

**JOHN AGUILAR:** The talk today is going to be on the rehabilitation therapies to maximize function and independence post-stroke. So disclosures, I have no commercial interests. That means I am not beholden to anyone, and I can say whatever I'd like. I have all the qualities to be president of the US.

Objectives, the point of this talk today is what we're going to do is try to understand the relationship between impairment and disability. We're going to review a little bit about the impairments that typically result after a stroke and their impact on function and on independence. We're going to review some of the common, most common complications. As we know, there's a multitude of complications that can occur after a stroke. But we're going to hit on some of the most common ones and discuss a little bit how they can affect rehabilitation.

We're going to review a little bit of the rationale and the evidence supporting some of the rehabilitation modalities that are aimed at maximizing function and independence. And hopefully we can get all this done and get you started on your weekend.

All right, so the impact of strokes, the big takeaway message from this slide is that you can look at all the statistics, and stroke has an effect on living with disability, in particular in the United States. It's one of the major players. And if you look at the third bullet point there, you're looking at what is the typical pathway, where do patients suffer stroke end up? And as you can see, not everyone who suffers a stroke ends up going home right away.

And even if they do end up going home, they're still requiring care. They're still requiring therapy. They're still not there yet. And a significant amount of them are still requiring home health services, which means they're immobile enough that they're considered homebound, right?

So disability in terms of the previous slide, we talked about this [INAUDIBLE] disability, but there is a difference between disability and impairment. So when we talk about impairment, what we're really discussing is a deficit in neurological function. So that's impairment as it relates to stroke.

Disability, and this was defined back in the '80s by the World Health Organization, is a reduced ability to perform functions or activity. So it could be activity of daily living, like bathing, dressing, grooming, eating, walking, communicating. OK We look at some of the most common impairments post-stroke. And the brain's a fascinating organ that plays a big role in all the functions that we do.

Some of the nomenclature you may want to be familiar with, paresis or plegia. When we talk about paresis or plegia, we're talking about motor function, weakness of the muscle, or paralysis. When we talk about aphasia, we're looking at-- we're just scratching the surface, but scratching the surface, it's a speech deficit.

Spatial perception can be affected after a stroke, and that's looking at the relationship-- the patient's own understanding of their relationship with the environment. You can have visual deficits. That can be a visual field cut, or actually the eye movements can be impaired after stroke. You can look at hemi-neglect with some inattention to the opposite side of the hemisphere from the side that was affected by the stroke.

Apraxia and ataxia, you know, they sound similar. And they even almost can look a little bit similar. But there is a difference there between motor planning and motor control. We talk about increased tone, that sort of touches a little bit with paresis or plegia when you have a decreased tone, but it goes beyond that. It can actually progress until there's too much tone, or increased tone.

We look at sensory deficits, strokes can impact your sensory function. That can be soft touch or proprioception. We talk about swallowing after stroke, which can be affected. And your ability to communicate, dysarthria, which is more of a motor control of your speech. Cognition is a very big impairment, and it has a multitude of components. We're looking at executive function. We're looking at things such as recall, looking at attention.

So what is the relationship between impairment and disability post-stroke? Because they sound so similar. They sound like they go hand-in-hand. And what's thought is that an initial impairment leads to an initial disability. I'll give an example there.

So we begin with paresis or plegia. So as we covered in the previous slide, that's a weakness of the motor strength, or the muscle, which then leads to difficulty-- if you break it down-- difficulty contracting the necessary muscles to support body weight, which in turn leads to difficulty walking. Same thing, expressive aphasia is just another example. Difficulty producing spoken language can then lead to difficulty communicating your wants and needs. So the initial impairment then leads to the initial disability. And in all those examples there, it's pretty straightforward.

But what we're about to find out is that it's not so straightforward. The goal of rehabilitation is to, if we can, improve independence, improve the function, and improve the quality of life. So when we improve independence, we're improving the disability. When we improve the function, we're improving the impairment. And overall, we hope that that will achieve an improvement in their quality of life.

So looking forward, I touched on that the relationship is not always so straight forward. So when we look at outcomes after a stroke, what they noticed is that just because you do not have an improvement of the impairment does not necessarily mean you cannot have an improvement of disability.

There are strategies. There are means of improving independence that can sometimes not mirror improvements of impairment. And the cause behind this is that there's multiple factors that influence the outcome on the activity, limitation of participation, restrictions on quality of life after a decline in body function. The improvement of the impairment alone is not the only factor.

So looking further into functional independence, it's really difficult to measure, to quantify, to judge, to compare outcomes, to compare processes, to compare treatments when it comes to looking at function and independence. When you look at the research that is done, the manner in which improved function and increased independence post-stroke are measured can vary.

The quality sometimes of the research is lacking. When we look at confounding variables that are sometimes not corrected for, age, previous strokes, severity of paralysis, social support, and then the natural recovery. How much of what we see can we attribute to the interventions that we've done apart from just time?

Lots of the studies are lacking in terms of sample size. The length of time that some of these studies go out limits how you can generalize in terms of long lasting return of the function. And then, there's the ethical dilemma of trying to develop a randomized controlled trial when it comes to interventions in patient rehabilitation.

So when we look at measuring function and independence, you're going to see several different measures. One of the simplest ones that any clinician can do who does a physical exam is find impairment. And that is probably one of the quickest ways you can find impairment after a stroke, the most readily available.

There are other scales, such as the National Institutes of Health Stroke Scale. You can look at upper limb motor scales from the Fugl-Meyer scale. There's a multitude of impairment measures that are used across research studies. And they're not all shared. There tend to be some that sometimes are used in this country versus a different country, between one institution and a different institution.

I listen here some of the just most common ones that you will typically find across institutions and across research studies. So when we look at measuring function and independence, you look at disability measures. One of the most common ones that we use here in the United States is the FIM score. And the reason that the FIM score is one of the most commonly used is because it's tied to the Centers for Medicare and Medicaid, which is a big driver in terms of what resources are available to patients, what body is really governing the criteria for getting some of these services you look at, Medicaid and Medicare, and how they measure someone's level of disability.

But it's not the only measure. There's the Barthel index, which looks at activities of daily living. There's the Frenchay Activity Index, which looks at a little higher level ideas, or some research actually just looks into disposition. If you're able to make it home, that itself speaks to a high independence level, versus if you had to go to a skilled nursing facility.

So overall, if you look at the rehabilitation pathway at the very top, you see the ICU or acute score. That's where the patient with stroke presents. And then, the hope is that they move on to the next level care, whether that be an LTAC, or long term acute care hospital, inpatient rehab center, or skilled nursing facility, or if they're lucky enough to get home with home health care or outpatient therapy.

If you look at all the pathways, it's an oversimplification that looks very linear because they all sort of lead to home. That's pretty much everyone's goal. But as we know, not everyone makes it home. And not everyone has such a linear pathway. Sometimes, you can move up and down along the pathway. So we'll touch a little bit on that, as well.

So when we look at the rehabilitation of the stroke patient, rehabilitation starts almost immediately after someone has suffered a stroke. It starts in the ICU if they must be admitted to the ICU. It starts on the acute floor if they're stable enough to be in the acute floor. But there's many barriers when it comes to doing early rehabilitation. There are many factors that play in and perhaps explain why not everyone gets rehabilitation as soon as they potentially could.

There's a section that lines or drains chest tubes, or intubation are barriers to doing rehab. If the patient needs to be sedated due to the medical condition, that can also be perhaps a barrier to rehabilitation. A medical acuity or instability, so what they're prioritizing first is trying to keep the patient alive. So that might not leave time to focus on trying to improve function just at that moment.

The resources of the facility that you're at, whether or not they have the staff or the equipment or the training of staff. Pain can sometimes be an initial limiter to rehab. Participation, and fear on part of the patient or perhaps even the staff when it comes to rehabbing someone who's on the acute floor or who's in the ICU.

And overall, when we look at the length of stay in the hospital or in the acute floor, the time is pretty small. The median length of stay for someone in the US with an ischemic stroke is only four days. So if they're only staying in the acute side for four days, odds are they're focusing mostly on stabilization in the medical care of the patient.

So if you take nothing away from this talk other than this one slide, that would be a success. No matter what study that you look at, no matter what consensus statement, no matter what group of experts or consensus panel, the big takeaway message, the consistent message, no matter what degree of evidence or lack of evidence, is that the best approach is a team approach using interdisciplinary care amongst multiple specialties.

This is not all inclusive. There are some people that are left out in this image here. But at the center, it's the patient and the caregivers and the patient's family who buy in to this process. And really, everyone in that process really needs to buy in if you're going to have a team approach. And it's been shown to improve outcome when we're talking about recovery and increased independence after suffering a stroke.

So when we start looking at rehabilitation in an acute setting, what is the main goal of doing rehab in the acute setting? So the first thing or the thing that you're going to focus on is optimizing function and condition in preparation or anticipation of the next level of care. So what does that mean? That means identifying impairments. Like I said, one of the first things you can do is a physical exam.

Engaging in your resources. That means engaging your therapist to help you identify some of those impairments that might not be so readily apparent. Prevent complications which can impact future rehabilitation. So that, I gave examples of skin breakdown or a fall. So you're trying to set up the patients for success so that when they do move on to the next level of care where the focus then becomes rehabilitation, they're not focusing all their time on trying to manage the medical complications. They can focus most of their time dedicated to rehabbing the patient and participating in therapy. That way, you can try to minimize the time that it needs for a new diagnostic test, new therapeutic treatments apart from rehabilitation.

Even at the acute state, you can already begin education. Education of the patient, if they're cognitively intact, education of the patient's families. Discussing how the stroke-- how did the impairments impact them? How has it led to disability? What to expect, educating them on the system that we live in, and how they're going to progress through the symptoms.

And some of the barriers they might not have thought of originally, that may impact them later. Education in the beginning is very important because sometimes it takes that message to be carried over multiple times before that message can sink in. So you may have delivered that message five times. So if you're going to have to deliver it five times, better go ahead and start.

So when you look at rehabilitation in an acute setting, I'm talking about in the ICU, I'm talking about in the acute floor, first thing we talked about was identifying impairments and engaging therapists. What can the therapists do for you?

They can begin mobilization. Now, mobilization is a very general term, very generic. What does that mean? No one really knows what that means. If you look at the research studies done at early mobilization, the what, the when, the how much in the stroke population is not well established. Does mobilization mean just doing passive range of motion in bed? Does that mean getting the patient out of the bed into a chair? Does that mean getting the patient up and walking? How early? What does that mean? Does early mean 24 hours within stroke, 48 hours, or within the first week?

So there's no real consistency across studies when it comes to the definition of mobilization or even earlier. Interesting topic, it was thought that early mobilization could help benefit, help expedite recovery after a stroke. But as discussed, early is not well-defined. And there is the potential that there is a such thing as too much, too soon.

One of the studies that was done by Bernhardt looked at outcomes from patients who began mobilization, getting out of bed in patients who suffered both ischemic and haemorrhagic stroke had less likelihood of a better outcome three months post if they began rehabilitation within 24 hours.

The control group won't begin on average rehabilitation five hours later. So that's a pretty small margin there in terms of time. Mobilization can include range of motion exercises, things you can do in the bed, including strengthening with resistance bands, compensatory techniques, and then improving endurance and therapy tolerance. All of this is in anticipation of the next level of care.

So we talked about beginning rehab. The next thing is to prevent the complications which can impact future rehabilitation. One of the banes of stroke is falls. How do we prevent falls? And unfortunately, there is a good body of evidence, or at least a volume of evidence or research done when it comes to preventing falls in the general geriatric population. But unfortunately, strategies that impact falls in the stroke population, specific to stroke, is not as robust.

So we look at the stroke patient as having impairments that predispose them to having a fall. So we've looked at the side of the stroke, right side greater than left side sometimes is thought to lead to a higher risk of falls. Neglect or visuospatial deficits, that refers back to having this stroke on the right side versus the left side.

Behavior, so we look at impulsivity in the stroke population. We looked at a patient who suffered stroke on both sides. We looked at a patient who has cognitive deficits, which is confusion. They have poor ADL performances. If they have urinary incontinence.

Some of the most driving forces in human nature are the need to eat and drink, and the need to eliminate. And that can sometimes override all reason. So they're going to pop out of bed if they have impaired insight and need to void. And sometimes, there are things that we ourselves do to the patient that then makes them a risk factor for falling. So if we give them sedatives or medications that confuse them, or give them medications like diuretics, which cause them to want to void more frequently. That can also potentially predispose them or increase their risk of falling.

So again, I touched on this before. The evidence, when you look at fall prevention in stroke, is not as robust. And when it comes to-- because the evidence is not as robust, our treatment strategies are not as evidence based. But nonetheless, there are some there that I think we should continue to employ.

So we look at adequate staff supervision to patients. It's hard to get carried away with that. And everyone goes, yay, we need adequate staff. But does anyone really know what that means in terms of patient to staff ratios? We're look at fall prevention education. We're looking at trying to train the patient as much as we can in order to maximize strength so that they will have a decreased risk of fall.

We look at trying to improve balance because we know where there have been studies that showed that the Berg balance scale is a good predictor of whether or not a patient is at an increased risk of fall. We look at different fall scores. We look at doing cognitive therapy, trying to improve cognition.

Sometimes, we have to resort to using restraints when appropriate to prevent falls. And educating family members who may think this is some form of cruel or unusual punishment when it comes to using restraints.

Sometimes, can use technology, such as bed alarms, chair arms. And then, again, speaking to the incredible need to void, trying to use timed voiding or prompted voiding in trying to decrease that urge.

We'll look again at the [INAUDIBLE] acute setting. It's a little bit different in terms of the way someone falls in the hospital and the way they fall at home. It tends to be that the majority of the falls that occur in the hospital tend to happen with transfer activities or attempting to do a transfer without the supervision, whereas at home, it tends to occur with walking. We look at this pyramid or triangle, which is a vicious cycle where there's a fear of falling, that then leads to reduced levels of physical activity, and then that leads to deconditioning, and then that leads again into loss of independence, and fewer community interactions, and social isolation, which then perpetuates that sort of fear of falling. And that's sometimes a cycle that's hard to break.

So bringing ourself back to the rehabilitation pathway, we talked initially about where we have starts at the very top in the ICU acute floor. And where do we go from there? We were looking at rehab strategies either in the long term acute care hospital. We look at rehab strategies in the inpatient rehabilitation setting, the skilled nursing facility, or at home, which may mean home health care or outpatient therapy. And we'll touch a little bit on each in a minute.

So what is the optimal pathway? Whether or not it's optimal or not, lots of times, the decision is made by a multitude of factors. Just from my own personal experience, there's a big push to get patients who qualify into inpatient rehab settings.

Most of the studies that are out there looking at inpatient rehab tend to have better outcomes when comparing patients who go to a skilled nursing facility. However, there are some large limitations to those studies. A lot of them, in terms of their design, are observational designed. Lots of times, they're in or they have a limited number of facilities.

They are baseline deficits-- you know, the patient that makes it into the inpatient rehab facility is not a random sampling. Those patients are pre-selected based off certain criteria. And when they do research studies trying to account for those baseline differences, you really are taking a bit of a leap of faith in some of those statistical methods. Maybe the statisticians wouldn't like me saying that. But like I said, I can say whatever I like.

So talk about the LTACH. So LTACH stands for long term acute care hospital. If you look at the breakdown of the Medicaid and Medicare paid patients, you didn't really see a percentage for long term acute care hospitals patients. That's because the majority of patients after stroke don't go to a long term acute care hospital.

The stringent criteria, and the need for long term care with ventilation dependent care and pain management and really judging someone needing to have care at that level beyond 25 days will limit the amount of patients that meet criteria for a long term acute care hospitals. But even in a long term acute care hospital, you can continue the rehabilitation process.

But overall, they do provide, I would say, a relatively small proportion of the post-stroke care, or post-stroke rehabilitation. We're not going to stress too much about the LTACHs. The next thing is inpatient rehabilitation.

The big driving force into who makes it into inpatient rehabilitation of course again is Medicare, or the Centers for Medicare and Medicaid Services, who define the criteria. And they're the criteria that all other payer systems are following. So you are going to need a multiple therapy discipline, PT, OT, speech therapy, or even prosthetics or orthotics. That's not very unique, but it is a criteria.

You're going to need-- patient's going to need the ability to participate in three hours therapy per day, five days a week, averaged out. You're looking at 15 hours of therapy a week. And some patients just are not at that endurance level. And they by criteria standards need to be day one of inpatient rehab.

To a certain degree, you're going to have to use your best judgment, clinical knowledge to anticipate that they're going to be reasonably-- and that's a very elastic term-- be reasonably expected to actually participate in therapy and benefit significantly. That's another elastic term with the rehab program. They have to be at a medical level where they require supervision face to face from a physician three days a week.

And you're going to provide for them an interdisciplinary coordinated team approach. So some of the factors that a clinician looks at when they're trying to look at, what pathway will fit the patient after their stroke? What is the best pathway to deliver that rehabilitation process?

We look at some of the severity of the residual deficits. We look at the cognitive and communicative ability, their psychological status, which may be also a barrier as the previous talk talked about progression with function. We look at their swallowing ability, what their pre-morbid functional ability was, as well. Very important at predicting their potential for future recovery.

Some of their medical co-morbidities. You know, if there's something that's going on that would preclude them from participating in therapy. The level of family or caregiver support. If you're looking at a patient who has severe deficits, and though they are anticipated to make improvements, but not to the level where you expect them to make it back into the community setting, that too can be something that will perhaps limit their ability to get into inpatient rehabilitation. And that sort of speaks to the likelihood of returning to the community living setting.

And then, there's the ability to participate in the rehabilitation program. Sometimes, it's ability. Sometimes, it's willingness to participate in the rehabilitation program. You look at skilled nursing facility level.

Sometimes, it's referred to as the subacute path. The criteria set forth by Medicare services looks at needing on site a minimum eight hours a day skilled nursing services that they do provide rehabilitation services, but they're not held to that same standard, that same criteria of 15 hours a week.

The care must follow a physician's plan. But it's not at the level where you need a physician to see you three days a week. And so there's a difference between skilled nursing facilities and a nursing home. Sometimes, patients get those two confused, and they think one means the other.

When it comes to Medicare, patients tend to use their short term benefit to get into a skilled nursing facility. They have 100 days per year. And then, they're able to then transition to the long term benefit, or the nursing home level, if they haven't progressed enough that they can make it back out into the community setting. So there's some differences there.

When we look at the home and community, basically we're looking at outpatient therapy or home health. So with outpatient therapy, you're looking at someone having the ability to be transferred to the outpatient site. Can they get from their home to that outpatient rehab? Sometimes, that's limited by finances. Can they pay their gas? Do they have a family member who can then transport them? Are there outpatient facilities in their community?

We serve a very wide population here in Winston-Salem that covers multiple counties where some of it's very rural. You look at the therapies that are provided in the outpatient center. You can have PT, OT, speech. And the plan to care is certified by a physician. So there's still that physician oversight their.

Vocational rehab, so getting at the tail end, it's something that's available to patients after about six months or a year of disability. But that's another resource out there when you're really trying to maximize their functional gain and getting them back. The primary goal of vocational rehab is it's a vocation. So getting them back into the work environment that the patient wants to get back into.

They also look at home health care. From a Medicare standpoint, they have to be certified as being homebound by physicians. That means unable to leave from the home except to receive medical care, or to have occasional non-medical trips. And the skilled therapy is provided in that home environment.

So what are the rehabilitation strategies, regardless whether or not they're in the LTACH, they're in the inpatient rehab, they're in a skilled nursing facility, or they're getting home health care, getting outpatient therapy? You want to identify and mitigate common complications. There are many complications happening after stroke, but these are some of the most common that will inhibit someone's progress with therapy.

Not going to talk too much about depression because that was already discussed in the previous talk. But we'll talk about a couple of them like shoulder pain, fatigue, hypersomnia, incontinence, and then spasticity.

Then, the second part of that strategy is looking at what are the impairments that occurred in that particular patient after stroke, and what can we do to improve or mitigate the effects of that impairment?

So as you can see in that picture there, that person is grimacing. There's lines coming out of the stroke. This gentleman must be suffering from shoulder pain. Shoulder pain is very common in the post-stroke patient, particularly in the patient who's hemiplegic, who has paresis, weakness of that limb.

The cause of it, the differential diagnosis of shoulder pain is exhaustive. It can be coming from a central-- from the stroke lesion itself. It could something known as complex regional pain syndrome, which is a diagnosis exclusion, poorly understood and with limited treatment-- well, there's a multitude of treatment options, but limited proven treatment options, I should say. Peripheral nerve injury for traction on the nerve. You can look at increased tone in that limb causing the pain.



Joint capsule dysfunction, which is a mechanical problem, or ligamentous strain, muscle strain, radiculopathy, or really nerve pain coming from a neck origin. Tension on the brachial plexus, thrombophlebitis, either from an infiltrated IV site, a DVT, or unrecognized trauma. Again, sometimes patients with a stroke present after a fall. Infection could be going on. All these things can limit a patient's participation in the rehabilitation process.

So when you look at shoulder pain, most consensus is that it's probably multi-factorial, combination of shoulder tissue injury, joint mechanics, and perhaps a hypersensitivity that's mediated by the stroke itself. Interesting study looked at the mechanics of a shoulder, a weak shoulder and stroke. And they screened everyone using ultrasound and found significant findings, which included effusion in the shoulder. It could include tendinopathy of the tendons. It can include rotator cuff tear.

The thing with this is just as we found-- findings from ultrasound did not always correlate with that patient developing shoulder pain. So the relationship being one to one is not very clear. So shoulder pain, what can we do for the shoulder pain? What do we do for shoulder pain?

One of the rehabilitation strategies is to make sure the patient has proper positioning. We use lap trays. We use arm troughs to try to prop that arm up to release some of the tension on that arm. We try and maintain range of motion. This is again trying to fight some of the spasticity that we might think contributes to the shoulder pain.

We tried actually improving, strengthening the arm. The shoulder in and of itself was an unstable joint. It relies on the strength of the shoulder to actually maintain your shoulder in that joint capsule. Sometimes, we do use slings during ambulation in particular to help protect the arm or the shoulder from traction injuries.

We can use strapping, which may mean kinesio taping or various other types of taping. Unfortunately, the research on that really has mixed results as to whether or not that leads to improvement in shoulder pain. And sometimes, we can use modalities such as transcutaneous electrical stimulation or neuromuscular electrical stimulation as well. Unfortunately, again, the efficacy in treating pain or preventing pain is really yet to be seen in those interventions.

We talked a little bit about shoulder pain. One of the most common complications after a stroke that can inhibit progress with therapy includes fatigue. Very common after a stroke, and sometimes very common to identify the underlying cause. Common causes, hypothyroidism, anemia, renal disease, diabetes, inflammation, cancers, autoimmune disease, sleep disorders, infections such as pneumonia or UTI, which patients with stroke are predisposed to.

Sometimes, what we give, tricyclic anti-depressants, beta blockers, benzodiazepines, and depending on the location of strokes, sometimes anti-convulsants can lead to a picture of overall fatigue and decreased participation in therapy.

Talk a little about urinary incontinence. Causes of it can be varied, whether it be from the stress or hyperreflexia, so overactive bladder, cognitive impairment with normal bladder function. So the patient's not really having the wherewithal to let you know that they have to go to the bathroom. Overflow incontinence secondary to a weak bladder. Urinary tract infections or pelvic floor weaknesses.

Things that we try to do to mitigate that, again, try to do timed voiding. I know I talked a little bit about medication that can cause sedation. Unfortunately, one of the medications that can sometimes help with overactive bladders, anticholinergic medications, trying to relax that bladder enough that you can hold onto a little bit of urine.

Sometimes, using daytime mobilization to try to eliminate some of that urine during the day time when it's less convenient than at night, and then perhaps using strategies such as evening fluid restriction, so they're not having to go at night. It's probably not a good idea to drink that jug of water at your bedside right before you go to bed.

Spasticity, the bane of inpatient rehab. So spasticity is defined, very well defined, as a velocity dependent increase in resistance to muscle stretch. So when we have spasticity, we don't really want to have to spend a lot of our rehab time trying to overcome spasticity. We really want to focus on neurocognitive therapies.

But when it's there, we really have to address it because it's going to be a ceiling to what we can achieve sometimes. So treatment strategies are to remove painful input. Painful input can actually make spasticity worse, whether it be from infection or other painful stimuli.

We try to preserve the range of motion. We try to improve positioning in order to maintain ranges of motion. One of the most common interventions for spasticity, especially in the wrist, is use of the resting hands plane. Unfortunately, the evidence hasn't really proven that they're effective at preventing the progression of spasticity in the wrist. And its recommendations can vary depending on which body you listen to.

The Veterans Administration happens to recommend the use of night time wrist clamps in patients with specificity and hemiplegia. And in the UK, actually their consensus statement is not to use wrist clamps. We have different modalities, and we have medications whether they be oral or injectable.

Now, some of this may be limited to what setting you can use it due to reimbursement issues, although definitely in the outpatient setting, botulinum toxin is a viable option. That's been proven to help.

Now, we look at approaches to therapy when it comes to-- we begin to switch gears to the approaches of therapy. We dealt with the complications. Now, how do we improve the impairments? So we look at hemiparesis and hemiplegia, which are motor deficits.

Now, the mainstay of therapy is doing range of motion strengthening repetitive tasks, specific tasks, doing those tasks over and over again. But there's certain nuances and certain, what should I say, thoughts or theories as to how you should maximize functional improvement after a stroke.

So different schools of thought might be-- one example is PNF, proprioceptive neuromuscular facilitation, where they use more spiral and diagonal components of movements in order to achieve more functional patterns, whereas the Bobath approach used by therapists tries to inhibit the primitive patterns of movements and facilitate more normal movement patterns. So synergistic movements are discouraged.

The Brunnstrom is almost a complete opposite of that, where the thought is that the primitive reflexes, the synergies, those abnormal movements are actually normal in the beginning. It is a part of the normal process for recovery of motor function. You have other techniques, as well, so the sensorimotor approach and the motory learning program.

The difficulty with all these different approaches, probably the most common used one is probably the Bobath approach or the NDTs, is there's no real good evidence or research that will compare one versus the other that really shows a consistent superiority of one over the other. So there's a little bit of limitation in terms of what can be recommend for the [INAUDIBLE].

So when we look at the weakness and motor deficits, other interesting approaches include constraint induced movement therapy. The best evidence for constraint induced movement therapy comes from research that's done six months, around six months out of their stroke. So six months is classically thought to be the time period where most of the recovery after strokes is going to occur.

And so what they did in the study, they're trying to eliminate the improvements that come from traditional therapy from just mother nature taking its time with recovery. Constraint induced movement therapy in practice may be a little bit limited in that the limb must have some movement in it. So not everyone may benefit from constraint induced movement therapy. And that the intensity of therapy is pretty significant. And with our current system, our payer system, it's not really open to most individuals.

The other interesting technique that is somewhat a little out there is eletromyographic biofeedback. So this uses external representation, whether it be in auditory or visual form, to help give the patient cues as to some of the internal activity as a way of assisting modification of their voluntary motor control. So they have electrodes attached to their arm. Those electrodes are attached to a screen that may cause a blip to go up on a graph, or a color to change when they attempt movement with the arm.

So further approaches into therapy dealing with-- or staying on topic with the hemiparesis and hemiplegia. We look at a picture there of a body weight supported trip device. So this is a device that you can harness a patient to. And there's many different forms of body weight assisted therapy whether it be in a form like this, or maybe robotic therapy.

The thought with body weight assisted support treadmill training is that it provides upright posture. It minimizes fall. How can they fall if they're strapped into the device? And it facilitates a normal gait pattern.

The evidence really hasn't proven that the body weight support system is any more efficacious than the more traditional methods. Doesn't really account for perhaps the amount of therapists that you're going to need to use if the patient really is that weak. But overall, if you're just looking at functional outcome, there's no real [INAUDIBLE] that we [INAUDIBLE] superior to our traditional methods.

One of the other therapy modalities that is often used after [INAUDIBLE] that therapists use, that therapists love, that patients love is the use of aquatic therapy. Unfortunately, when you look at the evidence, it's lacking. To really confirm or really refute that water-based exercise after stroke actually improved gait and gait related activities. So this in no way means don't use aquatic therapy if it's at your disposal. Because goodness, any amount of movement if you're having trouble getting someone to mobilize is a good thing.

But just know that the evidence out there is still lacking. So everything up to this point when we talk about rehab strategies is trying to reverse the impairment, trying to make the impairment better. But as we know, sometimes you can improve independence. You can improve function without improving the impairment.

So how do we do that? We use that with compensatory strategies. So using devices. So in the hemiplegic patient, there's a multitude of devices. In that picture there, you see a long handled shoe horn. You see a reacher. You see a saccade. At the very bottom, some of the best evidence for improving function with a device uses AFO, or ankle foot orthosis, which can improve gait, which can improve independence with weakness after a stroke.

So this is one of the ways in which that relationship between impairment and disability is not always linear. You can improve independence or function despite not having an improvement in the impairment itself. So we talked a little bit about weakness, motor strength.

The other thing, the other strategy, the other complication after stroke as you can see in this gentleman here who's coughing with water is he can't swallow. So he suffers from dysphasia. When you look at the body of recommendations out there, there's a pretty good consensus that early dysphasia screening should be done. But there's no real consensus on which instrument to use to screen for swallowing.

When it comes-- so that's identifying the problem. When it comes to trying to work with the problem, we look at compensatory strategies. These are strategies that can be implemented in the acute setting, inpatient rehab, or skilled facility, or even on outpatient sites.

We look at doing chin tucks, which would facilitate forward motion of the larynx, trying to protect that airway if the patient has the cognitive wherewithal to do that. Or if they have a caregiver who's able to prompt them to do the chin tuck. We have head rotation, which tries to close the ipsilateral pharynx, so you try to close the paretic side.

The head tilt, try to guide the bolus of food into the stronger side. Supraglottic swallow, so holding your breath at the same time as swallowing, getting the patient to do that. Upright positioning for feeding, that's a simple measure that anyone can really employ. And then, dietary modification, that's really speaking toward diet changes, whether it be changing the allowable consistency of liquids or the solids.

When it comes to dysphasia, there are different tools in the bag of the speech therapist. They can use treatment modalities. When it comes to the evidence for long term efficacy for dysphasia, unfortunately a lot of those modalities have inconclusive evidence there that includes pharyngeal electrical stimulation. That includes physical stimulation, so tactile. That includes methods such as direct current stimulation or transcranial magnetic stimulation. I don't see too much of the last two. But what I tend to see most often are the first two.

So another thing that speech therapists can work on is aphasia. So that's the difficulty with speech. So strategies there, we look at trying to recover some of the communication. We look at some of the strategies that they employ include silent rehearsal, so practicing social prompts, self-cueing, attending to the speaker's face, self-monitoring comprehension. We look at compensatory strategies for these disorders.

So instead of trying to use spoken language, we look at drawing, gesturing, describing objects if you're not able to come up with exact words. Sort of tip-toeing around it. We'll look at assistive communication. This has to do a little bit more with devices. It can be as simple as a communication board. It can be a pencil and paper. It can be a smartphone or speech generating device.

When you look at the recommendations across different groups of experts, there is a general consensus that intensive treatment is favored. But can they define what intensive treatment really means? No, just like early, just like the word mobilization, intensive can mean many things. So there's no real amount of intensity or distribution or duration of treatment that can really be recommended from the research.

So moving on, we look at dysarthria and apraxia of speech. These are motor deficits of speech. And how do we try to address those? Most of the treatment has to do with behavioral treatments and compensation.

When we look at behavioral treatments, things that they try to do to physiologically support speech include improving respiration, phonation, articulation, and resonance. Again, when it comes to consensus, you're not going to find a lot of consistency when it comes to consensus when it comes to recommendation on timing, frequency, the type. And again, the level of evidence to really give one a support is lacking.

A lot of our treatments can also include compensatory strategies again using picture boards, portable application systems, electronic devices with eye tracking capability. So these are ways in which you can not necessarily improve the impairment, but you can improve the disability. Now, just with technology and compensation strategies alone.

Cognition is a big one, as well. The strategies when you look at trying to improve cognition looks at trying to restore and re-establish cognitive activity. When someone suffers from a stroke, if they suffer from cognitive deficits, lots of times, they lose their personality with that. And family members really want to get their loved one back to where they were before. They want to be able to talk with the patient they used to talk with. They want to be able to interact with that person with that same personality.

So we do everything we can to try to reestablish them as close as we can back to their baseline. So we try to restore or reestablish cognitive activity. Unfortunately, sometimes we're not able to get them at that point. So we have to implement strategies to compensate for their impaired cognitive function. How do we do that?

We use adaptive techniques and equipment to try to again increase independence. So this is trying to increase their disability without necessarily increasing or decreasing their impairment, I should say. Again, this is going to be a recurring theme when it comes to the effectiveness of our strategy, when it comes to effectiveness of our therapies.

The research is going to be lacking-- the studies, the quality, the size, and just the sheer number of studies is going to be lacking when it comes to the effectiveness of cognitive therapy. When you look at-- there have been Cochrane review articles on these strategies. Cochrane itself is going to have some limitation.

What Cochrane does is they try to make up for the quality of evidence by pooling all that evidence together. But then, the question becomes, how generalizable can you make those recommendations?

But in the end, when you look at the Cochrane reviews of some of the strategies to improve cognition after stroke, the attention can sometimes be improved. But when it comes to executive function after stroke, really that remains to be seen. Really not a lot of evidence to support that.

And this brings us to the last aspect of the talk today, when we look at hemispatial neglect, which is a part of cognition. There are a multitude of strategies we use despite the lack of evidence-- and we will continue to do that, because really, what's in our tool box is a little limited. We use devices such as prism meditation, eye patching, trying to stimulate that visual field on the affected side. We do cueing and sometimes stimulation. All in all, though, again, that reoccurring theme, effectiveness of rehabilitation strategies [INAUDIBLE] remains unproven.