you've had more than one concussion, that there could be some cumulative effect, especially if they occur within a shorter period of time.

Now, some of the factors that occur after the injury that may predispose the prolonged recovery would be if there are other medical consequences, other injuries associated with this, like a neck injury or a broken bone, so that there's overall greater impairment. One of the things we'll talk about is, if they return to activity prematurely, it can prolong recovery. Families where they've received education about the expected course, the kids tend to do better, so the lack of education, conversely, is related to a greater risk. And to the extent to which the family and kid have prior adequate coping resources affects their response to the injury.

So, let's talk about the case for rest, the importance of rest. We know that there's a window of vulnerability for getting re-concussed, so that if a concussed person — once a person is concussed, they're at about twice the risk of a second concussion, and the highest risk period is within the first 10 days of the first one. And we know from physiologic studies, many of which have been in animals, that there are metabolic changes that occur after a concussion has taken place, that make you more vulnerable to that second injury. And this period of time is also a period of decreased cognitive deficiency, so that for the same demand, there seems to be a greater energy use on the part of the brain, and so which, in turn, may be related to provoking or making the symptoms worse. There also are a number of naturalistic studies that have shown that shorter or less complete rest is correlated with

prolonged recovery, and even in studies of people who have not had adequate rest, and that had prolonged recovery, even later on in the course, people who then undergo a rest period show a better rate of recovery than those who haven't. So, those are the pieces of evidence in support for rest.

And this is a study done out of Pittsburgh, the Sports Concussion Program, that looked at a number of athletes and showed, if you look in the orange band, those are the people that showed the highest level of activity post-concussion, and they also have the most prolonged recovery.

So, let's take a window into the brain. We're not going to talk a lot about neuroimaging studies, but I think it's important to help us understand what's really going on with these kids. So, even in those with prolonged recovery, often in neurocognitive batteries, their function can look adequate; although it's more likely than the kids who don't have prolonged recovery to look impaired. But many kids, even with persistent symptoms, have normal neurocognitive function. However, what you see in — I'm sorry about this keeps showing up here, but I'll keep getting rid of it — that if you look at fMRI studies, that it requires more brain activation of a larger region, so essentially, more metabolic activity in order to accomplish the same cognitive tasks. So, there's less efficiency. And another way of looking at that is what's known as connectivity, so that you can look at the interrelationship between activation in different areas of the brain. And what one study showed is that kids who are post-concussion will show greater activity and connectivity, and that that's related to better function. But what you have to understand is, the brain is paying a high metabolic price for that, and this is one of the reasons why kids may become fatigued and need to rest, or not spend a lot of time on a computer screen, or something like that. So, this is some of the physiologic reasons for rest.

It's also important to know that many concussions are not reported. And we know the reasons for this; there's a lot of pressure to continue to play, and people don't want to be pulled from participation. But consequently, the issue is under-reported, so there may be many more kids who have multiple concussions, even though we may only know about one. The good news is that with education of kids, their parents, coaches, that you can improve the rate of disclosure, so although that doesn't help in managing an individual kid with post-concussion syndrome, I think this is an important aspect of the problem of sports concussions to consider, because you don't want people not reporting them, which then would lead to — okay, all right. I was just getting a little technical assistance there.

So, what are the psychiatric sequelae, the mental health sequelae of post-concussion syndrome? So, they fall into a number of categories: Sleep problems, such as insomnia; attentional difficulties, like attention deficit disorder; depression, engaging in more risk behaviors because of lability and impulsivity; and suicidal behavior.

So, sleep is really one of the most fundamental problems that is altered in kids with post-concussion syndrome, and, in fact, it's related to all the other sets of symptoms. So, then, if you have poor sleep, it increases your mood lability, it increases impulsivity. It makes people more impulsive. It interferes with cognitive performance, and it makes people more prone to risk-taking and sensation seeking. It affects cognitive bias, so that somebody may tend to be more prone to attend to things that may reinforce a sense of depression and hopelessness. Greater irritability, and if people have pain, for example,

headache, poor sleep is also related to that. So, many people feel that the first thing that you ought to do when you're dealing with a kid with post-concussion syndrome is to make sure that you deal with the sleep, because if you do, you have a better chance of helping all the other problems to improve.

So, there hasn't really been a lot of studies looking at this, but one of them that looked at kids with traumatic brain injury of various types, not only just the milder form, showed, in particular, an increase in hyperactivity, and kids being treated with stimulants. Another study focused mainly on mild traumatic brain injury showed a three-fold increase in risk for psychiatric disorder. And as we've said before, kids with a prior history of psychiatric disorder were more likely to develop a disorder after a traumatic brain injury, and that disorder was more likely to persist. This comes from a longitudinal study of former NFL players, and they showed a dose response relationship between the number of previous concussions and the risk of depression. And it's a dose response relationship; the higher the number of concussions, the higher the risk. Now, this is many years afterwards, not in the immediate post-concussion period.

This study is something that looked at a very large population registry in Scandinavia. Because it was a population registry, you could take people that had traumatic brain injury and you can link it to previous records. And because in Scandinavia there's universal healthcare, the rate of treatment of the disorder is pretty much representative of the rate of the disorder. And so, what you can see here is that kids with — any age group, that people with traumatic brain injury have much higher rates of disorder prior to the experience of the traumatic brain injury, and in some cases, the conditions say substance abuse may actually predispose to the injury. But in addition, they showed that post-injury, there was also an increased risk of disorder.

And this same study also looked at the risk of suicide, which is much higher in people with traumatic brain injury. But they compared four groups; those that had neither a psychiatric disorder or traumatic injury, those that had one and then those that had both, and then the highest risk was in the people with traumatic brain injury who also had a psychiatric disorder. On the flip side, the risk of suicide was somewhat increased, but really not that much relative to traumatic brain injury in the absence of psychiatric disorder. So therefore, psychiatric disorder is something really important to try and detect in these folks.

Now, there's been relatively little done in traumatic brain injury in youth. But this large study was recently published, and their criteria for traumatic brain injury is somewhat more serious than what we would consider for a sports concussion, so it's not clear to what extent these findings would apply to a milder injury, but they're what we have to go on, for now. Anyway, it was a survey of almost 4700 kids in Canada, and the type of head injury had at least five minutes of unconsciousness, or being retained in the hospital for one day. And in this survey, they actually found that about one in five kids had this experience. It seems kind of high, maybe more kids in Canada play hockey, I'm not really sure of the explanation. But they found an increased risk of suicide attempt and ideation, and seeking help for suicidal thoughts, and getting treatment for depression or anxiety. In addition, they had a whole lot of other risk behaviors that were increased; being bullied, bullying, carrying weapons, fighting and so on. What we don't know is, how much of this behavior was present before they had the head injury, and if

the other study in Sweden is any at all representative, it's possible that some of these behaviors actually account for why these kids got the head injury. We know, for example, that kids with ADHD and substance abuse are more likely to experience a head injury, and therefore, while some of these findings may be the result of the head injury, some of them may — actually are predisposed to them.

So, the concern about suicide in concussions is, it has to do with an interception of the problems caused by concussion with what we know about normal adolescent development. So, suicide occurs when there is an imbalance between distress and inhibition. So, in other words, somebody may be depressed, but they also may have a lot of reasons why they don't want to engage in suicidal behavior. But in somebody with a concussion, they may have a lot of sources of distress; pain relative to headache, depression, loss of activity, maybe not being able to participate in sports. And in addition, they're more likely to be disinhibited due to the same process. They have more difficulty with prefrontal cortical control, which would normally inhibit action or negative emotion. And so, when you have both of those together, you have a greater likelihood of suicidal behavior occurring.

In addition, the reason why this is a perfect storm is that, we know that adolescents, their brains are not fully mature, and, in fact, the areas of their brain related to drive and reward and emotion mature before the part of their brain that has to do with decision-making, and inhibition. And so, you have this immature brain with greater distress and greater disinhibition. And it's for these reasons that we're worried about this set of difficulties in these kids. And, in fact, there are studies not necessarily in kids with sports concussion, but that relate concussions and head injury to suicide. This is one population study that shows about a three-fold increase in the relationship between suicide and concussion. The highest risk period was in the first three years after a concussion, and what you can see here is that people under the age of 21, it was also increased.

This comes from the same study that we talked about before in Sweden, and they compared the rate of suicide and other source of mortality, premature mortality, to population controls and also to siblings of the brain-injured people, who haven't had a brain injury. And you can see that there's about a three-fold increase in all forms of mortality, about a three-fold or so increase in suicide. But they're also more vulnerable to dying due to assault, motor vehicle accidents, so they're really at risk probably all related to the same reason. There's some evidence that people with a brain injury may be more likely to be the victims of homicide because they will get into situations or provocations without using good judgment. I'm not blaming the victim, but they may put themselves at greater risk. So, we can see that not only suicide, but other forms of mortality may be elevated.

And this is a longitudinal study, and it shows that the peak incidence of suicidal ideation after traumatic brain injury, though, is about two months after the injury, so there is a window of time where the risk is higher, and that's the period of time that we're talking about now.

I don't know, actually, if I spoke about what we mean in terms of the temporal period for prolonged recovery. But most people recover by four weeks, and the vast majority by 12 weeks. So, we're really talking about something in that range, between one and three months of symptoms that are persistent.

Now, there have been a lot of studies in the military, looking at the relationship of traumatic brain injury and suicide. And, in fact, the risk of ideation and attempts goes up with the number of concussions, and the relationship is most salient with sleep. Sleep disturbance after a concussion is the single symptom that's most closely related to suicidality.

This is a study that looks at the relationship between depression and multiple traumatic brain injuries and suicidal behavior. And what this slide shows is that the risk is much greater if you've had multiple traumatic brain injuries, but also if you've been depressed. So, this highlights this idea that traumatic brain injury in combination with a psychiatric disorder that may be a sequelae of the brain injury is what really puts people at suicidal risk.

So, to summarize what we know about the mental health sequelae of traumatic brain injury, there's a higher rate of depression, substance abuse, aggression and impulsivity in people prior to the injury, that may, in fact, predispose to the injury. But, in fact, there's also an increased risk of these problems after a concussion. And in addition, there's about a two to four-fold increased risk for suicide attempts for suicide in any psychiatric disorder. The highest risk for suicide and attempt is in those with both traumatic brain injury and psychiatric disorder. And we didn't speak a lot about this, but in some of the studies, it seems that some of the central issues in risk for suicide and depression are a sense of worthlessness and lack of belonging, and a perception of functional impairment. So, in other words, two individuals that are functioning the same, and one has a worse perception of his or her function, that person is at a greater risk for depression. And we've spoken about the interrelation between sleep and headache, depression. We didn't speak as much about PTSD, but it's also in certain types of head injuries, so that you can't really look at one of these problems in isolation. And that multiple concussions increase the risk to a greater extent than a single concussion for depression and suicidality, and that these difficulties are associated with neurocognitive impairments in memory, executive function and inhibition, which makes sense because those deficits also lead to difficulties in emotion regulation, and in decision-making and in response prevention.

Okay, so now let's talk about the clinical approach to these kids. So, one of the first things you want to know is, how they were doing before; mental health difficulties, cognitive function, history of headache. And you want to know what kind of protective factors you're dealing with, such as parental support, education, school advocacy and accommodation. And then, you want to assess the symptoms of post-concussion syndrome, as well as looking at the interrelationship among them. And then see whether there's evidence for new onset of exacerbated — in other words, conditions that might have been there, but now are worse. And I'll just say that one of the reasons I got interested in this area is, a number of my patients participate in sports, and experienced concussions. And many of them were close to being finished with treatment, and then we still were going to have to start all over again, and they were very challenging to treat. And so, that was an example of an exacerbation of a pre-existing condition.

And it's important to assess imminent suicidal risk, so that would be the level of ideation, whether or not the person who is having suicidal thoughts has an actual plan or suicidal intent, how frequent the thoughts are, how long they occur, and to what extent their experience is intrusive and dominating the

person's consciousness, somebody with a recent attempt, obviously, and then looking at this relationship of distress and restraint. So, people with a high level of stress are people with depression or anxiety who have physical pain, people who are hopeless about their recovery or return to play. Then there are a number of factors that can decrease the level of restraint, so, insomnia, substance abuse, kids who are more impulsive, who have poor emotion regulation, and who have poor supports or connections — the reason being that many kids, even who are suicidal, will say things like, "I wouldn't ever actually hurt myself because I care about my friends," or, "I wouldn't want to hurt my parents." And so, people who have poorer supports are in a more worrisome situation.

These are some — I don't know how relevant this is for many of you, but these are some freely available measures that are useful for tracking these symptoms, and you can get many of these online. There's a nine-item measure of depression, the patient health questionnaire, and the same group developed a measure for anxiety. And there's a four-item question about suicidal thoughts and behavior. The PCS is a measure of the symptoms of post-concussion syndrome, which is useful for tracking this. And we would also track pain and overall mood. And because insomnia is so common, we would recommend following that as well.

So, now that we know all this stuff, what can we do for these kids? These are the main problems that I'd like to speak about; sleep, problems with impulsivity and depression, headaches, and cognitive difficulties. Often, you're dealing with more than one of these, and so, you want to listen carefully to see if you can understand which symptoms are driving what. So, you may have a kid, for example, with a really bad headache, and then subsequent to that, the headaches don't go away, and they start to get depressed. But the problem really isn't the depression, per se, it's getting rid of that headache. If you can't get rid of the headache, then obviously you try and help the kid cope with it. But that would be an example where you would be trying to sequence and make some kind of hierarchy about what problem to attack first.

So, you want to identify the conditions that are the most impairing, and which symptoms are exacerbating the other problems a person has. So, you may see a kid, for example, who has sleep difficulties, and that's leading to greater headaches, irritability, depression. You may see a kid who has cognitive difficulties, challenges, and they become angry and irritable about that, and demoralize. But the real problem is the cognitive history. And always, your goal is to decrease distress and increase restraint, because you're always worried about that issue of suicidal risk.

And this is just a helpful way, I think, to think about the different constellation of symptoms, and the fact that each of them overlaps with, and can affect all of the other sets of symptoms. But we really reviewed the different sets of problems before. But I think this is a nice depiction.

So, all in all, we prefer non-pharmacological to pharmacological interventions. There is some evidence that kids with either prolonged recovery may be more vulnerable to side effects of medication, and so, you — although medication can be helpful, if there's a similar type of effective intervention that doesn't involve a drug, we recommend them first. So, as we spoke about, there should be a period of rest and a step-wise return to activity. There should be, if necessary, some accommodations in school workload.

You've heard about the wonderful program, BrainSTEPS, which, for certain kids, it can be really helpful. It's important to provide education to patients and families about the expectable course, so that either they don't have unrealistically bad or unrealistically good expectations. There may be problems related to, say, neck pain, or balance, or vestibular problems that physical therapy can help with, or occupational therapy. Some people believe in graduated exercise as a way of getting people back to functioning. And it makes sense, it just hasn't been proven. There are a number of things that you can do to help people improve their sleep hygiene. There's cognitive rehabilitation, so focusing on executive function. And there are CBT for depression and anxiety, and for that matter, certain pain syndromes, like migraine, as well.

So, there hasn't been a lot done in kids, in fact, there hasn't been that much done in anybody. But there is evidence that different types of CBT and psycho-education can help symptoms related to traumatic brain injury. So, in one study, it was useful for hopelessness and suicidal ideation. Another one was more focused on education and coaching, and that was associated with improved function, and also helped a person's post-traumatic stress disorder. There is one study looking at MOODGym. MOODGym is an online intervention for depression, but they found that there was pretty poor adherence to the program, and part of it is, a lot of these kids have trouble using computer screens, and so the whole idea of an online intervention was sort of contradictory to where these kids were at, at that particular point in time. And then there was an intervention I thought was pretty cool, called "CogSMART," and it basically focuses on augmenting executive function. And I'll just show you some of the components.

So, as I mentioned before, there's education about the natural course, and then there are a variety of interventions that focus on sleep, on headache management, stress reduction, and trying to organize your life in a way that doesn't exacerbate these symptoms. And then there were various strategies for people that are having difficulty with memory, or attention, with learning and memory and with problem solving and executive function. And although — so it makes a lot of sense, and I'd like to see it more widely tested.

And there have also been a couple of other cognitive behavioral studies; one over the phone that was used, a component of cognitive behavior therapy called "behavior activation," and this is where you try and get people to engage in the activities that are going to be rewarding to them, and also help them with problem solving, and that was found to be effective. And there was also a problem solving intervention for adolescents that was shown to improve parent-rating of kids' executive function, and it worked in older, but not younger adolescents; possibly younger kids can't take advantage of this type of training.

So, let's talk about medication. So, as I mentioned, psychosocial interventions are preferred, but sometimes you need to use them. It's important for the practitioner to be humble, because there are no well-established treatments. But what you can do is, define a target symptom and have a good way of measuring it, and have a goal, and be willing to admit failure if the goal doesn't improve. A lot of times, what I see, sometimes, when kids come to me is, people have started a number of medications and keep adding to them, because one doesn't work, and they'll add another one. And while there are justifications for combining medications, you don't want to just pick up a whole lot of drugs that aren't

working, and it also increases the likelihood that you're going to have drug interactions and side effects. And it's important to start low and go slow, and only change one thing at a time. And we have a table that shows this, but sometimes you can use one drug for more than one problem, so you want to be strategic and think about the different problems that a kid's having, and then try and choose your agent judiciously. One example is, you may have a kid with sleep problems, and also headaches. So, one agent that people use is amitriptyline, it's known as Elavil, which is used both to help people sleep, and for headaches. And as I said, if a drug isn't working, you should discontinue it. And it's very important to monitor carefully for side effects, as well as response.

So, sleep is, as I said, is a pretty common symptom. It's often disturbed secondary to the injury or pain. And as we mentioned before, it affects all the other symptom constellations. One thing you might want to rule out are other causes of sleep disturbance, the most common undiagnosed one is something called "restless leg syndrome," and that is more common in people with iron deficiency, anemia. And you also want to rule out sleep apnea, which you can do to some extent, based on the history of snoring, or not.

There are good psychosocial interventions for sleep; make that, there are two important principles. One is that kids need a safe and soothing environment for sleep, which is [INAUDIBLE] is often what they have, which is quite a lot of stimulation. So, you want to negotiate a decrease of media stimulation, a wind-down period, and for kids who are having trouble sleeping because they have difficulty relaxing, you can work on developing some relaxing imagery, or imagery that is based on enjoying something that is pleasurable, which is helpful for kids who are ruminating a lot at bedtime, in other words, they're thinking a lot about, say, something that went wrong during the day, or something they're worrying about. But [INAUDIBLE], in the meantime, they're not sleeping. And you also want to encourage the kids to have a regular circadian cycle, so that if a kid has more than a two-hour difference between the amount of sleep they're getting during the week and on the weekend, then that's pretty much evidence of a sleep deficit. And you want the kid to have a regular bedtime, and wake up.

And finally, there's a few other elements about sleep hygiene, avoiding caffeine and naps in the afternoon, and the idea that beds are for sleeping, so that if a person is tossing and turning, they shouldn't necessarily stay in bed, but should get up and do something different, and not only get into bed when they feel tired.

So, there are some medications that have some efficacy for kids. Melatonin, which you can get over the counter, has been shown to be effective in clinical trials with kids with ADHD and autism. And there's no reason to think that it doesn't work equally well for kids with concussion. There are not a lot of side effects to it, and as I said, it's over the counter. Some other agents for kids who have post-traumatic nightmares, there's a drug called prazosin. Mirtazapine, or Remeron, is an antidepressant that didn't work that well as an antidepressant, but it's quite sedating, and so that's something that you might use. Traditionally, people have used trazodone, but it can cause priapism in boys, which is when you have a sustained erection that won't go away. When you tell kids about that, they sometimes think it's a good thing, until you explain that it can lead to impotence, in which case, they don't want to take it. So, we don't use it in males, and the drug may interfere with the drug metabolism of some other agents, and so

we try to avoid using it, period. And while some people may choose to use benzodiazepines or antipsychotics, we now recommend that people avoid them. The antipsychotics are the dopamine antagonists, the physiology of concussion is that you have a relative dopamine deficit, and consequently the antipsychotic would be pushing you in the wrong direction, and in animal studies, it's actually been shown to prolong recovery. Benzodiazepines we also don't like, although they can be useful for people with acute anxiety. They tend to be disinhibiting, which, again, in these kids is not a great idea, habit forming, and may actually increase in the likelihood of engaging in suicidal behavior.

Post-traumatic headache is quite common in these kids, and even four years later, one in four kids with a concussion will have one. It may be made worse by exertion, and there are different types of headaches, so there is somewhere, the problem is really secondary to neck pain, in which case, really, they should be seeing a physical therapist or a physiatrist for a nerve block. On the other hand, some kids have post-traumatic migraine, and in this case, it's managed like any other migraine, along with a headache specialist.

It's important to have kids avoid using rescue meds to the best of their ability, because they tend to leave a rebound. And as I said, you want to determine whether or not it's related to neck injury, because the set of specialists you're going to be interacting is quite different. If kids' sleep is also off, you can see whether or not improving sleep will also improve the outcome, reduce headaches. There also now have been some cognitive behavior interventions for headache, in which they showed improvement relative to an educational intervention. Amitriptyline we've mentioned before, which can help both sleep and headaches, and divalproex, it's related to Depakote, is, again, has not been rigorously evaluated, but it's often used. And topiramate, or Topamax, is efficacious for chronic recurring headache, but it has serious cognitive effects, and so it has a limited role in these kids. And headache docs will often use antidepressants. And so, if I'm sharing a patient with a headache physician, I will get in touch with them to see what they're thinking, because if they were thinking of going with an antidepressant anyway, then I'm happy to prescribe it.

And so, when you're thinking about what medication to use, you may think about what other problems they have. So, if they also have depression, an antidepressant might make sense. If they're having trouble with sleep, amitriptyline. If they have cognitive difficulties, on the other hand, you want to avoid topiramate, and if a kid has seizure difficulties, then you might want to avoid some of the medications that lower the seizure threshold.

So, there will be a quiz on this afterwards, but what you can see, that a lot of the medications that are used haven't been rigorously evaluated, some of them have. And they all have some significant side effects, so usually we don't initiate these drugs; we collaborate with the neurologist about this.

Now, what about cognitive difficulties? Very common in these kids. And so, you have kids with inattention, slow reaction time. Their executive function is off, and they may have difficulty processing information, and recalling things.

So, physiatrists often use amantadine. In our experience, we don't use it as much, because kids experience side effects, but in the defense of the rehab folks, the physiology of concussion is that

there's glutamate over-activity, and it's a glutamate receptor inhibitor, so as an intervention, it makes some sense. On the other hand, we just find stimulants easier to use, and we use them a lot anyway in treatment of ADHD. And there have been some studies that have shown it to be helpful. I really provided this more for completeness. And there also is something called — the trade name for this is amantadine. And some people use it for augmentation of memory. Because of the nature of its action, it's contraindicated with amitriptyline, so that's just important to know.

Folks with mood symptoms, an antidepressant has been shown to be effective. There's some soft evidence that the SNRI, so that would be a drug like Effexor, which has action of both norepinephrine and serotonin, may be more effective for pain syndrome. So, if you've already tried Prozac, and you still want to treat depression and anxiety, and the person has headaches, then a lot of times, the neurologist will agree that let's try an SNRI. And in one small study, they actually found that a stimulant, methylphenidate, Ritalin, was as effective as sertraline for a reduction in depression, and that it helped with cognitive function to a greater degree. So, basically, these are some of the same agents that we use to treat these problems in people without concussion.

There have been studies that have looked at other types of lability; for example, people have used propranolol, that's Inderal, for the treatment of aggression. And because this drug is also used to prevent the recurrence of migraine, if you have somebody with both, this might be something worth considering. And I think as we were talking about one of the principles, is that you want to try to define agents that hit multiple targets, so if you have somebody with a problem with both sleep and headache, then amitriptyline might be a good idea. Somebody with headache and a mood problem, then an antidepressant. Somebody with headache and difficulty with aggression, then propranolol may be something you would consider. If, on the other hand, your main problem is something cognitive, or if you're not sure to what extent the cognitive issues are affecting your mood problems, I would probably go with a stimulant first, because it's very rapidly acting; you'd know within a couple of days whether it's going to help, whereas an antidepressant takes weeks to work, and that would also help you understand whether or not the depression was secondary to the cognitive difficulties.

And really, every time that I am involved in using more than one medication, I check with the pharmacist, and I have an interaction checker on my computer, because you can't really remember all of these things. But I've just shown some of the common interactions and things that you may want to think about; for example, somebody that's using amitriptyline, so Elavil and Zoloft, that it's likely to raise the level of amitriptyline as well. So, it's just important to check those, if people are involved. And if you're on the other end, say you're a nurse, and the kid has a lot of medications, and they're having difficulty, you should be suspicious of the possibility of a drug interaction.

So, there are also some important case management issues with these kids; one is to develop a safety plan in kids that have any indications of suicidal risk, and this is a plan for coping with suicidal urges. So, you help the kid identify what are the triggers for suicidal thoughts and urges, and help them identify some distractors that they can use, review reasons for living, reasons why they shouldn't do this, and then helping them develop a list of people that they can reach out to, as well as ways that they can get in touch with a professional in the event of a crisis. A parent and patient education is very important,

and a lot of times these kids need help with advocacy at school. So, it depends what some schools have, a lot of resources already in place, but sometimes they don't. And then it's the responsibility of the clinician with the family to try and help make reasonable accommodations and help set reasonable goals.

So, I just had a couple of case examples that, I think, illustrate some of these issues. So, the first one is a 17-year-old girl who had a concussion playing soccer. And she returned immediately to school and practice, but now she's experiencing dizziness, headache and difficulty concentrating. So, the question is, what would you recommend is the next best step? So, this is a kid that didn't really have any period of rest. And so, that would be what you would recommend before you would get involved with anything. And really, during this period of time, this kid isn't even in the prolonged recovery period. You want to help them avoid that, so they need to have, you know, a graduated plan of return to activity.

This is a girl with a history of depression that was in remission. She was a cheerleader, and she experienced a concussion. So now, she has daily headaches and difficulty concentrating, suicidal thoughts and occurrence of a depression. So, the question is, how would you prioritize the patient's problems? You would talk with her, try and find out what she thinks is the most impairing issue; how she rates her depression compared to before, to what extent the headache or difficulty concentrating is driving her depression, and to what extent the depression may be driving the issue with headaches. And from there, you would try and prioritize what you would do first.

And this is a boy who's experienced a concussion playing football, it's his fourth concussion that he told you about, I might add, and the second within one year, and he reports significant headache, dizziness and mood lability, concentration. And he's very upset, because he won't be able to play football. So, the issue is, what's the most pressing issue for this kid? What I would say is, you have to help him mourn the fact that he can't return to football, at least not in the foreseeable future, and help educate him about what the risks are, he and his parents and his coach. And then, you can begin to parse out these other problems. But often, sleep is a fundamental one, as we talked about. But if a kid has really prominent headache, I think it's very difficult to deal with concentration issues, until somebody is able, at least has enough pain relief that they're able to focus.

So, this concludes my remarks, and I very much appreciate the opportunity to share this with you. And I believe that we still have some time for questions.

>> Well, thank you so much, Dr. Brent, that was wonderful! And we will take questions now. If anyone has a question, please type it in the questions box. We don't have any yet. So, we'll wait another few minutes, see if anyone has any. Any questions for Dr. Brent? Here's a question. Okay, Dr. Brent, the question is, do you think parents should be told about suicide risks on the first visit to the doctor following a concussion?

>> Right, okay. I think that you want to — it depends on the context. So, you want to assess the kid for that. If they don't have any suicidal ideation at that point, the only thing I think I would tell them is that they need to be — both the kid and the parent — aware of any changes in their functioning, so that if

they notice more lability, then I would say sometimes people get upset, they have thoughts of suicide, and as well as other things. So, I wouldn't necessarily single that out as something distinctive from other things that you would be worrying about. But I would mention it, and say that those are some of the reasons that you would want to get back in touch with us sooner than necessarily our next appointment.

>> Do you actually say the word "suicide" at all, during the first meeting?

>> Well, to be honest, I don't see people at the first meeting. But if you're asking for my recommendation, I would. But I wouldn't use it — I wouldn't — I mean, it's in the context of other risk-taking behaviors, and so on. But I don't think we need to be afraid to use the word. I think that the reverse is a much greater risk. There are case reports of kids post-concussion who killed themselves, seemingly without warning. And so, you would at least want to, when you're seeing that kid and family, say to them that sometimes people experience changes in mood, changes in the way that they're processing information, and they may have thoughts of suicide, and these are all things that we need to know about right away, if you experience those things.

>> Okay, great. The next question that came in is, can you clarify the abbreviations on the chart related to medication? Like, the arrow plus DA., NE and NMDA?

>> Yeah, this one? So –

>> I think so.

>> So, AMI, there's the abbreviation — I don't know can you see my arrow? Maybe not? No. Well, under amitriptyline, there is this AMI. So, that would be the level of AMI.

>> Oh, she says it's actually further back on another side, sorry.

>> Here?

>> Yeah, I think here.

>> So, that's dopamine, and that's NMDA is related to a glutamate receptor. So, that's dopamine and norepinephrine.

>> Okay.

>> Is that the slide?

>> I think it is. One second, my box keeps jumping around. Okay, the next question, are suicide hotlines aware of head injury risk factors? I think head injury clinics are becoming more aware of suicide issues, but do you think most are aware of concussions and the relationship?

>> I don't know. I mean, I think it's an education issue. I don't really know the answer to that.

>> Okay.

>> I think that in the research world, we're certainly becoming aware of it.

>> Right. The last question that we have, so far, is, chiropractic and homeopathy are so effective in addressing these issues. Are you familiar with these modalities? Neck pain and headaches can frequently be easily resolved by chiropractic, problems with confusion and concentration are easily addressed with homeopathy which is FDA-regulated.

>> It's out of my area of expertise.

>> Okay. Any other questions for Dr. Brent? Okay, well, one just came in. We are starting a teen support group with yoga and incredibly light exercise for PCS groups. So, that's more of a statement. Have you used these, they'd like to know?

>> I haven't. I think it's a good idea. I think if the idea of some kind of gradual, graduated exercise, and particularly something that I think has a centering effect, like yoga, I think it's a really good idea. I'll just throw something kind of wild out, which is, I was talking with somebody who's a child psychiatrist in Vermont, and he says he recommends people learn a musical instrument, which, you know, never would have occurred to me. But according to him, he says he has all these guys on the ice hockey team learning how to play the violin. So, I think that there are a lot of what we would consider non-traditional approaches that may be helpful. But I think yoga and meditation and those types of things make sense for a range of chronic pain conditions. So, it would make sense to me.

>> Okay. Well, thank you, everybody, for attending today's session. Thank you, Dr. Brent, for taking time to educate us on this important issue. And thank you, everybody! Have a good evening!

>> Okay, take care!