DIRECTIONS

HOW CAN WE OPTIMALLY SET UP A MANUAL WHEELCHAIR FOR EVERYTHING THE USER NEEDS TO DO?

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FROM THE EDITOR-IN-CHIEF

Summer 2024 is knocking on our doors! Truly, where does the time go? This issue features pertinent articles for your practice. I'd also like to remind you about the robust iNRRTS continuing education program. We offer relevant, cost-effective programming for the industry and profession through on-demand webinars, live webinars, CEU Article Reviews and the CRT Supplier Certificate Program. Visit https://nrrts.org/education/ for details.

Amy Odom, BS

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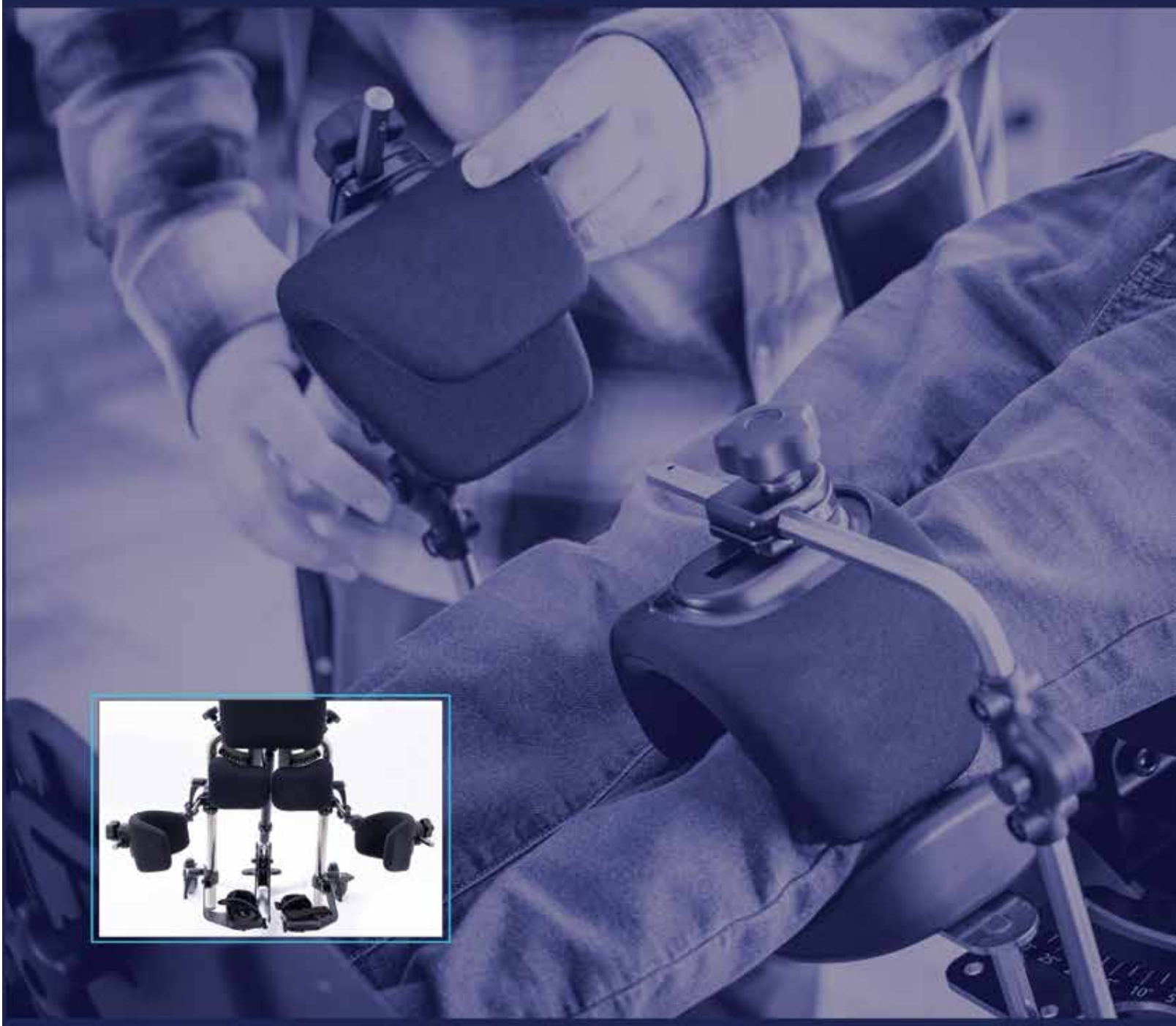

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THE ELITE IN CRT

Written by: **CAREY BRITTON, ATP/SMS, CRTS®**

I maintain excitement about the direction of iNRRTS amidst a period in our history where mediocracy is being accepted over striving to be great. In a time of consolidation of our industry, I am surprised at how many Rehabilitation technology suppliers are not iNRRTS Registrants. The most common responses are: It is not required; I do not have the time; or it costs too much. Other professions have learned if they do not guide the direction of their profession, others will.

Those of us who are Registrants see iNRRTS as a beacon of light, where Registrants are striving to be better. Most of the Registrants I speak with found the organization while they were searching to increase their skills, education and to add a certification, which provides confidence in themselves as well as the clinicians and clients they serve. iNRRTS Registrants treat what they do as a profession and not a job, striving to be the best, and separating themselves from others who do not have the same vision.

iNRRTS remains the only organization that promotes, educates, advocates and supports the RTS; providing access to elevate every RTS, no matter their current skill level. I foresee a future where insurance companies, hospital systems, rehab centers, schools and other systems that utilize Complex Rehab Technology demand a RRTS®/CRTS® be involved in the process to ensure quality outcomes. It is surprising this has not already happened. If you are a consumer, why would you settle for anything less?

In this past year, we have transitioned from a national organization to an international organization. Our journal and our education offerings continue to get better and better. Many committees have been established to incorporate more Registrants to get involved and help guide the direction of our organization. We are attracting more clinicians who see the value in the world-class education we provide. Our active past presidents group has been creating a buzz in their vision for our industry.

In a world that is satisfied on what's acceptable, iNRRTS continues to provide the resources to create elite CRT professionals. This is something each Registrant should be proud of and continue through leadership, education and advocacy to spread the word. If you have not already done so, invite each RTS in your office and show them the importance of the RTS to guide the direction of our industry. Share with your clinicians and customers the value of the RRTS®/CRTS®.

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Carey Britton, ATP/SMS, CRTS®, is president of iNRRTS. Britton works for National Seating & Mobility in Pompano Beach, Florida.

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A CAREER DEDICATED TO HEALTH CARE EXCELLENCE

Written by: **ROSA WALSTON LATIMER**

Sandi Noelting has 29 years of experience in the health care industry and is the learning management system administrator at iNRRTS. Sandi's husband, Bill Noelting, is the organization's director of marketing. As a diversion from the exacting, detailed aspects of her work responsibilities, Sandi, a self-described foodie, has published a cookbook, and she and Bill produce a regular podcast featuring restaurant reviews.

Sandi Noelting, iNRRTS learning management system administrator.

> WORKING FOR AN OUTSTANDING ORGANIZATION SUCH AS iNRRTS IS AN EXCELLENT OPPORTUNITY. ITS DEDICATION TO EXCELLENCE AND SERVICE TO ITS REGISTRANTS AND THE INDUSTRY AS A WHOLE INSTILLS A STRONG SENSE OF PRIDE IN MY WORK.

TO BEGIN, PLEASE TELL US THE BACKGROUND OF YOUR HEALTH CARE CAREER.

Before I moved to Nashville, I worked in retail, but I could not transfer because the company didn't have a store in the Nashville area. I decided to go to college to add specific education to my work experience. I believed if I could manage a retail store, I could manage a doctor's office or clinic. I attended Draughons Junior College in Nashville, Tennessee, a private school that offered a specialization in health care related professions. Because I graduated summa cum laude, along with the reputation of this particular school, I was immediately offered a job. I first worked in the physician's department of an accounting firm. My job was to help address any problems with procedures or billing in our clients' offices. After leaving the accounting firm, I worked for a home health company, where I reviewed the nurses' paperwork to ensure everything was in order before submitting for reimbursement.

I was manager of supplier products and data with National Seating & Mobility for 19 years. One of my strengths is managing details and coordinating information. I loved this job immensely! My responsibilities included ensuring all our data, costs and pricing were as accurate as possible for our rehabilitation technology suppliers, our customers, and the billing department.

My job at NSM was very demanding, and after almost 20 years, it became too much. I worked all the time, even on vacation, and I decided I needed to take a break.

YOU INTENDED TO GET SOME REST, BUT YOU TOOK ON A SIGNIFICANT PROJECT INSTEAD. WOULD YOU TELL US ABOUT PUBLISHING YOUR COOKBOOK, "RESPECT THE RICE"?

I thought I would want to rest after leaving NSM, but I soon became bored. I had wanted to put a cookbook together and decided this was the time.

When Bill and I each had corporate full-time jobs, we often ordered take out. Our favorite seemed to be Chinese, and we almost always had a leftover container of rice in the refrigerator. I never liked throwing food out ... ever. So, after a while, I had to stop the madness, and when I did cook dinner, I began to incorporate the leftover rice into whatever I was making. I started writing down my favorites and searched for new and different ways from around the world to use and reuse rice. Most recipes are straightforward and usually require rice and a few ingredients you most likely have in your pantry. I took all of the photos for the book and thoroughly enjoyed the experience of putting the book together. Copies of "Respect the Rice" are available for purchase at Barnes & Noble online, and I plan to offer them in e-book format soon.

HOW DID YOU COME TO WORK AT iNRRTS, AND WHAT ARE YOUR RESPONSIBILITIES AS LEARNING MANAGEMENT SYSTEM ADMINISTRATOR?

Sandi and Bill Noelting

After the cookbook was done, I was bored again. When I was ready to return to work, I made inquiries to see what might be available. Our industry is a close community, and when word got out that I was looking for a job, Weesie Walker (former NRRTS executive director) offered me the position of learning management system administrator.

In this role, I ensure everything is in place and functioning correctly to facilitate the process of someone wanting to further their education and earn a certification or CEUs. I enter the information into our systems and ensure all information is correct — the online test or evaluation, the individual's login information and email, and the resulting certificate. This process needs to go smoothly, and I like working in the background to help make the experience positive.

CONTINUED ON PAGE 8

Peony bushes line the walkway of the Noelting's home in Franklin, Tennessee, near Nashville.

The cover of the cookbook Sandi Noeltingi wrote and published.

INDUSTRY LEADER
(CONTINUED FROM PAGE 7)

Working for an outstanding organization such as iNRRTS is an excellent opportunity. Its dedication to excellence and service to its Registrants and the industry as a whole instills a strong sense of pride in my work. I appreciate that iNRRTS fosters a culture where employees are encouraged to develop and apply their strengths.

WHAT DO YOU DO FOR FUN WHEN YOU AREN'T WORKING?

I was born in Avion, France, and with that French influence came my love for cooking, which also led to the idea of a cookbook. My parents were children of World War II, and they wanted a better life for their 3 children. An aunt who lived in New York sponsored us, and that is where we entered the United States when I was three years old. We ended up in Chicago, and I grew up in downtown Chicago. Because I was young when we left France, I've always felt that the United States was my home. I traveled back to France a few times with my mother to visit relatives, and I admit that I liked the food there better. There are things in France that you simply cannot get here.

Bill and I enjoy trying different types of food and restaurants. When we eat out, we critique how our food is presented or whether we would cook something differently. At first, we joked about writing notes on our experiences and doing a podcast. Then, in 2019, we began producing the podcast "He Said, She Said Restaurant Reviews."

We enjoy traveling and often discover new restaurants to review on our trips. In April each year, we go to Key West, Florida, to celebrate Bill's birthday. In August each year, I go to Las Vegas because I love going to CanyonRanch, a resort and spa there.

We live on a little more than 5 acres of land in Franklin, Tennessee, just south of downtown Nashville and enjoy gardening. We grow a variety of things – tomatoes, lots of herbs and flowers. I grow orchids in a greenhouse that Bill and I built. We have a lemon tree that is doing fabulous this year. I am very excited about having fresh lemons!

Sandi may be reached at SNOELTING@NRRTS.ORG.

Sandi Noelting lives in Franklin, Tennessee, with her husband of 19 years, Bill Noelting. She is the learning management system administrator for iNRRTS and has almost 30 years of experience in health care administration and management. She is also the author of a cookbook, "Respect the Rice," available at Barnes & Noble https://www.barnesandnoble.com. The couple produces a podcast, He Said, She Said Restaurant Reviews, available on all podcast channels and at https://HeSaidSheSaidRestaurantReviews.com.

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CRT UPDATE: SUMMER 2024

Written by: **WAYNE GRAU**

POWER SEAT ELEVATION

National Coalition for Assistive & Rehab Technology and the Independence Through Enhancement of Medicare and Medicaid Coalition met with Centers for Medicare & Medicaid Services to discuss the pricing methodology and data utilized in the gap-filling method (legislatively approved), which was used to develop the fee schedule of $2,003 for seat elevation (11.5% lower than the preliminary fee schedule). To ensure access for all consumers, NCART and the ITEM Coalition shared their concerns about the impact this low fee schedule could have on consumer access. We want to thank CMS for allowing us to discuss our concerns and provide them with our data so they can review the information. Follow-up information and analysis were submitted to CMS for review.

UPDATE ON THE CONSUMER CHOICE BILL FOR TITANIUM AND COMPOSITE WHEELCHAIRS — HR 5371

HR 5371 would provide consumers with the choice of a lighter-weight manual wheelchair to best fit their lifestyle. Should this legislation become law, consumers can again choose a titanium or carbon fiber manual wheelchair frame. They will be allowed to pay for this upgrade using their funds. Medicare beneficiaries are currently prohibited from upgrading to this equipment, even though it may be the best option to accommodate their needs. The bill was successfully voted out of the U.S. House of Representatives last fall with some amendments added to gain additional support for passage. Lobbying efforts have begun in the Senate to get a companion bill introduced to pass the bill before year-end.

POWER STANDING UPDATE

NCART, ITEM Coalition, Clinician Task Force, manufacturers, suppliers and other industry stakeholders continue to gather more data on the medical necessity of power standing. The groups are also preparing to provide this information to CMS once the national coverage determination process opens. The industry remains focused on meeting with our champions to continue helping them understand this incredible product and the value it will bring to consumers who need this technology.

TO ENSURE ACCESS FOR ALL CONSUMERS, NCART AND THE ITEM COALITION SHARED THEIR CONCERNS ABOUT THE IMPACT THIS LOW FEE SCHEDULE COULD HAVE ON CONSUMER ACCESS.

NCART HIRES INDUSTRY VETERAN – JULIE PIRIANO

NCART has named Complex Rehab Technology industry veteran Julie Piriano to the newly created position of senior director of payer relations & regulatory affairs.

Piriano, who has worked in the seating and mobility industry for 40 years, most recently served as vice president of clinical education, rehab industry affairs and compliance officer for Pride Mobility and Quantum. She is a member of the board of directors for the Rehabilitation Engineering and Assistive Technology Society of North America. She serves on numerous other CRT industry-related boards and committees. "NCART has been an invaluable resource for the CRT industry, and I look forward to working collaboratively with our members to strengthen their relationships with payers and regulators," said Piriano. In addition to her work with organizations in the CRT market, Piriano is a national and international speaker on seating and wheeled mobility, focusing on evaluation, documentation and clinical applications of available technologies.

THANK YOU

NCART would like to thank all NCART Government Affairs committee members. The CRT industry operates in a legislative and regulatory environment where the best policy ideas do not necessarily translate into legislative language. This group (too many to name) comprises experts who ensure that good policy remains at the forefront of everything NCART fights for at the federal and state levels. This group provides great legislative and regulatory advice for all NCART members and for that we say THANK YOU.

BECOME AN NCART MEMBER

NCART is the only national advocacy association of leading CRT providers and manufacturers dedicated to protecting access to CRT. To continue our work, we depend on membership support to take on important federal, state and payer initiatives. Please consider joining if you are a CRT provider or manufacturer and not yet an NCART member. Add your support to that of other industry leaders. For information, visit the membership area at www.ncart.us or email wgrau@ncart.us to schedule a conversation.

CONTACT THE AUTHOR

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Wayne Grau is the executive director of National Coalition for Assistive & Rehab Technology. His career in the Complex Rehab Technology industry spans more than 30 years and includes working in rehab industry affairs and began working exclusively with complex rehab companies. Grau graduated from Baylor University with an MBA in health care. He's excited to be working exclusively with complex rehab manufacturers and providers, Providers, and the individuals we serve who use CRT equipment.

FILER LOVES MAKING CLIENTS' DREAMS OF ALL SIZES COME TRUE.

Written by: **DOUG HENSLEY**

The things many take for granted are the things that give Chad Filer that sense of professional accomplishment.

"There really is nothing like the feeling of delivering a power wheelchair to a person who hasn't checked their mail in two years," he said. "Or delivering a chair that elevates to a person who really wants to make their own cup of coffee."

To Filer, those accomplishments are the sounds of dreams coming true.

For most of the past two years, he has served as an assistive technology professional at Carolina's Home Medical Equipment. The family-owned company is located in Matthews, North Carolina. Prior to that, he was owner of Southeastern Seating and Mobility for the better part of 10 years.

"I specialized in helping with workers' compensation customers after a catastrophic injury," he said. "I consider those my home access formative years and where I learned to look at the 'whole home' perspective as it related to my clients getting back into their home after leaving a rehabilitation hospital."

Filer brings a diverse and specialized background to his current role. He served four years in the U.S. Navy, including one year aboard the USS Theodore Roosevelt (CVN 71) during Operation Enduring Freedom during the first stage of the war in Afghanistan.

Not surprisingly, he said he really enjoys the chance to work with veterans and is able to connect with them because of his own military experience.

"I served in the U.S. Navy on a Marine base and then worked with the Army as a contractor after my enlistment was over," he said. "Having so much exposure to three different branches really helps me relate to several of my veteran customers. I have seen people come back from duty overseas with injuries that affected their lives.

"If my clients are servicemembers, most open up and tell me a little more than they may have normally, once I let them know that I was in the service as well. If nothing else, swapping stories about duty stations is a good way to break the ice. It's a kinship I try to foster and let them know they are in good hands with me and that I understand, at least a little, about what they have gone through."

He holds a bachelor's degree in technical management from Embry-Riddle Aeronautical University in Daytona Beach, Florida and a master's degree in leadership and organizational communication from Northeastern University in Charlotte, North Carolina.

He transitioned into the complex rehab industry about 15 years ago and moved to Carolina's Home Medical in October 2022. In his current role, he works with clients to determine mobility needs and also sets up and demonstrates equipment for them.

"Independent mobility is a powerful thing," he said. "To have that taken away by illness or injury is something I can only empathize with, and I have that conversation very frequently with my clients. But then to have a semblance of that independence brought back into your life is a magical thing to be a part of."

It's all about the final adjustments.

A day in the life of working for a family-owned complex rehab company.

Filer's job is as rewarding as it is exciting. He gets the opportunity to work with people to resolve their biggest challenge. He provides solutions that literally change their lives.

"I really do love the diverse nature of my work," he said. "Being a home access consultant as well as a seating and mobility specialist offers my customers a different perspective as it pertains to their home evaluation and the discussions that we have."

Put another way, Filer's training and certifications, coupled with the company's commitment to its clients, can make things happen quickly.

"As a true one-stop shop, we offer so many different products that can assist them that they end up getting too much information from me sometimes," he said. "I have also been blessed to work with some really good occupational/physical therapists and case managers in the Charlotte market who are passionate about what they do.

"I also have awesome teammates at Carolina's Home Medical Equipment that make my job easier by doing their jobs at a very high level."

These new responsibilities provide him with plenty of professional challenges, even if it might not have been something he saw coming earlier in his career, especially since it allows him to provide higher-touch customer assistance.

"The hybrid role of taking on home accessibility in addition to my ATP (assistive technology professional) responsibilities was not on my radar 10 years ago," he said. "But when you run your own business and you're asked almost weekly if you can do any other items that your customer might need, you tend to get tired of saying no and do some research. So, I started taking one home access item on until I felt comfortable enough to add more."

In his time on the job, he has had an up-close perspective on a number of cool stories, including some that ended in unexpectedly uplifting ways.

"I love a good recovery story," he begins. "I had a customer about a year ago call me and tell me to come and pick up his chair. I just assumed that something had happened, and he didn't like the quality of the chair or he had an accident in it and no longer wanted it."

Turns out, that wasn't the case.

"It seemed that he and his therapist had worked so hard on getting him back into walking shape that he no longer needed the manual wheelchair that I had helped him obtain. He asked me to come and take a stroll with him, and I took him up on that."

Filer understands well that no one gets very far on their own, and he is grateful to a friend and mentor for helping him expand his professional knowledge base.

"Mike Fisher, may he rest in peace, taught me keeping up with the latest seating and mobility technology was going to pay off in the long run for me and my clients," he said. "He instilled in me that attending the International Seating Symposium anytime that I could was a great thing for generating new ideas as there is no such thing as a cookie-cutter model in complex rehab. They call it complex for a reason – everybody is different, and every "body" is different."

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Chad Filer, CEAC, ATP/SMS, CRTS®, is an At-Large Board Member for iNRRTS. He works for Carolina's Home Medical Equipment in Matthews, North Carolina.

HOW CAN WE OPTIMALLY SET UP A MANUAL WHEELCHAIR FOR EVERYTHING THE USER NEEDS TO DO?

Written by: **DEBORAH L. PUCCI, PT, MPT, AND CURT PREWITT, MS, PT, ATP**

Sponsored by: **KI MOBILITY**

EDITOR'S NOTE: This is the second article in a series. Please refer to "How Can We Make it Easier to Propel a Manual Wheelchair?" in DIRECTIONS, Vol. 2, 2024, for the first article.

In the first article of this series, we discussed the science relating to propulsion efficiency of a manual wheelchair, but as we all know, custom manual wheelchair prescription is a complex task. If everyone thinks of an ultralightweight manual wheelchair as a mobility device, should we prioritize propulsion efficiency above all else? While it is important to understand what impacts the efficiency of the wheelchair, professionals need to recognize that a user only propels their wheelchair for a small portion of their day. They need to be aware of all the activities that users perform from their wheelchairs and understand all of the factors that impact each individual's ability to perform them. Finally, they must piece together all this information to understand the complex interaction between the user and their wheelchair. If all of that is not difficult enough, it must be done with the understanding that the prescribed equipment must meet the user's needs for five years or more! With that in mind, we need to do our best to anticipate what may change for that user during this time.

In the face of this seemingly daunting task, how can providers and clinicians confidently move forward to provide the best clinical solutions to meet the mobility needs of manual

wheelchair users? The use of evidence-based practice provides a framework for this complex process. Evidence-based practice is a health care philosophy that integrates client factors and values, clinical expertise and best available research evidence to help guide clinical decisions.[1]

VALUE OF EVIDENCE-BASED PRACTICE

Users often have similar lists of concerns regarding their mobility device. Within the framework of evidence-based practice, the professional must understand that how the user prioritizes those concerns is unique and based on individual circumstances. Their values, priorities and expectations are influenced by many factors. These include their views regarding their medical condition, personal health practices, roles, family structure, support network and environment of use. These individual differences mean that even a goal like independence with mobility might be more important for one user than another. As professionals involved in the prescription process, we are responsible for recognizing and respecting each user's values and priorities for their mobility device. In doing so, we assist them in making choices about their mobility device that align with their personal needs and desires, not our own.

According to David Sackett, a pioneer of evidence-based practice, clinical expertise refers to the proficiency and judgment an individual gains through experience. [1] This accumulation of information available for each provider and clinician includes knowledge gained through their education, experience, shared encounters with users and colleagues, and research evidence. Regardless of the area from which professionals are accessing this requisite knowledge, it is important to recognize that this body of knowledge is constantly evolving. We cannot simply continue to practice as we have always practiced. Our understanding of best practice must be continually substantiated. As Mark Twain once said, "It ain't what you don't know that gets you in trouble. It's what you know for sure that just ain't so."

External clinical evidence from systematic research is crucial to help professionals to ensure they are implementing current best practice. Evidence must be current, peer-reviewed and reflect the most recent developments and discoveries relating to the subject matter. Additionally, professionals must be able to determine the strength of evidence to distinguish between expert opinion and weak or more robust evidence. It should also be relevant and address the clinical question being asked. Combined with clinical expertise, this ensures the evidence is valid and applicable to the situation and user. For example, in the first article of this series, we addressed evidence showing that placing increased system weight (wheelchair and user) over the drive wheels of a manual wheelchair improves propulsion efficiency. [2,3,4] Clinical expertise tells us, however, that we must balance weight distribution with the user's abilities to prevent setting the wheelchair up in a configuration that may be too unstable.

CONFIGURATION AND ADJUSTMENT FEATURES

As mentioned in the first article of this series, custom configuration and adjustability are hallmark features of the ultralightweight manual wheelchair. These features set this category of manual wheelchair apart from all others. Custom configuration allows the chair to be fabricated and set up to meet the needs of an individual user.

CONTINUED ON PAGE 16

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CLINICAL PERSPECTIVE
(CONTINUED FROM PAGE 15)

Adjustability allows the chair the capacity to be modified in the field to accommodate for changes in user needs over time. These features are both the "beauty and the curse" of this class of manual wheelchairs. They increase the complexity of making prescriptive choices yet offer the opportunity to provide a mobility device tailored to each user's unique needs.

Just how complex does the configurability and adjustment of an ultralightweight manual wheelchair make the prescription process? Consider that a single configuration choice or adjustment feature of a wheelchair will impact multiple other aspects of the chair setup. No choice can be considered in isolation. A common example is adjustment of the horizontal axle position of an ultralightweight wheelchair. Adjustment, either forward or rearward, requires subsequent adjustment to the wheel locks of the chair to ensure that they continue to make adequate contact with the tire surface when applied. Failure to do so could have detrimental effects, such as instability of the chair during a transfer. This is just one example of the "domino effect" that requires professionals to carefully consider wheelchair configuration and adjustment at the time of initial prescription, initial fitting of the device and subsequently during follow-up appointments. It is also important to recognize that the specific configuration choice or adjustment does not matter. Any decision or change requires consideration of all other aspects of the wheelchair that might be impacted by the decision or change. This should lead us to a checklist of sorts, like a circular flow chart (Figure A). We may enter the list of adjustment features at any point, but it should become routine to work our way through the other features to verify whether we have created a need to adjust one or more of several other features.

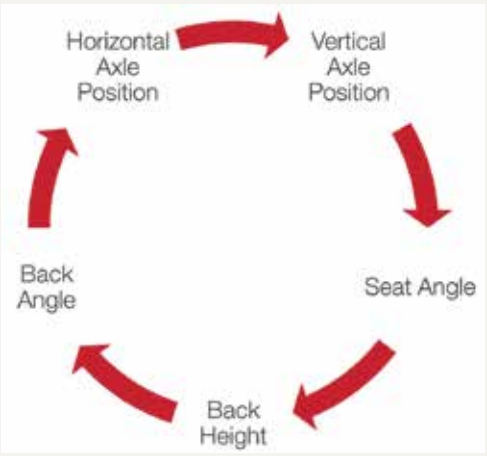

FIGURE A

We may even end up back where we started and repeat the checklist. Note that Figure A is shown as a representation of this concept. It should not be considered a complete list, nor should it be viewed as a recommendation of any particular sequence.

There are innumerable aspects of ultralightweight manual wheelchair configuration and adjustment that could be included in this discussion. Some of the most common are horizontal axle position, vertical axle position, seat angle, back angle, back height, front frame length and angle, and rear wheel diameter. Let us consider each of these individually.

AXLE POSITION IN THE HORIZONTAL PLANE

Axle position in the horizontal plane influences two important aspects of wheelchair mobility: stability and propulsion effort.[5] A more rearward drive wheel position relative to the user will decrease system mass (combined weight of user and wheelchair) over the drive wheels. This improves the rearward stability of the chair, making it less likely to tip backward. As we have discussed, however, it is detrimental to propulsion effort because it increases rolling resistance by increasing system weight over the caster wheels. Additionally, it decreases user access to the handrims by moving the drive wheels more posterior in relation to the user's shoulders. Research has shown this negatively impacts propulsion effort by shortening a user's push stroke.[6, 7, 8, 9, 10, 11, 12] In contrast, a more forward drive wheel position increases system mass over the drive wheels, decreasing rearward chair stability, decreasing rolling resistance and improving user access to the handrims for a longer push stroke (Figure B).

When deciding on the horizontal position of a user's axle, it is important to consider their abilities. Do they have the balance and proficiency with wheelchair skills to tolerate a more unstable yet more efficient axle position? Conversely, are their skills and comfort level

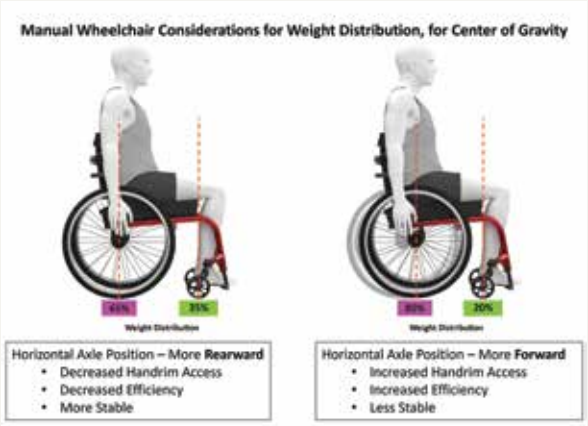

FIGURE B

more appropriate for a more stable yet less efficient axle position? The physical characteristics of the user should also be taken into consideration. For instance, children often have shorter seat depths than adults. Therefore, small changes in horizontal axle position will have a greater impact on wheelchair stability. For example, when increasing the seat depth of a child's chair and moving their body weight more posteriorly in the system, one might have to accommodate by moving the axle more rearward in the horizontal plane to maintain stability. Another example is a user who carries a significant portion of their body weight anteriorly on their trunk, such as a user in the third trimester of pregnancy. A more forward axle position in the horizontal plane might improve propulsion efficiency in this instance by decreasing system weight over the caster wheels.

FIGURE C

AXLE POSITION IN THE VERTICAL PLANE

Like horizontal axle position, axle position in the vertical plane also impacts chair stability and propulsion effort. In general, a lower system center of gravity will increase the stability of the wheelchair. In addition to affecting overall seat height and stability, vertical axle position influences propulsion effort by affecting user access to the drive wheel. Multiple studies

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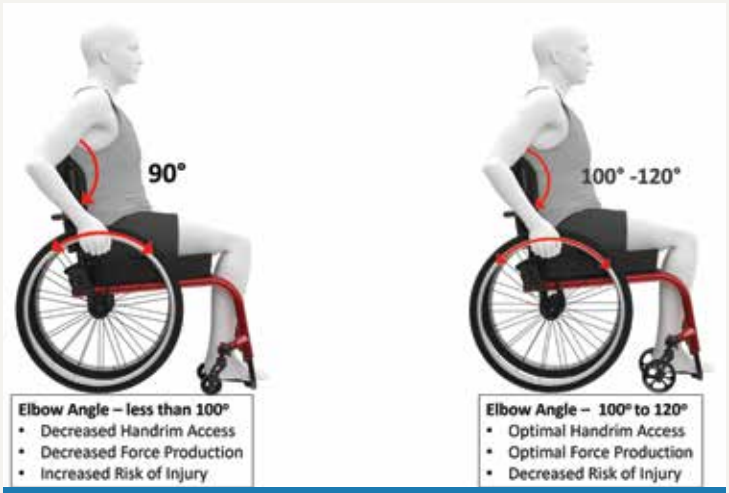

FIGURE D

CLINICAL PERSPECTIVE
(CONTINUED FROM PAGE 17)

have demonstrated that an elbow angle of between 100 to 120 degrees, with a user's hand at 12 o'clock on the handrim is optimal for propulsion. Note that research defines elbow angle as the angle between the upper arm and the forearm. This should not be confused with elbow flexion from kinesiology, the angle on the opposite side of the forearm (Figure C). This position provides the potential for a longer push stroke by increasing the length of the handrim that can be utilized for propulsion. This recommended range of elbow angle also maintains the joints of the upper extremity in the most mechanically advantageous position for generating force [13, 14, 15] Seat heights that place a user's elbow angle between 80 to 90 degrees with the hand at 12 o'clock on the handrim have been correlated with less efficient force production, higher cardiorespiratory demand, and placement of the joints of the upper extremity in ranges of motion that increase stress on the shoulder, elbow and wrist (Figure D).[13] Vertical axle placement can be impacted by seat cushion height. Therefore, definitive seating must be considered when making initial configuration choices regarding the vertical axle position. Suppose thought is not given to the initial finished seat height or the potential for a change in finished seat height. In that case, the overall seat height of the chair or drive wheel diameter may need to be altered to maintain an elbow angle in the desired range. These changes can have adverse consequences for the user. Smaller drive wheel diameters are less efficient. Altering the chair's seat height may also negatively impact the user's ability to interact with their environment or to perform activities of daily living.

FIGURE E

FIGURE F

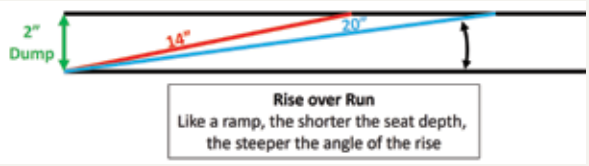

FIGURE G

SEAT ANGLE

Seat angle is often used interchangeably with the terms seat slope or "dump," which is the difference between the front and rear seat height of the wheelchair (Figure E). Unlike seat slope, however, seat angle is seat inclination relative to the horizontal plane (Figure F) and is dependent on the seat depth of the wheelchair. A comparison that should be familiar is that of a ramp. Like a ramp, the shorter the seat depth, the steeper the rise or angle of inclination. For this reason, it is important to consider that two inches of seat slope for a user with a 14-inch seat depth results in a steeper seat angle than two inches of seat slope for a user with a 20-inch seat depth (Figure G). Adding seat slope increases the seat angle of the chair, and small changes can be more impactful to posture or function for users with shorter seat depths. Like axle position, seat angle also impacts both stability and propulsion effort. It is often added to a chair to increase pelvic stability to help decrease sliding or improve forward trunk stability for a user with impaired trunk control. Increasing seat angle places system weight lower and more rearward than a more level seat angle and always requires re-evaluation of the horizontal axle position of a chair to ensure that stability is not compromised for that user. Refer back to Figure A, which discusses the domino effect of adjustments. A change in seat angle, like a change in axle position can also move the user outside the desired 100 to 120 degree elbow angle range. Suppose one anticipates that the seat angle of a chair might be increased for a user at some point. In

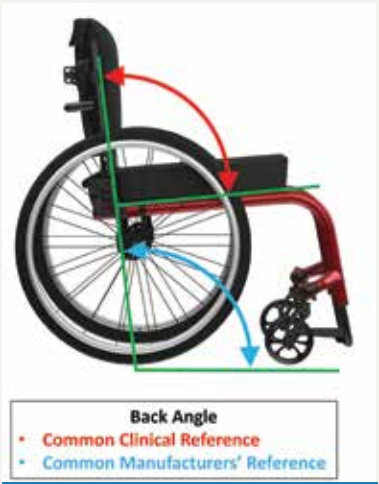

FIGURE H

that case, it is wise to plan for this at the initial prescription and begin with a greater elbow angle at the initial fitting. This can help maintain an elbow angle within the 100 to 120 degree range once an adjustment is made. In other words, the initial chair configuration should include enough available range of adjustment in the direction you anticipate you might need to effect change.

BACK ANGLE

Some consider back angle to be the measurement of the angle of the back cane in relation to the seat rail. However, it is important to consider that many wheelchair manufacturers reference this angle as the back cane in relation to the floor (Figure H). Back angle choice is often determined based on the postural needs of the user. An individual, for instance, may require a back angle of greater than 90° degrees for improved seated stability if they have decreased trunk strength or control. An example might be a user with a cervical-level spinal cord injury without strength or motor control below the level of their sternal notch. In this case, a more closed back angle might result in forward loss of trunk balance during propulsion or functional activities requiring reach of their upper extremities. Similarly, a more open back angle may be necessary to accommodate for decreased hip flexion range of motion due to a condition such as heterotopic ossification or a hip joint contracture.

As is the case with seat angle, a more open back angle results in a more downward and rearward distribution of system weight, impacting both the stability of the chair and rolling resistance. Like the previous features, back angle can also significantly impact propulsion by influencing user access to the drive wheel. It is also key to understand that with the addition of definitive seating, back angle for the user becomes the relative angle of the two support surfaces (back support and seat cushion) (Figure I). The contour of a seat cushion, as well as how the back support has been mounted or adjusted, can significantly impact this angle. In the case of back upholstery, the material can wear and stretch, changing the angle of the support surface over time. This can alter the user's positioning and propulsion efficiency in multiple ways. It can change the seat depth of the chair, the user's orientation to the drive wheels and the system weight distribution.

FIGURE I

In contrast to back upholstery, a solid back support typically maintains all of its positioning relationships to the chair over time. An added benefit of a solid back support is the ability to adjust positioning both through mounting hardware and back cane angle adjustment when available. Similar to aging upholstery, solid back support adjustments can also have unintended consequences on a user's position and propulsion efficiency. Therefore, the initial configuration and all back support adjustments require careful consideration as to their functional impact on the user.

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BACK HEIGHT

Much like back angle, back height is most often determined based on the postural needs of the user. It is typical for a user with greater postural support needs to require a higher height back support. Research has demonstrated that a lower back support affords a user a greater shoulder range of motion, a longer push stroke with reduced push frequency and no significant impact on handrim forces. [16] A pilot study on the influence of solid back support showed data that trended toward users having a higher vertical forward reach, a longer one-stroke push distance and a faster timed 23-meter push and ramp ascent than users with an upholstered back. [17] Clinically, these findings show the need to strike a balance between a user's need for posterior trunk stability and upper extremity freedom of movement for both propulsion and function. It is important to recognize that the length of the back support, as well as how it is mounted and adjusted, will determine the finished height.

CONSIDERATIONS FOR THE FRONT END OF THE MANUAL WHEELCHAIR

As we have discussed, a more forward position of the drive wheels places a greater percentage of mass rearward in the system. Increasing the distance to the caster wheels through a more open front frame angle or a longer frame length, with no concurrent change in horizontal axle position, results in a greater percentage of system mass over the drive wheels (Figure J). This offers a provider or clinician another means to balance a user's need for stability and propulsion effort. When making this decision, consideration should also be given to the user's postural support needs and environmental access. Questions to consider include: Do they have sufficient range of motion in their hips, knees and ankles to support their lower extremities in the prescribed position? Will spasticity or abnormal tone result in their lower extremities falling behind or forward of the footplate? Does the frame length or angle allow them to access their typical environments of use?

FIGURE J

WHEEL DIAMETER

The most common choice of drive wheel diameter for adult users is 24 inches. However, a choice of a larger diameter may be necessary to achieve the desired elbow angle of between 100 to 120 degrees, with a user's hand at 12 o'clock on the handrim. It is rare to want to decrease this diameter, as a larger wheel provides more leverage, magnifies a user's push force and helps them overcome the necessary force of friction. To achieve and maintain the desired elbow angle of between 100 to 120 degrees, with a user's hand at 12 o'clock on the handrim, it is critical to consider potential changes in axle position, seat angle and back angle. Additionally, children may require a change in drive wheel diameter. If growth necessitates an increase in seat-to-floor height, changing to a larger diameter can retain the desired access to the drive wheels for propulsion.

HOW DO MANUAL WHEELCHAIR USERS ACTUALLY USE THEIR CHAIRS?

When considering how to set up the features of a manual wheelchair, emphasis is often heavily placed on how configuration impacts propulsion effort. However, as addressed in the discussion of evidence-based practice, independent mobility may not be the primary goal of some users. For many individuals who are full-time wheelchair users, propulsion is a small portion of what they do in their chairs. For these individuals, seated in their wheelchair is the position from which they perform all of their activities of daily living. In fact, one study that explored how wheelchair users move about in their chairs determined that, on average, wheelchair users are only physically in movement about 10% of the time that they are up in their wheelchairs, or about one hour out of a 10-hour day. [18] In this study, it was also noted that manual wheelchair users perform numerous short bouts of movement during a typical day. Like most able-bodied persons, they engage in ordinary household or work-related activities that do

not require moving long distances. They move from a kitchen counter to a refrigerator or dining table, from their desk to another desk, from bedroom to bathroom,and so on. These bouts of movement are not very fast and do not involve significant distances. In fact, it was pointed out that the majority of movement bouts are less than 30 seconds duration, less than 13 meters distance and slower than 0.5 meters per second. They cover a total distance of around 1.9 km (1.2 miles) over a day that is comprised of a little less than 100 separate bouts of movement. Two of these authors replicated this study in 2017, with roughly double the number of participants, and obtained virtually the same results.[19] These findings highlight the importance of providers taking into consideration all of the activities an individual has to or wants to do from their chair. In fact, if a wheelchair is configured and set up to maximize propulsion efficiency without consideration of all the functional tasks that the user will do from the chair, there is the potential for the chair to be configured in a position that is too unstable for those tasks.

LEARN TO PREDICT THE FUTURE

Effective prescriptive planning requires proper attention to the configuration and adjustability of each user's wheelchair. Prescriptive planning is the process of making decisions about the initial setup of the wheelchair while allowing for changes to it over time. Building adjustment potential requires evidence-based practice that considers current needs and anticipated changes. These considerations involve the user's body function and structure, their activities and level of participation, and environmental and personal factors. Employing clinical expertise, professionals should ask three broad but important questions: What is likely to change for this user during the usual "life" of this wheelchair? How will the change(s) impact the setup of the wheelchair? How can I configure the wheelchair to allow for these changes? In other words, the professional should configure the chair to meet the initial needs, consider what kind of change may be needed and ensure they've built in the range and direction of adjustment to be able to do it.

With regard to body function and structure, one must consider the primary disease, illness or injury as well as factors such as age, time post-injury or illness, and any secondary diagnoses or co-morbidities. With that in mind, one must weigh the potential for functional decline or improvement in body function or structure. Although not an inclusive list, this includes areas such as strength, endurance, range of motion, skin health and cognitive functioning. For example, a person with multiple sclerosis may experience a decrease in strength and endurance with a concurrent decline in wheelchair handling skills over time. Conversely, a young, otherwise healthy individual with a new spinal cord injury will likely demonstrate improved capacity and tolerance for wheelchair-handling skills over time.

As it relates to activity and participation, information needs to be obtained regarding current activities of daily living and how those activities are performed, as well as any activities that the user hopes or plans to be able to perform from their chair. These can include self-care, occupational,or recreational activities. In our current funding environment, this often requires even more diligence in understanding because providers and clinicians may have limited access to seeing individuals in their unique environments of use. Consequently, professionals frequently rely on a verbal account from the user rather than observing the activity or the environment in which it is performed.

Specific to environmental and personal factors, a user's primary and any secondary environments of use need to be identified. These may include places of employment, education, recreation or social activity. They also encompass all forms of transportation. More difficult is also an understanding of the user's support system, family structure and any roles within this structure that impact the configuration of the mobility device.

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WRAP-UP

How should we integrate all this information into some practical takeaway knowledge? Much of what it takes to optimally configure and adjust a manual wheelchair for an individual user, initially as well as over time, comes down to adhering to a few fundamental principles:

- Consider all the activities a manual wheelchair user performs from their chair, including those activities done when they are not propelling their chair.
- Plan for change and build in enough adjustability. Ensure that the chair is adjustable in the range, and in the direction, your clinical expertise and the research evidence tell you that you'll need.
- Implement a follow-up plan. Users need to be seen more than once every five years. You built in the adjustability mentioned in point two so the technology can be adjusted — but you need to have the user come back in so that it will be adjusted.

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WORKING YOUR WAY THROUGH THE MANUAL WHEELCHAIR CONFIGURATION PUZZLE

Written by: **DEBORAH L. PUCCI, PT, MPT**

"It is really hard to move this wheelchair," she said.

"It looks like you are sitting on that chair, not in it. You can barely reach the rear wheels to get a decent push," I told her.

"It's because I have short arms, but I was told you guys could help," she replied.

This straightforward, matter-of-fact response gave me the immediate sense that I had just met a person who was both self-aware and pragmatic. Leah was only in her third week of inpatient physical therapy, but she was ready to take charge of her rehabilitation journey. She had been referred to the wheelchair and seating clinic to be evaluated for a definitive manual wheelchair. However, the first order of business in my mind was to improve the setup of the chair she was using during her acute rehab stay. It was an ultralightweight, rigid manual wheelchair that was quite obviously not configured or adjusted optimally for her needs. Hospital-issued chairs are not custom-configured for the individual, so they are rarely ideal, but this one clearly hindered her abilities.

When we met, Leah was 27 years old with a diagnosis of incomplete paraplegia following a motor vehicle collision. Additionally, she had sustained L1-3 transverse process fractures, a left clavicle fracture and a renal contusion. At admission, her AIS (abbreviated injury scale) score was T12 AIS B (sensory incomplete), but she had started to gain strength below the level of her injury. Her AIS score now was T12 AIS C (motor incomplete, with less than half the muscle groups below the neurologic level strong enough to move against gravity).

Prior to her injury, she had no past medical history significant for mobility limitations. She lived in a small rural town with her significant other and two dogs. Her home was a ranch-style house with two steps to enter. She was self-employed as a hairstylist who owned her own salon. In addition, she worked part time as a bartender. Her plan at discharge was to return home, with a long-term goal to return to employment as a hairstylist. During her rehab stay, her significant other oversaw modifications to the home for a ramp entry and to widen any doors necessary to permit entry to all rooms of the home.

At the time of her wheelchair evaluation, Leah reported low back pain and buttock pain of a burning nature that limited her wheelchair sitting tolerance. She also had lower extremity spasticity that manifested predominantly in an extension pattern.

This spasticity often interfered with her ability to perform transfers without assistance. She was independent with wheelchair parts management and level surface wheelchair mobility for household distances. Unfortunately, the poor setup of her hospital-issued wheelchair had limited her long-distance indoor propulsion, participation in outdoor mobility and training with higher-level wheelchair skills. She could perform up to a two-inch unlevel transfer with minimal assistance using a transfer board but reported difficulty transferring on and off the air cell seat cushion.

Leah was independent with weight shifts, oral facial hygiene and dressing and required partial assistance for toileting and bathing. Physical assessment revealed no significant postural asymmetries except for a flexible but slightly exaggerated lumbar lordosis and anterior pelvic tilt. Anatomic measurements also confirmed that she indeed had a long torso in relation to the length of her upper extremities.

A review of the configuration and setup of her hospital-issued wheelchair revealed 24-inch rear wheels with a center of gravity preset of .5 inches, an 18-inch rear seat height and a 19-inch front seat height. This setup resulted in a finished rear seat height of 18.5 inches on a high-profile air cushion. With this setup, Leah had poor access to the rear wheels. Instead of the

FIGURE A Optimal elbow angle range

recommended 100 to 120 degrees elbow angle (Figure A), she demonstrated nearly extended elbows with her hands at 12 o'clock on the handrim of the drive wheels. This limited her ability to produce an efficient and effective push stroke. The rear seat height of the hospital-issued chair was lowered to 16.5 inches for a 17-inch finished rear seat height. This was the lowest possible rear seat height for this chair, but it still did not provide optimal access to the handrims using standard 24-inch rear wheels.

FIGURE B Leah in her definitive chair. Note the elbow angle, the low rear seat height and relatively large rear wheel.

Leah was seen multiple times in the seating clinic during her acute rehabilitation stay. Interventions included further adjustments to the chair she was using and equipment trials to determine the optimal configuration and set up of a definitive wheelchair. The final configuration of Leah's definitive wheelchair required a rear seat height of 15.5 inches and a finished rear seat height of 17.5 inches with 26-inch rear wheels and a center of gravity preset of 2.25 inches. This setup allowed an elbow angle of 100 to 120 degrees with her hand at the top of the handrim (Figure B).

When you have been involved in wheelchair and seating prescription for more than 25 years, it is rare to encounter an individual who does not bring another similar person or situation to mind. However, Leah portrayed a unique clinical presentation I had never encountered before. I have worked with countless individuals with paraplegia, but none who, at 5 feet 5 inches, required a 15.5-inch rear seat height, 26-inch drive wheels and a 2.25-inch forward axle position to achieve an efficient push stroke. Additionally, the incomplete nature of her injury with a rapidly changing clinical presentation added to the challenge of configuring and setting up her chair for her current needs while planning for potential future adjustments.

Leah's buttock pain and difficulty with transfers on an air cell cushion prompted us to trial several seat cushion options. She clearly required a cushion with more stability to promote functional independence with transfers. I had minimal concerns regarding tissue injury due to her intact sensation and ability to perform independent repositioning and weight shifts. Additionally, my clinical experience taught me that individuals with incomplete injuries and neurogenic pain akin to her "burning butt sensation" frequently have an increased sitting tolerance on firmer cushions. I have often seen these persons report improved comfort on what would be considered overly inflated air cell cushions. After multiple trials, a contoured viscoelastic foam seat cushion was determined to provide the most stable surface for transfers and provide Leah with the best sitting tolerance.

Also unusual for a person with a T12 incomplete injury, Leah's chair was configured with 3 inches of seat slope, often referred to as "dump" (Figure C). I had initial concerns that this aggressive seat slope would present a challenge for transfers. Still, I recognized that it also had the potential to benefit her in other ways. Given her need for a low rear seat height to maximize her access to the drive wheels for propulsion, this configuration would offer a higher front seat surface for transfers. Provided she could scoot forward to the front of the seat, Leah would be at a more level transfer height with surfaces like her

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FIGURE C Seat slope

bed and car. The considerable seat slope also provided the opportunity to decrease her tendency toward anterior pelvic tilt and excessive lumbar lordosis. Increasing her hip flexion might assist in stabilizing her pelvis in a more neutral position and reduce the pull of her psoas muscles on her lumbar spine by placing them in a shortened (more relaxed) position. My experience has validated what my education taught me about spasticity being both velocity- and length-dependent. Clinically, sitting with greater degrees of knee flexion and ankle dorsiflexion can often help reduce the impact of extensor spasticity for some individuals. Fortunately, the stability of a viscoelastic seat cushion and improving strength and endurance helped Leah gain independence with transfers. Both her posture and her spasticity improved with the prescribed seat slope (Figure D).

Despite my years of experience, I find that the front frame configuration of a rigid frame wheelchair can be the most challenging to determine for a new user. The decisions regarding frame length, front frame bend, caster position and footrest taper impact not only the user's seated posture but also the weight distribution of the wheelchair and environmental access. Furthermore, unlike many other selections, these choices lack future adjustability. Adding to this challenge is the fact that new users are often rapidly changing in their abilities. They also have no experience regarding how they prefer their wheelchair to be set up for comfort or to allow them to do everything they want or need to do from their chair. Unfortunately, many are hoping not to need a wheelchair and are reluctant participants in the decision-making process.

FIGURE D Note Leah's frame length, frame angle, knee angle and foot placement

Leah was anything but a reluctant participant in the process of obtaining a chair. However, her abilities were rapidly changing, and her only frame of reference was an ill-fitting hospital chair. She was hopeful that her lower extremity strength would continue to improve and that she would progress to standing and walking in some capacity. Additionally, she and her inpatient physical therapist had discussed the possibility of a front wheel power add-on. This would provide her with improved independence with mobility in unpaved areas and uneven terrain surrounding her home. She wanted to ensure that her chair would be compatible with this type of device if she chose to pursue one later. After careful consideration, we decided that an 80-degree front frame angle and an additional inch of frame from the front edge of the sling to the front frame bend would best meet her needs (Figure E). This configuration supported sufficient knee flexion to help quiet her lower extremity spasticity. It also accommodated her muscular calves, avoiding contact with the front edge of the seat sling. Pairing this with a 2-inch "Y" style footrest taper ensured that an angle adjustable footplate could be replaced with a flip-back footplate, if needed, to permit sit-to-stand transitions. A flip-back footplate typically sits farther rearward than an angle adjustable footplate (Figure F). An 80-degree front frame angle ensured that if this change was made, she would have adequate foot support without requiring significantly more knee flexion.

A 14-inch-high back support with a gentle contour was chosen to provide both posterior pelvic and lumbar support while sitting below her scapulae. This height provided adequate posterior pelvic and trunk support and allowed Leah full shoulder range of motion for propulsion and functional activities. Angle and depth adjustable hardware and angle adjustable back canes were selected. Having adjustment through both the canes and back support hardware provided the ability to fine-tune the backrest for postural control and to ensure that the desired seat depth was achieved and maintained. Quick-release hardware ensured that the back support could be removed for transport.

FIGURE E Frame length

Minimal adjustments to the prescribed configuration of the chair were required

FIGURE F Footplate options

when Leah was seen for the initial fitting of her definitive chair. These included back support height and angle, horizontal axle position and footplate angle adjustments.

Leah reported feeling "comfortable" in her chair with the recommended configuration and setup. She said that it felt "light and easy to push." By the time she received the chair, Leah had progressed with her ability to perform higher-level wheelchair skills, including independence with wheelies. She had continued to experience the return of muscle strength below her level of injury but was not performing sit-to-stand transitions or ambulation outside of therapies. Her spasticity had also increased and continued at times to interfere with her transfer ability. She was contemplating a change in medical intervention to help decrease her spasms. Still, she was hesitant because she recognized that she often used her spasticity to compensate for deficits in strength. Her continued changes in physical presentation and abilities highlight the importance of planning for changes in the setup of a chair and for establishing follow-up visits based on an individual's unique needs. With that in mind, and because she lives a significant distance from our clinic, we discussed having her schedule a follow-up to coincide with her next physician visit.


Leah holds a wheelie.


Leah, happy in her definitive chair

Sometimes when you encounter a patient with an unusual presentation it can be a bit daunting to know how to begin. Just as you should do with any user, proceed one step at a time: Gather a comprehensive picture of everything the user wants and needs to do from their chair. Determine the initial setup needed and ensure you have planned for anticipated changes. Implement an appropriate follow-up plan and schedule based on the individual's situation. We did this with Leah, and I am confident we can continue to optimize the setup of her chair in the future.

I would like to extend a special thank you to Leah for allowing us to tell her story, and to Rich Blanchette, ATP with NuMotion Chicago, who was an integral member of Leah's wheelchair and seating team.

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NAVIGATING THE TRANSITION FOR NEW LEADERS IN AN AGING WORKFORCE

Written by: **ANDREA MADSEN, ATP**

As the workforce landscape continues to evolve, the Complex Rehab Technology industry is facing the challenge of managing an aging workforce while also fostering the development and promotion of new leaders. With baby boomers reaching retirement age and Gen Xers moving into senior positions, there is a growing need to identify, develop and promote new leaders to drive organizations and the professional practice of CRT provision forward. Navigating this transition requires a strategic approach that balances the wealth of experience and knowledge of elder leaders with the fresh perspectives and skills of younger generations.

The aging workforce presents both opportunities and challenges. On one hand, elder professionals bring valuable experience, expertise and institutional knowledge to the table. This tribal knowledge is invaluable to not only encapsulate the history and genesis of CRT provision as a practice but also to cast forward the intended trajectory of their labors. On the other hand, there is a need to ensure continuity, innovation and growth by promoting new leaders who can bring fresh ideas and perspectives.

Promoting new leaders in an aging workforce requires a delicate balance between leveraging the strengths of elder leaders and providing opportunities for younger professionals to step into leadership roles. Failure to manage this transition effectively can result in a loss of talent, knowledge and productivity, ultimately affecting the industry's long-term success. Implementing mentorship programs can be an effective way to facilitate the transfer of knowledge and skills from elder professionals to junior employees. Pairing experienced leaders with high-potential individuals creates opportunities for learning, development and relationship building. Mentorship programs help new leaders gain valuable insights and perspectives while allowing elder professionals to pass on their expertise and experience.

Succession planning is crucial for identifying and developing the next generation of leaders within an organization. By systematically identifying key roles and the competencies required to fill them, organizations can ensure a smooth transition as vacancies arise. Succession planning should include a mix of formal training, on-the-job experience and mentorship to prepare future professionals for their roles effectively.

Investing in the training and development of younger professionals is essential for preparing them for leadership roles. Offering leadership development programs and continuing education opportunities can help build the skills, knowledge and confidence necessary to excel in leadership positions. Providing ongoing learning opportunities not only prepares new leaders for their roles but also demonstrates an organization's commitment to professional growth and development. Investing in ongoing education boosts personalized care fidelity and enhances superior outcomes for consumers.

Implementing flexible work environments can help retain elder professionals who may be considering retirement while also attracting and retaining younger talent. Offering options such as part-time consulting or remote work allows veteran leaders to gradually transition into retirement while continuing to contribute their invaluable expertise. Flexible work environments also appeal to younger professionals who value work-life balance and autonomy.

Creating an inclusive workplace is essential for promoting new leaders from within an organization and from within the CRT sphere. Embracing diversity in age, gender, ethnicity and background fosters creativity, innovation and collaboration. By creating a culture where everyone feels valued and respected, organizations can attract and retain top talent from all generations.

Promoting new leaders in an aging workforce is not without its challenges. However, by taking a strategic and proactive approach, organizations can overcome these obstacles and ensure a smooth transition. Managing a multi-generational workforce requires understanding and appreciation of the differences between generations. Organizations must bridge the generation gap by promoting collaboration, communication and mutual respect among employees of all ages. Elder leaders may be resistant to

change, especially if they feel their expertise and contributions are undervalued. Communicating the need for new leadership and involving seasoned professionals in the transition process can help alleviate concerns and foster acceptance.

Ensuring the transfer of knowledge from elder leaders to younger professionals is essential for maintaining continuity and productivity. Implementing formal knowledge transfer processes, such as mentorships, shadowing and cross-training, can help preserve critical institutional knowledge. Retaining both elder and younger talent is crucial for the long-term success of the CRT supplier profession. Offering worthy recognition, career development opportunities and a positive work environment can help attract and retain top talent from all generations.

Promoting new leaders in an aging workforce is a complex but necessary process for organizations looking to thrive in today's competitive environment. By implementing strategies such as mentorship programs, succession planning through investment in education, training and professional development, flexible work environments and embracing inclusion, organizations can successfully navigate this transition. Overcoming challenges such as resistance to change, the generation gap, knowledge transfer and talent retention requires a strategic and proactive approach. With the right strategies in place, organizations can leverage the strengths of elder workers while also developing and promoting the next generation of leaders, ensuring continued success and growth for years to come and preserving vital access to life sustaining CRTs.

iNRRTS is the international leader in establishing an educational pathway to engage new participants in the CRT professional workforce and is essential for preparing individuals for professional proficiency in today's rapidly changing environment. By identifying professionally relevant skills, offering flexible learning, providing unparallelled access to the professions foremost subject matter experts, fortifying industry partnerships and promoting continuous learning, iNRRTS can ensure that individuals are equipped with the skills and knowledge they need to thrive. By doing so, we can cultivate a CRT professional workforce that is competent, confident and prepared to meet the challenges of the future and drive exceptional personal care and innovation.

For more information on what iNRRTS can do for you please visit: https://nrrts.org/education/

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WHAT MAKES AN ATP?

Written by: **ANDREA VAN HOOK, RESNA EXECUTIVE DIRECTOR**

We all know the basics of what it takes to become an Assistive Technology Professional. You need a certain amount of training and education in assistive technology, a certain amount of work experience and you must pass an exam. Then, to maintain your certification, you must complete 20 hours of additional assistive technology education every two years, continue working and pay a renewal fee.

But does that really make you an ATP? Or is there more to it than passing an exam, sitting in classes, paperwork and paying fees?

The truth is, there's a difference between passing the exam and being a quality ATP. A quality ATP is someone who:

- Builds trusted relationships with clients, clinicians, suppliers, and manufacturers.
- Understands, supports, and conducts thorough evaluations and assessments to ensure that the client is getting the technology that they need.
- Sees problems and works to solve them.
- Engages in those tough conversations with clients and operates with full transparency.

We all know ATPs who have these traits. They are the leaders in our workplaces and the ones to whom everyone turns for help and advice, even if they don't have the official job titles.

At RESNA (Rehabilitation Engineering and Assistive Technology Society of North America), we're invested in more than churning out ATPs by the dozen. The ATP certification started years ago to establish a minimum standard for assistive technology provision. But we've never been content with a "minimum standard." We want to help all ATPs set and exceed the highest standard and be recognized across the industry and among clients as trusted, knowledgeable and ethical professionals.

That's why, together with U.S. Rehab and the Assistive Mobility Rehab Group (AMRG, formerly DMERT), we're starting a new education and mentoring initiative – the ATP Guidance Program.

The ATP Guidance Program, launched at the Heartland Conference in June, will specifically guide rehab technicians who have achieved the AMRG Certification (formerly DMERT Level 2) to continue their career journey and become a quality ATP. It is a one-year program designed to combine the training, education and mentoring that is necessary to succeed and thrive in this industry.

The program combines education and assistive technology training, practice exam and test taking skills, network building and one-on-one mentoring. Each registrant will be paired with an experienced ATP mentor that will guide them through a structured program with practical how to's, experiential knowledge, communication skills and leadership. The goal is to not only successfully pass the ATP exam but also enter the workforce as an ATP with a network, a knowledge base, and those transformational skills that enable better outcomes for clients and lead to long, successful and fulfilling careers.

Once established, we hope to expand this program to others in the field and offer a pathway to ATP certification to those in other areas of assistive technology. We plan to enroll our first cohort this fall. To find out more, visit the websites of RESNA, U.S. Rehab and AMRG, and feel free to reach out to me directly at execoffice@resna.org.

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Andrea Van Hook is executive director of RESNA. She has over 20 years of experience in nonprofit association management. She lives and works in the Washington, D.C., area.

NEW iNRRTS REGISTRANTS

Congratulations to the newest iNRRTS Registrants. NAMES INCLUDED ARE FROM MARCH 20, 2024, THROUGH MAY 22, 2024.

Cassandra Hardiman, RRTS®
Motion

Christian Wilkerson, RRTS®
HME Mobility & Accessibility

Christian Raffield, ATP, RRTS®
Patients Choice Medical

Deven Caron, RRTS®
Motion

Dexter Carter, RRTS®
Complete Care, Inc.
Jeffery McKenney, ATP, CRTS®

Junior Sanchez, RRTS®
Healthcare Comp

Matthew S. Howard, ATP, CRTS®
At-Home Medical

Nicole Berger, MSPT, ATP, RRTS®
National Seating & Mobility, Inc.

Robert Connelly, ATP, CRTS®
Numotion

Ryan Recuenco, MA APA, BPE, R.Kin, RRTS®
Motion

Tyler Speer, RRTS®
Quipt Home Medical

William Shirley, ATP, CRTS®
Rehab Medical Inc.

NEW CRTS® REPORT

Congratulations to iNRRTS Registrants recently awarded the CRTS® credential. A CRTS® receives a lapel pin signifying CRTS® or Certified Rehabilitation Technology Supplier® status and guidelines about the correct use of the credential. Names listed are from March 20, 2024 through May 22, 2024.

Cacee Reuben, ATP, CRTS®
National Seating & Mobility, Inc.
Oklahoma City, OK

Gene Uweh, ATP, CRTS®
Reliable Medical Supply, Inc.
Stockton, CA

Jeffery McKenney, ATP, CRTS®
Alliance Rehab & Medical Equipment
Fenton, MO

Matthew S. Howard, ATP, CRTS®
At-Home Medical
Columbus, GA

Robert Connelly, ATP, CRTS®
Numotion
New Hyde Park, NJ

Trevor Shaner, ATP, CRTS®
Rehab Support Systems
Pomona, CA

William Shirley, ATP, CRTS®
Rehab Medical Inc.
Oklahoma City, OK

INRRTS AND 24-HOUR POSTURE CARE MANAGEMENT

Written by: **TAMARA KITTELSON, MS, OTR/L, ATP/SMS**

How time flies when one is having fun! This summer marks 16 years since I joined Clinician Task Force, became a Friend of iNRRTS and wrote my first article for DIRECTIONS in 2008. When Weesie Walker (former NRRTS executive director) tapped me to write, she gave me free rein to choose a topic and the result was "Postural Care Around the Clock."

My thinking and practice have evolved significantly since then, but that article provided an opening to share what has become my passion, and with a larger audience than my western Montana private practice would ever have allowed.

Understanding and acceptance of 24-hour posture care management is still in early stages here in North America. We have far to go for this eminently practical and cost-effective approach to become the standard of care for individuals who require Complex Rehab Technology. However, iNRRTS and CTF have played a critical role as we move toward that goal.

For those unfamiliar with 24-hour posture care management, it is an approach developed primarily in the United Kingdom and quite widely adopted in Australia, Europe and New Zealand. A definition published in 2006 states, "A postural management programme is a planned approach encompassing all activities and interventions which impact on an individual›s posture and function. Programmes are tailored specifically for each child and may include special seating, night-time support, standing supports, active exercise, orthotics, surgical interventions, and individual therapy sessions" (Gericke, T. Developmental Medicine and Child Neurology, 2006).

There are two schools of thought and terminology in this field: Some use "postural care" while others use "posture management" to describe the intervention. To foster inclusivity, the RESNA 24-7 Posture Care Management Special Interest Section (see below) has chosen to combine the two terms and refer to the practice as "posture care management." While most of these interventions are very familiar and commonly used in North America, one of them is not – nighttime (lying) posture support. This is surprising, considering that lying, sitting and standing are the three fundamental human orientations, and human development begins in lying. A growing number of us aim to change that oversight by raising awareness of how asymmetrical postures, gravity and time affect the human body, particularly while sleeping and resting (Fulford and Brown, 1976). While the topic of lying support systems is typically not considered during CRT evaluations, lying posture is indisputably linked to sitting and standing posture.

Protecting people's body shapes, health and quality of life – not to mention less frequent replacement of complex seating systems – are potential outcomes of posture care management becoming a standard of care. In a recent conversation with a colleague, I learned that in the United Kingdom, where posture care management is accepted and promoted in government publications, U.K. hospitals actively use posture care management sleep systems in their intensive care units, and in COVID-19 wards during the pandemic. In these contexts, posture care management systems act as a primary defense against skin breakdown by redistributing pressure throughout the body while lying. Supine positioning can be a challenging task when a person lies unsupported on a flat surface, as gravity may cause them to adopt or worsen asymmetrical postures, putting bony prominences at risk.

Posture care management interventions not only support individuals at risk of injury but also they offer peace of mind for patients in settings where staffing ratios interfere with attentive patient care and can be creatively adapted for use in under-resourced settings for a low cost and high reward.

Elizabeth Balboa, occupational therapist, teaches a class on posture care management in lying to family members at Yancana Huasy, a wraparound disability service program in Lima, Peru.

In other parts of the world, 24-hour positioning is a frequently discussed and often well-accepted approach, promoted as a means of protecting and even improving posture, function and health when mobility limitations exist. The CTF and iNRRTS have been supportive places to promote inclusion of posture care management for clinical practice in North America.

The need and use for this intervention tend to be better understood by seating and wheeled mobility practitioners who regularly observe deteriorating postures in their clients, who then require more frequent seating system replacement. Members of CTF were some of the first clinicians open to learning about 24-hour posture care management, inviting me to teach workshops at their facilities and spreading the word. In 2013, iNRRTS allowed me to teach a webinar on the topic, and this has been followed by numerous articles and webinars over the last 11 years, written and taught by others who are also passionate about this topic. Our tribe is growing, and I truly believe that we are on an eventual path toward 24-hour posture care management becoming an accepted standard of care.

Working toward this goal, the RESNA Board of Directors approved the formation in August 2020 of a new Special Interest Group named the 24-7 Posture Care Management SIG. We proposed that a high percentage of assistive technology users also require Complex Rehabilitation Technology, and many of these individuals experience postural problems that affect their ability to access assistive technology.

Our current effort is a writing project, the RESNA Position on the Application of Lying Posture Care Management (LPCM). This paper aims to fill a gap in the RESNA literature on postural support, as current resources address posture care management in sitting and standing but not in lying. The work group includes three CTF members: Trish Toole, Lee Ann Hoffman and me.

What might it look like if 24-hour posture care management were the standard of care in wheelchair provision?

In 2004, I founded a nonprofit called Eleanore's Project as my daughter's legacy. Allow me to share with you the development of such a program outside of North America, and its impact.

Since 2007, we have worked with Yancana Huasy, a wraparound disability service program in Lima, Peru. In 2007, Yancana Huasy had virtually no wheelchairs for their clients, yet many of their children were fully dependent and could only leave their homes when held or carried. They were open to receiving 25 individually fitted wheelchairs on a trial basis. Five months later Yancana Huasy therapists reported startling developmental progress in the children who received wheelchairs, attributing it directly to their experience of supported sitting posture and improved mobility. More importantly, the therapists observed renewed hope from parents as they saw their children progress.

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Lying comfortable and supported using materials at home and a custom carved leg support

CLINICIAN TASK FORCE
(CONTINUED FROM PAGE 33)

From then on Eleanore's Project collaborated with Yancana Huasy to develop a dedicated wheelchair service with training and mentoring in evaluation and fitting together and provision of positioning and mobility equipment every year.

In 2012, this expanded to teaching about posture care management in lying, which has become foundational and an integral part of the wheelchair program. Yancana Huasy therapists were quick to recognize and accept the power of therapeutic positioning for sleep and rest, with its potential to protect children's body shapes for the future. Teams were already working together to provide postural support for daytime mobility systems; in addition, they now added focus on the need for safe, supportive nighttime posture care management.

Today, families who receive CRT through Yancana Huasy are required to attend workshops taught by Yancana Huasy therapists. These classes focus on understanding of LPCM and basic wheelchair maintenance and seating concepts prior to receiving their equipment. On the day of their wheelchair fitting, the families demonstrate how they position their family member in lying at home, and therapists help troubleshoot the intervention when needed. Families typically leave their wheelchair fitting with custom-carved foam positioning pieces to support their efforts at home, exchanging pictures of their systems with the therapist for follow-up assistance. This ensures that when the wheelchair rider is not in their wheelchair seating system, their body shape is preserved and receives continuous support in a safe, well-aligned lying posture.

In Peru, during the COVID-19 pandemic, posture care management proved to be an invaluable, proactive preventative method of care. Individuals who had already waited months to receive their wheelchair were delayed an additional six months due to a quarantine period that did not allow Yancana Huasy to deliver services. Fortunately, their families had already attended workshops on posture care management and knew interventions they could carry out at home to protect their loved ones from destructive altered body shapes and pressure injuries. As Jose Antonio, Yancana Huasy executive director has said to me, "For our professionals, everything is about posture."

In my years of clinical practice here in the UnitedStates, I have often wondered if we might see more successful seating outcomes and CRT use if such training were part of the process. I hold hope that wheelchair users and families here can experience comprehensive, client-centered education prior to receiving equipment.

Early education creates a better understanding and awareness of equipment use and advances families toward successful mobility. Proper posture care management allows for protection from distressing body shape alterations like scoliosis and joint dislocations that complicate seating, and are frequently linked to gastrointestinal issues, pain, respiratory compromise and skin breakdown.

While replicating the special relationship we've created with Yancana Huasy and their therapists is unlikely, I have a dream that someday caring for sleep and rest lying posture will be as important as posture care management for sitting and standing. And I know that the CTF and iNRRTS will continue to play a role in that dream!

Yancana Huasy therapists Sandra Orihuela and Sandra Candela work with a child during wheelchair clinics at Yancana Huasy

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Tamara Kittelson, MS, OTR/L, ATP/SMS, is an occupational therapist and RESNA certified ATP/SMS. She founded Posture 24-7 and Eleanore's Project, promoting 24-hour posture care management and appropriate seating and wheeled mobility provision in low resource settings. She is founding chair of the RESNA 24-7 Posture Care Management and a member of AOTA, RESNA and CTF. She is also a Friend of iNRRTS. Kittelson has presented and written on these topics nationally and internationally. Kittelson served children and adults with complex neurodisabilities in Montana from 1983 to 2022. She credits her daughter, Eleanore, born with cerebral palsy and profound deafness, as her best teacher.

INDUSTRY GAME CHANGER: EMPOWERING EXCELLENCE IN COMPLEX REHAB TECHNOLOGY

THE iNRRTS CRT SUPPLIER CERTIFICATE PROGRAM

Written by: **BILL NOELTING**

The iNRRTS has taken a significant step forward by creating the CRT Supplier Certificate Program. This comprehensive training and education initiative is laser-focused on equipping individuals with the skills and knowledge necessary to excel as Complex Rehab Technology Suppliers.

WHAT IS A CERTIFICATE PROGRAM?

A certificate program is specialized education designed to develop or strengthen specific career skills. These programs offer a focused and practical approach to skill development, making them a valuable option for career advancement and personal growth.

WHAT IS THE CRT SUPPLIER CERTIFICATE PROGRAM?

The two-level CRT Supplier Certificate Program is designed to address a critical gap in the CRT industry. Until now, there hasn't been a dedicated program specifically tailored to CRT Suppliers. iNRRTS recognized this need and stepped up to fill it. The first 10 courses represent Level 1 Certificate achievement, which is available now:

- The Role of the Complex Rehab Technology Supplier
- Observing the Interview and Sitting Balance Assessment
- Observing the Mat Assessment for Seating Impairments
- Skin Integrity
- Measuring the Client
- Basics of Diagnoses
- Application of Postural Supports
- Key Concepts of Wheeled Mobility
- Manual Wheelchairs
- Power Wheelchairs

In addition to addressing specific skills critical to supplying CRT, the program also focuses on professional standards of practice, best business practices and ethics, ensuring that CRT Suppliers are well-prepared to serve their clients effectively.

The Level 2 courses will be available in early 2025.

KEY BENEFITS

Completing the CRT Supplier Certificate Program offers several benefits:

Improved RTS Performance: CRT Suppliers who complete the program gain a deeper understanding of their role and responsibilities. This knowledge translates into better performance, ultimately benefiting clients.

Enhanced Client Outcomes: By mastering the intricacies of CRT, Suppliers can contribute to improved client outcomes. Whether it's selecting the right mobility device or ensuring proper fitting, their expertise matters.

Happier Suppliers and Clients: Knowledgeable and confident Suppliers create a positive experience for both them and their clients. CRT Suppliers feel empowered with greater immersion and heightened

passion and can focus on delivering exceptional service. This transparency is shared with their clients.

Accelerated RTS Development: The program also serves as entry-level training, making it an excellent starting point for professionals interested in seating and mobility. It lays the foundation for continued growth and specialization at a time when the population of CRT Suppliers is reducing.

PROGRAM COMPONENTS

Throughout the Level 1 courses, the CRT Supplier Certificate Program covers essential topics related to CRT. These courses provide a solid understanding of the field, including:

Professional Standards: Learn about ethical conduct, legal requirements and industry guidelines.

- Best Practices: Delve into the best way to conduct your business and how to best communicate with your clients, manufacturers colleagues, and other industry stakeholders.
- Clinical Knowledge: Dive into the clinical aspects of CRT in the areas of seating and positioning, mobility options and the key concepts of wheeled mobility.
- Product Knowledge: Explore the wide range of CRT product types and how they meet individual needs.

The iNRRTS CRT Supplier Certificate Program is a game-changer for the industry. It empowers CRT Suppliers to deliver exceptional service, positively impacting clients' lives. As more professionals participate in this program, the entire CRT community benefits from increased expertise and improved outcomes.

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Bill Noelting is the director of marketing for iNRRTS. He is also the creator of "Talk Rehab" at www.noelting.com/talkrehab and "He Said, She Said Restaurant Reviews" at www.hesaidshesaid restaurantreviews.com/ and follow the podcasts on Facebook — Talk Rehab and HSSSRR.

WHO WINS WITH BLIND BIDDING?

Written by: **WRITTEN BY MICHELLE HARVEY, BSC HONS OT, RRTS®**

We explored the topic of blind bidding from the perspective of a client, therapists and vendors who have all experienced blind bidding in their provinces with different funders and for different equipment.

We interviewed all three parties, and we asked them the same three questions:

1. Do you believe blind bidding works, and why or why not?
2. Do you feel blind bidding allowed you or your client to receive the equipment and service they needed?
3. Do you believe blind bidding should continue in certain provinces or with certain funders?

Blind bidding has been a topic of discussion in Canada for well over a decade. It is very prevalent in some provinces and almost extinct in others.

Different funders have maintained the practice of blind bidding, whereas others have tried and failed.

In this final article of a three-part series, Allana Jost, OT, with Nova Scotia Health provides a therapist's perspective on blind bidding. The first two parts are available in DIRECTIONS 2024 Vol. 1 and Vol. 2.

QUESTION 1. DO YOU BELIEVE BLIND BIDDING WORKS, AND WHY OR WHY NOT?

No one wins with blind bidding – the whole premise behind it is fair cost to the client – so one vendor cannot overcharge for their product. It was like checks and balances. We no longer need this in our industry – vendors have regulations and guidelines (NART), and the amount to work a vendor puts in with the client and therapist to be undercut by another vendor, who has never met the client and does not know their unique needs, no one wins. In the end, it can cost the end user (insurance, client or third-party funder) more money because the client didn't get the product they were expect and wastes a lot of everyone's time.

Now some vendors, when providing a second quote (blind bid), they put a clause in it that if they win the "bid" they must complete their own independent assessment before the product will be purchased. There have been too many mistakes and incorrect equipment provided, that it is in everyone's best interest to provide great service the first time! Some people say that this only impacts big ticket items and custom equipment for a client, but I disagree – blind bidding can be detrimental with even the simplest pieces of equipment, especially in the world we live in now, post COVID-19. Something as simple as toilet grab bars – there are so many makes and models that two vendors can interpret the description differently and then the end user receives something completely incorrect and not safe to use or as user friendly in their home environment. With the no return policy on a lot of medical equipment (especially bathrooms), the client must purchase again or make do with incorrect equipment. Again, no one wins.

QUESTION 2. DO YOU FEEL BLIND BIDDING ALLOWED YOU OR YOUR CLIENT TO RECEIVE THE EQUIPMENT AND SERVICE THEY NEEDED?

Not to say, I haven't received equipment by a second bid, and it never worked, but it takes more work to make sure it is the right thing. It wastes time waiting to hear back from vendors about simple questions but to make sure they understand exactly what you are looking for. They only person who loses out then is the end user because they must wait longer for vendors and therapists to verify equipment, and in the end, they wait longer for the equipment.

QUESTION 3. DO YOU BELIEVE BLIND BIDDING SHOULD CONTINUE IN CERTAIN PROVINCES OR WITH CERTAIN FUNDERS?

Absolutely not! Another big thing when working with clients is the relationships that are built over time, and the ongoing change of clients within their diagnosis. To be told to switch vendors because now your insurance has a "preferred vendor" again undermines the whole therapeutic relationship and again the outcome. Vendor selection should not be based on a preferred vendor – it is the best fit, sometimes time sensitive decisions to best meet your client's needs.

I do think the funders would benefit from education and understanding the processes and checks and balances in place and that blind bidding is not saving anyone one time or money. I think education on current practice and the negative impact of blind bidding needs to be brought to the forefront. The whole goal is to provide the best service the first time – that can easily be done more effectively without blind bidding.

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Michelle Harvey, BSC HONS OT, RRTS® is COO of sales and product for HME Home Health. Harvey is an iNRRTS Canadian Review Chair, serves on the Canadian Advisory Committee and became an iNRRTS Registrant in July 2021.

PROTOTYPE ARTIFICIALLY INTELLIGENT POWER WHEELCHAIR TRAINING SYSTEM DEVELOPED AT WESTERN MICHIGAN UNIVERSITY

Written by: **RICHARD MEYER, BS, MS, PHD**

A prototype power wheelchair training system called Virtual Expert System drive (VESdrive) that combines artificial intelligence (AI), virtual reality, and a physical wheelchair has been developed at Western Michigan University by Richard Meyer from the Department of Mechanical and Aerospace Engineering and his student team comprised of Irene Kahvazadeh (Computer Science), Kira Hamelink (Engineering Design, Manufacturing and Management Systems), and Sindhu Vydyula (Mechanical Engineering). The prototype training system includes a foldable power wheelchair, high resolution virtual reality headset, control computer with custom software, electronic interface for communication between the wheelchair joystick and control computer, and roller stands that allow the power wheelchair's drive wheels to turn while the wheelchair remains stationary.

The control computer executes custom software that provides many unique features to the training experience. First, it generates one of three VR environments for training: a mid-century home unmodified for wheelchair use; a modern office with cubicles, conference rooms and lobby; and a large open park with paved trails that have elevation changes.

Second, AI implemented in the software provides guidance to the user in the form of a goal circle the user is trying to match with a target circle. The goal circle represents the power wheelchair speed and direction of an AI-based expert user, i.e., a virtual expert. The user's target circle changes direction and size relative to the goal circle to indicate the user's deviation from the AI-based expert's heading and speed, respectively. The AI simulates the actions learned from real human power wheelchair users.

Third, each VR environment provides a series of coins spaced out to pick up by driving through them in order to guide users from an initial starting point to a final ending point goal. For example, in the home environment, the user is tasked with moving from the living room in the front of the home to a bedroom in the back of the home, finishing next to a bed. The collection of the coins guides the user and is accompanied by video game noise to add excitement and make the training exercise fun.

Fourth, the custom software monitors collisions between the power wheelchair and any objects, for example, furniture, walls, trees, etc., and adjusts the power wheelchair's maximum forward speed and maximum turning speed. If the user is often colliding with objects, the speed is gradually lowered until the number of collisions decreases over a set time period or the minimum allowable speeds are reached. If the speeds are currently at lowered values and collisions do not occur over a set period of time, the speeds are gradually increased back to the maximum allowable values.

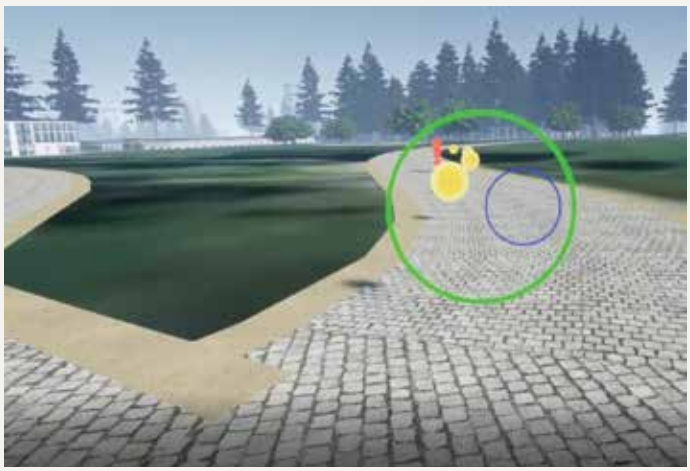
At the end of the training exercise, these maximum values are output and can be implemented in the user's power wheelchair as limits that reflect their current safe driving abilities.

A typical training session starts with the selection of the VR environment and an environment specific training scenario, such as navigating from the office lobby to the conference room, Next, the user puts on the VR headset and the scenario begins. They are then presented with the environment, coins nearby to start collecting, their target circle, and the AI virtual expert's goal circle.

Left: Virtual Expert System drive (VESdrive) in use; the system is easily portable and has a quick setup.

Bottom left: Overview of the prototype Virtual Expert System drive (VESdrive) components that work together to provide artificially intelligent power wheelchair operation training.

Bottom right: Virtual Expert System drive (VESdrive) virtual park environment demonstration scenario with artificial intelligence expert goal denoted by the blue circle and user target denoted by the green circle, coins to collect (path to take), and red exclamation point end goal to reach; the user objective is to collect coins while matching shape and location of their green circle to the blue circle through changing the wheelchair speed and heading.



The user starts driving the power wheelchair using the standard joystick. These signals are sent to the computer and joystick use is reflected in the change in orientation and speed of the wheelchair in the virtual environment. If a collision preventing power wheelchair motion is detected in the VR environment, then the real-world wheelchair wheel motion is also stopped with the computer sending the appropriate stop command to the power wheelchair drive system. The user is presented with simulated visual (the VR) feedback and real world tactile and auditory feedback via the motions and sounds caused by the power wheelchair's wheels turning in place while remaining safely on the roller stands.

The user trains in the VR environment until the scenario goal is reached or the training administrator stops the simulation. Data over time such as joystick commands, speed, direction, collision information, and more is then saved for review and additional data analysis.

The VESdrive provides an AI virtual expert based, fun, and consistent and repeatable training experience.

VESdrive is designed to be very flexible in VR environment scenario creation, taking only minutes, to ease test scenario development. The development team is seeking to further mature the product using patient and therapist feedback. Development of the VESdrive to date was made possible with grants from the Western Michigan University Technology Development Fund and Michigan Economic Development Corporation University Early-Stage Proof of Concept Fund (ADVANCE).

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Richard Meyer is an associate professor in the Department of Mechanical and Aerospace Engineering at Western Michigan University in Kalamazoo, Michigan. He received both his bachelor's and master's degrees from Missouri University of Science and Technology, and earned his Ph.D. at Purdue University. He has been with Western Michigan University since 2015. Meyer's teaching interests include control systems, numerical methods, machine design, mechanism design, optimization and autonomous vehicles. Meyer has published works in optimal control, mathematical modeling, autonomous vehicle operation and mixed reality power wheelchair training among others.

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The following individuals renewed their registry with iNRRTS between March 20, 2024, and May 22, 2024.

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