



RESNA Position on Assistive Technology for Lying Posture Care Management

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About This Paper

This is an official RESNA Position Paper on Clinical and Professional Practice. As such, it has been prepared in accordance with the specific guidelines and approval process defined by the RESNA Board of Directors for Position Papers. See [RESNA-Position-Paper-Procedures-approved-7-12-2018.pdf](#) guides for a complete description of this procedure. Key aspects of this procedure include:

1. Establishment of a Working Group of three or more experts to author the paper, using evidence from the published literature, documented best practices, and other input from experts in the field as the basis for the content.
2. Review of the draft by at least two subject matter experts from the relevant RESNA SIG or PSG, as well as all interested SIG or PSG members, and subsequent revisions.
3. Circulation of the revised draft to RESNA members and others for a 60-day public comment period, and subsequent revisions.
4. Review of the revised draft by the RESNA Board of Directors, and subsequent revisions.
5. Final approval of the paper by the RESNA Board of Directors

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Introduction

Problem

Postural support in the lying orientation is a key element of 24-hour posture care management (PCM), but it has not previously been described in a Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) position paper. The purpose of this paper is to educate and advocate for the appropriate use of lying posture care management (LPCM) to prevent secondary complications and improve function and health outcomes for people with movement limitations. Postural support in the seated and standing orientations have been addressed in previous RESNA position papers (Babinec et al., 2013; Dicianno et al., 2015; Masselink et al., 2024; Rosen et al., 2018; Worobey, 2023). This document fills a gap in knowledge by specifically discussing LPCM, both outlining the need for such intervention as well as providing appropriate definitions, current evidence, and best practices in this area. This document has secondary purposes: serve as an educational tool; encourage practitioners to continue development of LPCM interventions; urge researchers to produce more and better-quality research; offer practitioners justification of funding in their practice; make available evidence for policy decisions, and finally, help in advancement of best practice. Utilizing this information requires informed clinical judgement that must be applied to unique, individual cases.

Position

The Position

LCPM is a subset of 24-hour PCM that addresses the hours when an individual is in a lying orientation. LPCM involves collaboration between the individual, their care team, and their health care providers to design and provide comfortable support inclusive of the whole body. The supine position optimizes musculoskeletal alignment in ways that are not possible with other

horizontal orientations and maximizes pressure distribution. This use of the supine orientation for LPCM is strongly encouraged; however, supports can also be applied in side-lying or semi-side-lying for individuals who cannot safely assume the supine position. In some cases, supine lying accompanied by adjustment to the angles of the lying surface may be warranted (e.g., for individuals with a history of aspiration). Measures must be taken in these cases to prevent the individual from sliding down in the bed (e.g. leg elevation in combination with head of bed elevation; secure, carefully placed supports under the sheets). LPCM is the foundational element of 24-hour PCM and should be implemented as standard practice. By measuring and reporting LPCM outcomes, care teams and investigators will gain the knowledge needed to advance and further develop approaches and protocols for best practice.

24-hour Posture Care Management Definition

24-hour PCM is a collaborative therapeutic process by which a person who has limited mobility is enabled to lie, sit, and stand in increased symmetry through skillful placement of therapeutic supports. The purpose of 24-hour PCM is to provide/protect healthy posture and maximize the user's everyday function. This reduces secondary complications and improves health outcomes.

Lying Posture Care Management Definition

LPCM describes a collaborative therapeutic process by which a person with limited movement ability is enabled to lie in increasingly symmetrical positions through skillful placement of therapeutic supports. The purpose of LPCM, as part of 24-hour PCM, is to protect healthy posture and maximize the user's everyday function when otherwise, the individual may spend hours in habitual, asymmetrical, unsupported lying postures. LPCM can be used any time of day when an individual is resting or sleeping.

Assistive Technology for Lying Posture Care Management Definition

According to the Technology-Related Assistance Act of 1988, "assistive technology device" means any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities" (p.3). Assistive Technology (AT) for LPCM consists of both specially applied everyday items as well as uniquely designed products (either separately or together) to enable comfort and whole-body alignment during lying. Table 1 outlines examples of AT used for LPCM.

Individuals with impaired/limited movement definition:

Describes a person who is unable to easily move in and out of a stable midline orientation at will. This includes both those who cannot move at all and those who can move only within a limited range.

Good Posture definition:

“Good” posture is any posture that facilitates effective functional performance, is energy efficient, and does not cause damage to the body system (Pope 2007). For the purposes of this paper, “good posture” and “correct posture” are used interchangeably.

Symmetrical alignment definition:

Symmetrical alignment refers to a standardized lying posture in which the body is supine with arms at the sides, hips flat, and legs extended. The Posture and Postural Ability Scale (PPAS) refers to this position as placeable in neutral (Rodby-Bousquet, et.al, 2014).

Destructive lying posture definition:

A destructive lying posture is one that over time, and under the influence of gravity, will tend to promote deviation from neutral, symmetrical alignment of the body. A destructive lying posture facilitates *ineffective* functional performance, energy *inefficiency* and *causes damage* to the body system.

Whole body alignment definition:

Whole body alignment builds on the definition of symmetrical alignment and refers to supporting balance across multiple body segments (e.g., head, shoulders, spine, pelvis, lower extremities) such that “good” posture, comfort and pressure distribution is achieved.

Table 1

Assistive Technology for Lying Posture Care Management: Tiers of Complexity

Tier	Material Availability	Examples	Cost
I:	Materials Available-at-Hand Available in the home or clinic on the day of the evaluation for immediate use. Supplemented by tier two and tier three as needed.	Secured rolled towels Firm pillows Waterproof pads Stuffed animals (appropriately sized and shaped) crib pillows	0-\$ none-household or clinic overhead
II:	Specially Applied General-Use Products Readily available to the client in their environment, customized for the patient by the therapist	Two layers of non-slip rug backing Spacer mesh crib overlay Custom L-shaped brackets Custom carved foam supine leg positioner	\$-\$\$ Individual payor
III:	Specialty Products Available via Medical Equipment Suppliers (e.g., Durable Medical Equipment Suppliers)	Modular or custom purposefully manufactured systems designed for whole-body support. Search terms: Sleep positioning system. Supine Leg Positioner Recumbent Orthosis	\$\$\$\$ Individual or third-party payor (public or private insurance, grant, fundraising)

Technologies Mistaken to be Lying Posture Care Management

Frequent misconceptions exist as to what is and is not considered AT for LPCM. The following may be used by those who are candidates for LPCM or in conjunction with LPCM; however, used in isolation, *they do not equate to LPCM systems*:

- Safety or enclosed beds aimed at preventing falls or elopement.
- Adjustable hospital beds
- Mattresses or other support surfaces
- Pillows/Wedges/ T-rolls applied to only 1 or 2 body segments or isolated body parts
- Orthotics worn on the body (e.g., Thoracic Lumbar Sacral Orthosis, Ankle Foot Orthotics, Knee Orthotics)
- Supports that limit movement for individuals who can change their position, except by mutual agreement with the individual and their care team for purposes of increasing comfort and stability. Posture supports should be removable by the individual when they have the motor skill to do so.

Additionally, AT for LPCM differs from restraints as they are devices intended for safeguarding posture and providing comfort. When implemented following appropriate evaluation and recommendations with professional input, LPCM supports can be demonstrated to be posture supports rather than restraint-related once definitions are understood (Babinec et al., 2013; Gov.UK, 2018).

Position Summary

Best practice for care of individuals with impaired movement should address positioning in all three human orientations, including lying, sitting and standing. Individuals often develop secondary complications that may require invasive medical procedures (e.g., hip and spine surgery) and/or other interventions such as tone-reducing medications, botulinum toxin

injections, and orthotics when PCM is applied only to sitting and standing orientations and not for lying. It is possible that this cycle could be prevented or reduced while improving health-related outcomes if therapeutic positioning for lying were a part of standard care.

Populations & Subpopulations Affected

People of all ages – from infancy through older adulthood – who have a limited movement repertoire are candidates for LPCM (Gericke, 2006; Hill & Goldsmith, 2010; Innocente, 2014; Jónsdóttir & Toole, 2024; Osborne et al., 2023). Individuals who have mobility impairments often experience limitations in their ability to change their body positions and stabilize their bodies into an organized midline orientation while lying supine. When lying unsupported, these individuals may spend up to 12 hours per day in the same destructive postures, which equates to 4,368 hours per year (Rodby-Bousquet & Ágústsson, 2021; Sato et al., 2014). These extended periods are associated with preventable body shape distortions (e.g. hip dislocation, spinal curvature, rib cage compression or rotation) known to arise from being in extended periods of asymmetry (Ágústsson et al., 2019; Casey et al., 2022a; Casey et al., 2022b; Fulford & Brown, 1976; Hill & Goldsmith, 2010; Holmes et al., 2019, 2021a; Porter et al., 2007, 2008; Rodby-Bousquet, & Ágústsson, 2021; Rodby-Bousquet et al., 2013; Sato, 2020).

For example, persons with cerebral palsy (CP), Spinal Cord Injury (SCI), Duchenne Muscular Dystrophy (DMD), Spinal Muscular Atrophy (SMA), Traumatic Brain Injury (TBI), Cerebral Vascular Accident (CVA), Amyotrophic Lateral Sclerosis (ALS), Multiple Sclerosis (MS), intellectual disability (Robertson, 2018), and advanced dementia (Drenth et al., 2020) would be candidates. People requiring support for sitting and standing usually require support for lying. Thus, it makes sense that the care team, while evaluating the individual for wheelchair and/or standing frame use, should also assess lying posture. During the mat evaluation the team should determine whether the individual is *placeable in neutral* and if they can easily and

independently move in and out of a midline supine position according to the Posture and Postural Ability Scale (Rodby-Bousquet et al., 2014; Rodby-Bousquet et al., 2016). If not, the person is a candidate for LPCM.

People without motor impairment, but who experience chronic pain in sitting or standing, may also benefit from LPCM. Cary (2019) found that daytime pain is related to extended periods of lying with asymmetrical end-range or rotated postures. This daytime spinal pain improved with interventions that supported more symmetrical sleep postures illustrating the concept that in certain instances, those without motor impairments may also benefit from LPCM.

Contraindications

When considering the implementation of LPCM, the provider must always be mindful of the user's safety and comfort. While appropriate LPCM application is meant to prevent commonly experienced health-risks for target populations, it is also critical to monitor the individual for postural asymmetry, entrapment, thermal dysregulation, aspiration, and pressure injuries. Positioning elements need to be securely placed (for example under the sheet between two layers of non-slip mesh or attached to the base layer of the sleep system) so that the user remains stable and safe. Large, loose pillows are avoided because they are ineffective and potentially unsafe.

Without appropriate support, target populations tend toward asymmetrical postures. Additionally, people may be at risk of entrapment which involves the body or head getting stuck between sleep-related objects or furniture (National Institute of Child Health and Human Development, n.d). With LPCM, the person's entire body should be well supported. This enables a stable, relaxed and more symmetrical body position that limits the risk for entrapment. Additionally, heat management is a crucial element of safety as people with neurological impairment may have difficulty regulating body temperature (McCabe et al., 2022). Because

close postural supports may retain body heat, room temperature and blankets may need adjustment and products offering breathability may need to be chosen for the user to maintain a comfortable body temperature. Also, individuals at risk for aspiration must be carefully assessed for their respiration and ability to control their secretions while resting or sleeping, with potential modifications such as head and upper body elevation used as appropriate. Protection of skin integrity is another critical consideration. Sprigle and Sonenblum (2011) note that “body posture and positioning have a direct relationship to loads on specific body sites, which is why posture must be considered when devising pressure ulcer prevention strategies” (p. 208). They go on to advise “repositioning frequency should reflect the person, his or her equipment, and the environment of use” (Sprigle & Sonenblum, 2011, p. 110). When a person’s body is fully supported, pressure will be distributed in such a way that repositioning needs are often decreased. Skin checks are the best way to monitor increasing length of duration between position changes. The National Pressure Injury Advisory Panel (NPIAP, 2019) *Prevention and treatment of pressure ulcers/injuries: Clinical practice guideline* makes similar recommendations in terms of person-situation-centric repositioning frequency.

Relevance of Position

The World Health Organization (WHO, 2023a) estimates that 1.3 billion people, or 16% of the world’s population, have experienced significant disability with approximately 80 million requiring the use of a wheelchair (WHO 2023b, c). Thus, a substantial number of people worldwide live with mobility and motor-related impairments. The goal of this position paper is to support clinicians in reducing the global number of people with avoidable body shape distortion.

Nearly all children who experience spinal cord injury develop neuromuscular scoliosis while up to 75% of those with cerebral palsy are impacted (Hagglund et al., 2018; Pahys et al., 2014). As outlined in Table 2, these body shape distortions correspond with other conditions that impact health such as pain and disturbed sleep, in addition to being associated with early morbidity (Ágústsson et al., 2019; Fulford & Brown, 1976; Holmes et al., 2021a; Porter et al., 2007; Rodby-Bousquet et al., 2013).

In addition to the prevalence of these conditions associated with destructive lying postures, this LPCM position statement aligns with other symmetrical posture-related professional standards. The standard lying position is described by Tafti and Byerly (2022) as essential for medical imaging of the human body. Furthermore, healthcare professionals conduct assessments and interventions with a standard symmetrical starting position in lying such as Proprioceptive Neuromuscular Facilitation (Kim, 2015), Neuro-Developmental Therapy (Klimont, 2001), and posture assessments for seating and wheeled mobility (Lange & Minkel, 2024; Owens & Davis, 2023; Pope, 2007). In all therapeutic instances, the base posture is the most correct posture before commencing intervention or movement of the body. Positioning protocols for symmetry and the most anatomically corrected positions are accepted and widely implemented for patient/client-related diagnostic, assessment, and intervention purposes.

Table 2*Conditions Directly or Indirectly Associated with Posture and Body Shape Distortion*

Body structure/function	Evidence
<i>Contracture</i>	Cloodt et al., 2021; Hill & Goldsmith, 2010; Pickenbrock et al., 2015
<i>Hip dislocation</i>	Ágústsson et al., 2019; Porter, 2007; Pountney et al 2009, 2002; Miller et al., 2017.
<i>Scoliosis</i>	Ágústsson et al., 2019; Cary et al., 2016; Porter et al., 2007
<i>Swallow</i>	Alghadir, 2017
<i>Pain</i>	Cary et al. 2016; Cary, 2019; Casey et al., 2022a, 2022b, Holmes et al., 2021a, 2021b; Kittelson et al., 2024; Underhill et al. 2012
<i>Pressure</i>	Sprigle & Sonenblum, 2011; Hosking, 2017)
<i>Pelvic Obliquity</i>	Ágústsson et al., 2019; Porter et al., 2008;
<i>Respiratory Function</i>	Dawson et al., 2013; Hill et al., 2009; Koumbourlis, 2006.
<i>Cardiopulmonary Activity/Performance</i>	Deegan et al., 2023; Thomas, 2020
<i>Impaired Sleep Function</i>	Fogelberg et al., 2017; Hill et al., 2009; Piccinni et al., 2016; Mol et al., 2012; Smith & Haythornthwaite, 2004; Underhill et al., 2012,

RESNA and Constituencies

RESNA constituencies include AT professionals, AT users, and AT manufacturers. Each of these groups are key in providing AT for LPCM. AT professionals are involved throughout the entire service delivery process (from referral to follow-up) and may play a role in designing custom LPCM-products to ensure the AT meets the needs of a particular user. The AT user

presents with their own goals, habits, routines and customs which need to be considered throughout the service provision period. AT manufacturers support the efforts of both AT professionals and users by building technology solutions that are purpose-built and effective. AT for LPCM is an essential strategy for enabling people with motor impairments to lie in comfortable, supported and symmetrical positions. It should be used as a catalyst for increased attention, discussion, and development of LPCM best-practices so that RESNA constituents are well-equipped for LPCM implementation.

Significance to Society

The *best* practice for individuals with impaired movement should aim to address positioning in all three human orientations which would include the lying state. Without lying postural intervention, individuals continue to lie in asymmetrical positions, develop painful secondary health-conditions, and often require expensive and invasive medical procedures (e.g., hip and spine surgery) and/or other interventions such as tone reducing medications, botulinum toxin injections, and orthotics despite receiving PCM interventions for both sitting and standing postures. If LPCM was included as a part of standard care, it is possible that this cycle could be prevented while also reducing medical costs and improving health-related outcomes.

Rationale for the Position

Review of Literature.

Thus far, peer-reviewed published studies suggest that, at a minimum, body structures and functions, as well as activities (such as sleep), will remain stable while using LPCM, whereas without intervention those body structures tend to deteriorate (Holmes et al., 2019). Some studies indicate that sleep and pain may improve with LPCM (Kittelsohn et al., 2024; Stephens & Bartley, 2020); however, it is more likely that sleep remains stable while

improvements occur in body shape and musculoskeletal function (Goldsmith, 2000; Kittelson & Coombs, 2023; Pountney et al., 2009; Sato, 2020).

Stabilize/ Improve Body Structures and Functions

The most common benefits of using AT for LPCM appear to be related to the musculoskeletal system: however, there may be potential effects on the sensory and respiratory systems. For example, investigators have reported that when people (of a variety of ages and diagnoses) using AT for lying are placed in neutral or symmetrically aligned positions (over various time periods), changes in body structure and function occur. These changes include improved ability to lie straight, improved thoracic shape, relaxed muscle tone, reduced pressure, reduced daytime pain, and stronger cough or reduced risk of choking (Cary, 2019; Innocente, 2014; Kittelson et al., 2024; Kittelson & Coombs, 2023; Stephens & Bartley, 2020).

Additionally, investigators comparing groups have found those positioned towards symmetry had significantly better ($p < 0.001$) passive range of motion (PROM) of the hips and shoulders (flexion and external rotation), and comfort compared with those receiving sub-optimally aligned positioning (Pickenbrock et al., 2015). Those using AT for lying, when combined with PCM for sitting and standing, maintained significantly more hip integrity compared to those receiving only 2 of the 3 PCM orientations of intervention ($\chi^2 P < 0.05$; Pountney et al., 2002). Many of these studies did not specify how participants were positioned (e.g., how much-increased symmetry was achieved through the various positioning devices). Pickenbrock et al. (2015) reported results indicating that future studies should focus on how to precisely determine what degree of symmetry is needed to differentiate between LPCM outcomes: improved body symmetry or a halt in expected progression of body shape distortion.

Stabilize/ Improve Activity and Participation (Sleep)

Thus far, evidence related to using AT for LPCM during sleep suggests that sleep will remain stable and, in some cases, improve. Mol et al. (2012) examined sleep for 82 children with CP and found no statistically significant differences in sleep disturbance between children using or not using night orthoses (e.g. sleep systems, orthotics) ($L = 0.91$; $F(6,73) = 1.27$; $p = .28$) as well as no difference between children using sleep systems rather than orthoses ($L = 0.76$; $F(12,90) = 1.12$; $p = .35$). Additionally, Hankinson and Morton (2002) found that children using AT for LPCM over one year showed no significant changes in their number of sleep awakenings or sleep hours, but did find significant differences in the ability to settle into sleep ($n=7$, 0.05 mean change; Mann-Whitney, $\alpha = 0.01$). Goldsmith (2000) found children (24 out of 27) reportedly slept about the same or better after one year. Additionally, two separate pilot studies, one with adults in home care and another entitled “The Montana Postural Care Project” with persons across a variety of ages and conditions, found significantly improved sleep quality, $t(9) = 2.95$, $P=0.016$, after 12-weeks (Stephens & Bartley, 2020) or improved sleep quality after 6-9 months based on pre-post Pittsburgh Sleep Quality Index and Children’s Sleep Habits Questionnaire scores (Kittelson et al., 2024) Caregiver comments in the latter example paired improved daytime alertness with sleep quality.

Peer-reviewed studies provide critical information about the health-related outcomes for use of LPCM. However, individual cases provide valuable information about the use of LPCM’s critical importance for an individual given the uniqueness of users in this population. Thus, the following three case studies are presented to illustrate the efficacy of LPCM in very different scenarios.

Evidence from Sources Other Than Research Literature

Case Study: Joe

Joe is a 54-year-old man with mild intellectual disability, profound deafness, and MS. He lived in a group home, had an intrathecal baclofen pump for tone management and used a power wheelchair for mobility, in which he sat with posture deviations. Joe was referred for evaluation at a wheelchair clinic two hours from his home because of headaches, chronic shoulder and neck pain that was poorly managed with medication, and pain-related behavior outbursts. At the evaluation, sleep, pain and postural ability were assessed. During the mat assessment Joe's asymmetrical sitting and lying postures were noted to mirror each other. Joe was not placeable in neutral alignment, but he had flexibility toward neutral and could be positioned to rest and sit in greater symmetry than was typical for him.

At the clinic visit, Joe and his assistants were taught how to use everyday materials at hand to support his lying posture in improved alignment. Lateral supports were placed snugly on both sides of his hips and chest as well as under his legs, accommodating his more limited knee extension on one side. Over the next two months, Joe slept in the supported lying position with follow-up via photo documentation provided by his assistants.

At Joe's next clinic visit two months later, both Joe and his assistants reported that he was now sleeping well at night, had stopped requesting pain medication at bedtime and his behavior outbursts had abated. Additionally, his postural ability improved, and he could now be placed in a more neutrally aligned lying position.

First Person Perspective: Abby

Abby is an enthusiastic proponent of LPCM because of its contributions to her increasing independence. Abby has lived with cerebral palsy since birth. Initially functioning at Gross Motor Function Classification System (GMFCS) level 2, she walked from 4 years old using Ankle Foot Orthoses (AFOs) and a walker until she was 18 years of age at which time changes in

her body required her to use a manual wheelchair as her primary mobility aid. After a complicated hospitalization she received new wheelchair seating that was poorly fitted, resulting in pressure injuries and difficulty propelling, and confining her to bed (her words). Abby had shortened hip flexors and hamstrings, posture asymmetries along with pain, and migraine headaches. She had been told that she needed to consider transitioning from a manual to a power wheelchair due to pain and difficulty with self-propulsion. Abby did not want to make the lifestyle changes that power mobility necessitates. She remembered hearing about 24-7 PCM from her previous clinician and subsequently requested that clinician's help. During evaluation, the clinician assessed function on a "good day", pain, and postural ability. The wheelchair seating problems were noted and changes were initiated.

Abby was fitted with lying supports that were purchased from a medical supply company; these included a supine leg support pillow and half-round bolsters with a grab handle on the end. Learning to sleep on her back with postural supports wasn't easy. She had felt comfortable in her original, habitual fetal sleeping posture, curled up on her side in a ball and waking in the morning in the same position. However, the curled posture reinforced all the same problems she had in sitting. Little by little, Abby started teaching herself to lie on her back in short, daytime sessions, whenever she needed a break from her painful wheelchair seating. After a month she was using the lying supports for up to 4 hours and was able to fall asleep using the supports.

In Abby's own words: In a webinar for the RESNA 24-7 PCM Special Interest Group, Abby says:

*It was really hard (making the change from sleeping curled up to sleeping on my back)...
but I realized if I kept down the path I was on, I might not be able to do all the things I*

wanted... like play with my dog... or use a manual wheelchair as long as I want to...at first I would do it for five minutes every day and distract myself with my phone...about a month in I was up to 4 hours... and gradually I moved it to when I was closer and closer to falling asleep, and then I was just able to fall asleep. Later, when I had surgery, it was 12 weeks of flat on my back... and posture care was a lifesaver. (2023).

Figure 3

Abby's 24 hours of Posture Care

A DAY IN THE LIFE: Abby ...

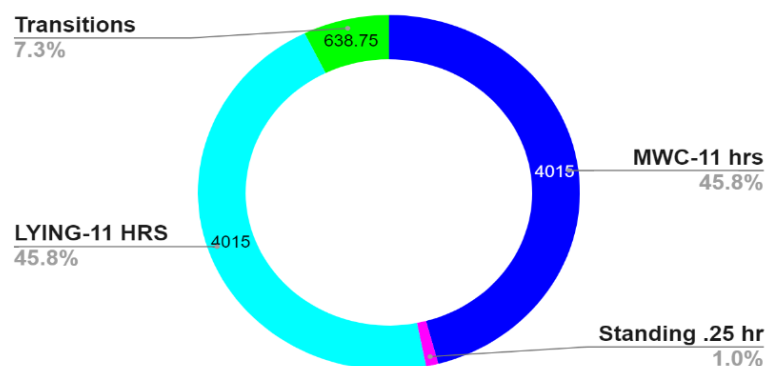


Figure 3 represents “a good day”, when everything about Abby’s body and her wheelchair were working perfectly. She had time to play with her dog, water her garden, fix her own breakfast and lunch, play her saxophone, as well as go out to see friends and attend appointments. Note that even on “a good day”, Abby spent as much time in bed as she does in her chair, and her day includes several lying down rest breaks. Abby reports that **about 30% of the time** she has “a bad day” when she is very fatigued, has body pain, a migraine, or wheelchair malfunction. On those days she spends at least 4 additional hours in bed using her supportive positioning. Abby says:

“Before learning lying posture care management, I slept on my side curled up, and woke up in exactly the same position... I had a lot of neck pain and migraines and spent a lot of time in bed... When I rested in bed during the day, I used to lay with my hips and knees flexed then too. It made everything worse, and I didn't know it” (RESNA 24-7 PCM SIG webinar 2023)

Five years after Abby initiated using LPCM, she can straighten her legs nearly to full extension and lie supine flat on her back with one pillow. She reports more good days than bad days and uses LPCM every night and during the day for breaks from her chair. She has no skin breakdown and has been able to stabilize her body shape distortions and continues to use her preferred mobility tool: a manual wheelchair.

Case Study: Kate

Kate is a 6-year-old girl who lives in a low/middle income country. Her mother learned about LPCM from an occupational therapist as a part of required training in 24-hour posture care management. This training occurred when Kate was 2 years old, prior to Kate receiving her first wheelchair from a non-profit organization. Kate has CP with hypotonia which presented with gross motor function similar to a person with GMFCS level V. When evaluated, Kate was unable to be placed in neutral alignment. She tended to lie with her head and chest turned to her right and legs abducted or windswept toward her right. Kate was at risk for developing chest flattening and rotation as well as hip dislocation.

A formal sleep positioning system was inaccessible, so the care team created a system of support made from specially applied everyday materials that could be placed on Kate's mattress. Her mother made lateral trunk and hip supports by covering sand-filled plastic bottles with fabric and constructing Velcro straps so the supports could be secured anteriorly and posteriorly at

Kate's torso while allowing for growth and quick removal as needed. The OT carved a custom foam pillow to support Kate's head in midline and a foam supine leg positioner to align her hips and knees.

Nine months later, at 3 years old, Kate's chest was a typical, rounded shape and the rotation was corrected. At age 6, Kate continues to rest and sleep using this homemade sleep system that has become part of her routine. LPCM in conjunction with supportive seating have helped Kate's family care for her and preserve her body shape.

Synthesis of the Current Evidence

These case studies and the existing peer-reviewed literature align with this position paper's stance that LPCM be implemented along with PCM for sitting and standing as standard practice of 24-hour PCM. Without LPCM some individuals with mobility limitations will continue to lie in asymmetrical postures for extended time-periods and develop painful secondary health-conditions that typically worsen and often require expensive and invasive medical procedures. The present evidence to universally incorporate LPCM suggests that such secondary conditions can be prevented or stabilized when LPCM is added to the PCM regimen. Because the overall body of evidence about the impact of LPCM is limited, it's important that care and research teams continue to gather data to further develop service delivery protocols and evidence of LPCM outcomes.

Limitations:

The limited number of studies examining LPCM outcomes, levels of the evidence and lack of universal standardized intervention procedures present limitations. As of 2019 there have been approximately 14 published studies that have specifically examined LPCM intervention outcomes (Humphreys et al., 2019). The levels of evidence have been described as "low" to

“medium” quality (Humphreys et al., 2019), in-part due to the published studies’ sample sizes, design types and time-periods over which LPCM is implemented. Additionally, some of the studies that included randomization (which would otherwise elevate the study’s quality level), investigated LPCM use over the course of 1-3 nights and/or outside of the natural context such as in a laboratory rather than the home-setting. While a number of LPCM care pathways have been published to support best practices for LPCM (Clayton & Goldsmith, 2014; Humphreys & Pountney, 2006) more work needs to be done to establish standardized protocols. Some published studies fail to accurately describe how participants were positioned (e.g., how much increased symmetry was achieved through the various positioning devices) making it a challenge to understand which positioning-based strategies were most effective. A report from Pickenbrock et al. (2015) stated that future studies should be done to detail precisely what degree of symmetry is needed for determining LPCM outcomes, even though the unique differences in the PCM target population may make this challenging. Such information would help the care team better predict whether LPCM outcomes will more likely result in functional stability or improvements. Moving forward, it will be valuable for providers and those conducting research to further establish and communicate positioning-based protocols, ensure LPCM studies are well-designed, and share information to resolve the stated limitations and ensure better understanding of LPCM’s health-related impacts.

Relation of this Position Paper to other Position Papers

This position paper’s purpose is to expose the present notable gap in the 24-hour Posture Care Management (PCM) approach which does not mandate the inclusion of Lying Posture Care Management (LPCM). This manuscript complements the established literature resources related to postures of sitting and standing (Babinec et al., 2013; Dicianno et al., 2015; Masselink et al.,

2024; Rosen et al, 2018; Worobey, 2023). The concept of 24-hour PCM emphasizes the importance of continuously supporting optimal body alignment across all functional positions, including lying, to prevent secondary complications associated with prolonged immobility and asymmetrical postures. While RESNA's previous position papers have comprehensively explored various aspects of supported standing, pediatric power mobility, tilt and recline systems, elevating leg rests, ultra-lightweight manual wheelchairs, and other seating systems for positioning (Babinec et al., 2013; Dicianno et al., 2015; Masselink et al., 2024; Rosen et.al, 2018; Worobey, 2023), they notably lack explicit guidance regarding lying posture within the PCM framework.

Addressing lying posture within PCM is crucial, as the exclusion of lying posture from prior frameworks potentially limits the scope of posture care management, impacting individuals' ability to maintain functional alignment in all positions over a 24-hour cycle. Including LPCM as part of this broader PCM initiative offers a more holistic approach to posture care management, reinforcing its relevance across all daily functions and activities. By expanding on these aspects, this paper fills a critical knowledge gap within the domain, supporting a more comprehensive understanding of posture care management that extends beyond traditional positioning in sitting and standing postures.

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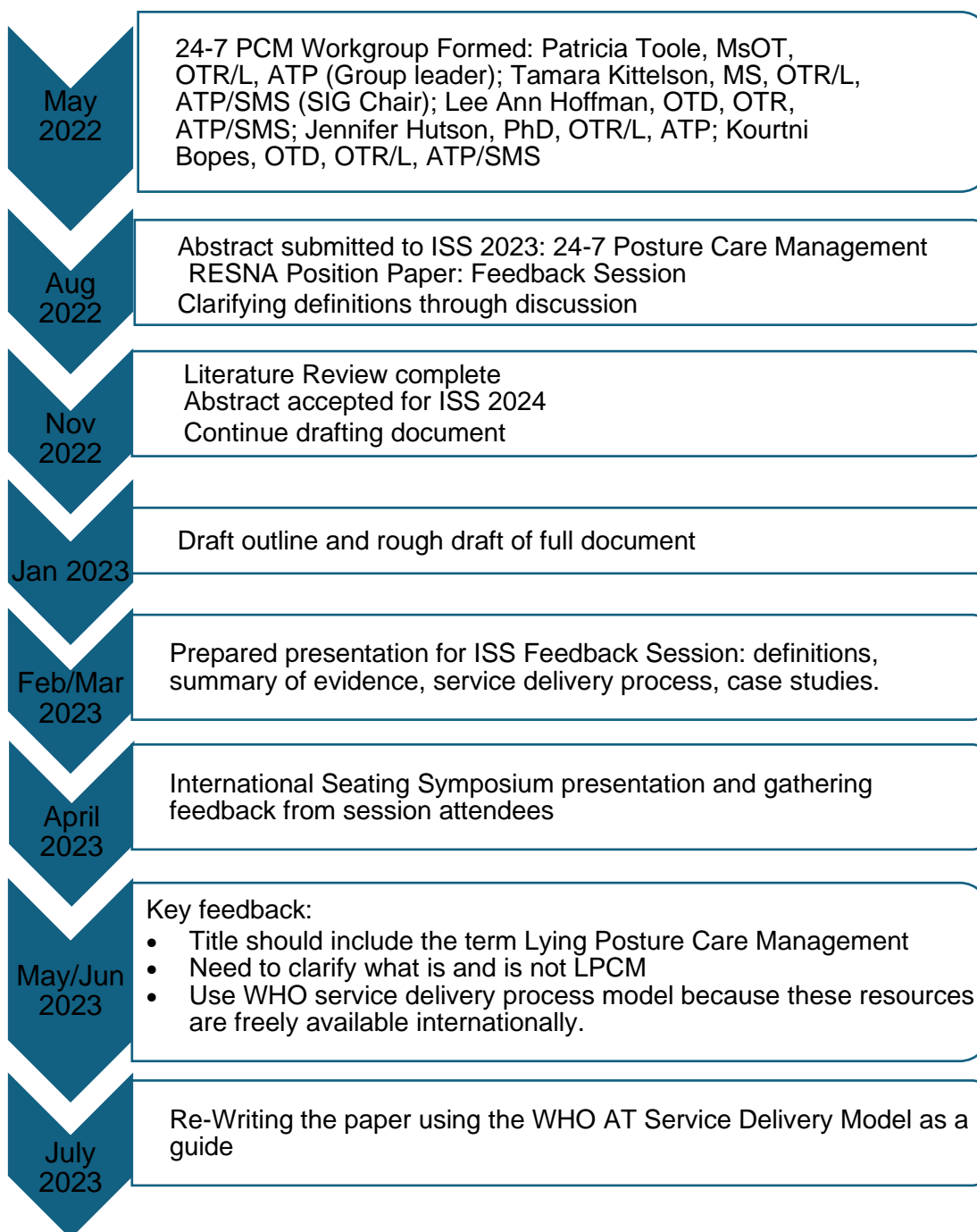
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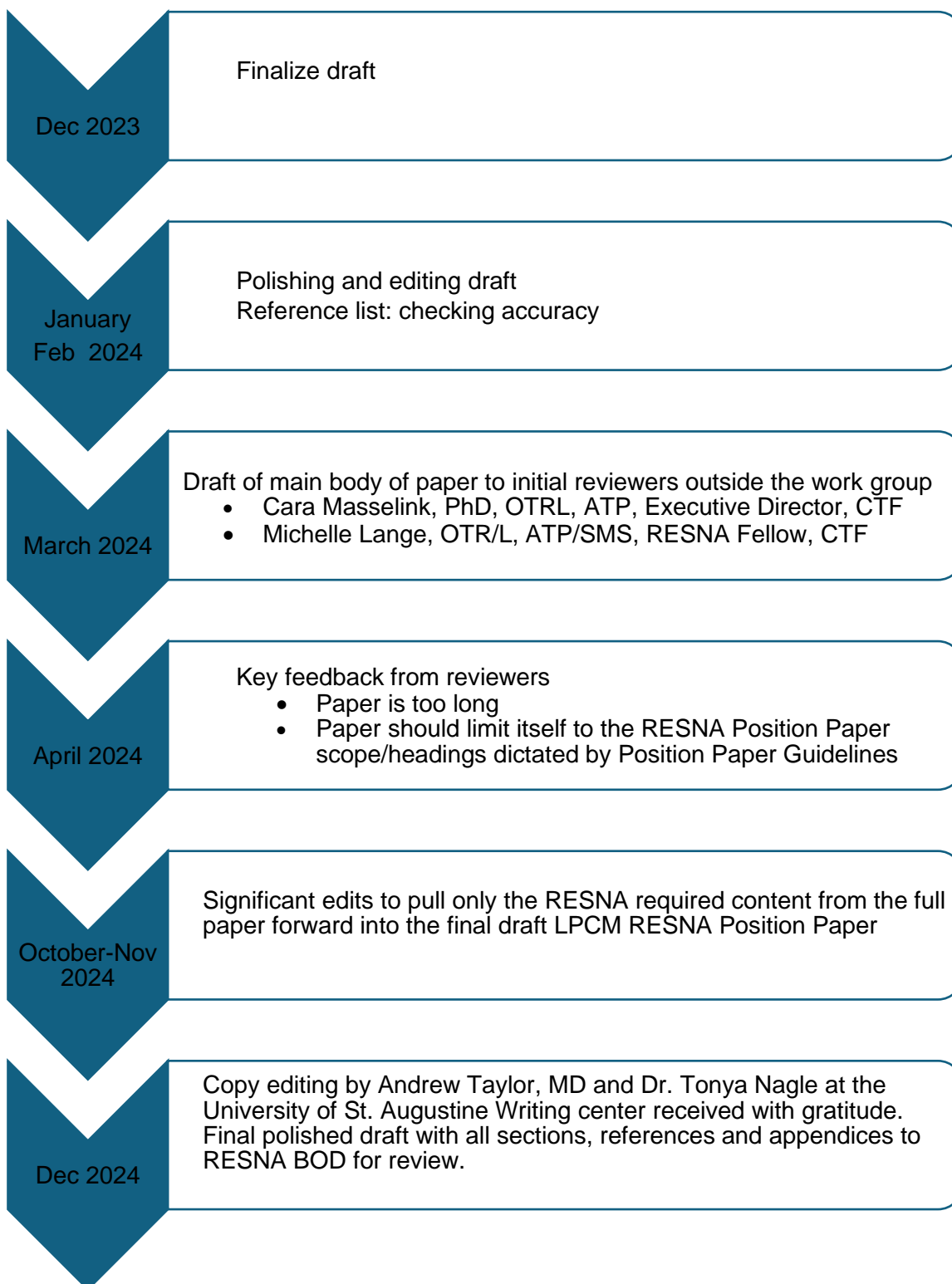
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Appendix A

Process and Chronology Used to Develop and Review the Position Paper





Appendix B

Development and Review Process

The workgroup was convened at the request of the 24-7 PCM Special Interest Group Chair, Tamara Kittelson with the approval of the RESNA board of directors in May 2022. Workgroup members were selected based on relevant experience, scholarship and interest in the topic. Group members had previously presented a review of current evidence related to 24-7 PCM at the RESNA Conference in July 2021 and began by updating the literature review. Regular meetings were held to clarify definitions, develop a topical outline, and review progress. To gain feedback specifically from professionals working with target populations, the group presented *RESNA Position Paper Application of 24-7 Posture Care Management: Feedback Session* at the 2023 International Seating Symposium (Toole et al., 2023). Feedback from participants was incorporated into subsequent drafts as outlined in the timeline in Appendix A.

Expertise of workgroup members

Patricia Toole, MAT, MsOT, OTR/L, ATP

Clear Path Occupational Therapy; Co- Chair, RESNA 24-7 Posture Care Management SIG

Patricia Toole, OTR/L, MsOT, MAT, ATP is an Occupational Therapist with 26 years of lived experience in assistive technology, seating, positioning and 24-7 postural care management. First trained as a teacher, she was thrust into the world of complex neurodisability with the unexpectedly premature birth of her oldest son, Alex in 1998. Since graduating with a MS in Occupational Therapy from University of Puget Sound in 2005, she has worked in the areas of assistive technology, wheeled mobility, and 24-7 PCM including 10 years leading the seating and assistive technology clinic at PROVAIL in Seattle. Patricia has presented nationally

and internationally including RESNA 2021 and ISS 2023, published for NRRTS and co-authored the 24-7 PCM chapter in Seating and Wheeled Mobility a Clinical Resource Guide. She is the founder and owner of Clear Path Occupational Therapy, continues to directly care for complex patients, and has served as Contributing faculty for University of St. Augustine for the Health Sciences, Dallas. Member: CTF, AOTA, WOTA, RESNA, ARATA. Chair WOTA- LC. Co-chair RESNA 24-7 PCM SIG. She is grateful for the lessons learned from her four boys, including Alex, 26, who lives with spastic quadriplegia cerebral palsy and complex medical needs.

Tamara Kittelson, MS, OTR/L, ATP/SMS

Executive Director, Posture 24/7, Founding Chair, RESNA 24-7 Posture Care Management SIG

Tamara graduated as an occupational therapist from St Catherine University in 1975, and completed her Master of Science in Rehabilitation Medicine/Early Intervention Specialty in 1981. She is certified as an Assistive Technology Professional and Seating and Mobility Specialist by the Rehabilitation Engineering and Assistive Technology Society of North America and as an intermediate wheelchair provider by the International Society of Wheelchair Professionals. She has utilized 24-hour posture care management, including the lying orientation, for more than 20 years as an integral part of her wheeled mobility practice. She published the results of The Montana Postural Care Project as well as a case study on this topic and has written and presented nationally and internationally. Tamara 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 a Friend of NRRTS, founding chair of the RESNA 24-7 Posture Care Management Special Interest Group, and a member of AOTA, RESNA, and currently Executive Director of the Clinician Task Force. She served children and

adults with complex neurodisabilities in Montana, 1983-2022. Tamara credits her daughter Eleanore, born with cerebral palsy and profound deafness, as her best teacher.

Lee Ann Hoffman, OTD, MSc., OTR, ATP/SMS, CAPS

Assistant Program Director – Occupational Therapy, University of St. Augustine for Health Sciences

Lee Ann Hoffman is an experienced occupational therapist with three decades of expertise in the field. She earned her bachelor's degree in occupational therapy from the University of Pretoria (RSA). Lee Ann holds a postgraduate certificate in Posture Management for Complex Disabilities and a Master of Science degree in Posture Management (with distinction) from Oxford Brookes University (UK) where her research focused on the relationship between posture and pressure care management in lying postures. She obtained her Post-Professional Doctorate in Occupational Therapy (with high honors) at the University of St. Augustine for Health Sciences (USA). Her doctoral work encompassed developing a supplemental assistive technology curriculum for posture care management tailored to occupational therapy students. With professional experience spanning four continents, Lee Ann has provided posture care management services and education in diverse clinical and resourced settings. Lee Ann is a certified Assistive Technology Professional (ATP) with advanced certification as a Seating Mobility Specialist (SMS) through the Rehabilitation Engineering and Assistive Technology Society of North America (RESNA). Lee Ann is a member of the Clinician task Force (CTF) and served a three-year term on the executive board. Currently, she is the lead instructor for the Assistive Technology course and is an assistant professor, and the assistant program director for the Occupational Therapy Programs at the University of St. Augustine for Health Sciences, Dallas, Texas campus.

Jennifer Hutson, PhD, OTR/L, ATP

Associate Professor- Department of Occupational Therapy, St. Catherine University

Jennifer Hutson is an associate professor in the Department of Occupational Therapy at St. Catherine University. She teaches courses primarily in assistive technology, adult rehabilitation and research. She facilitates problem-based learning sessions and advises students on evidence or research based Doctoral Capstone projects and Master's projects, covering a range of topics some of which include 24-hour postural care, seating and positioning for wheeled mobility, sleep and nighttime positioning. In addition to teaching, Jennifer also serves clinically as a sleep care positioning consultant. From 2002-2021, Jennifer's clinical practice has been at Gillette Children's Specialty Healthcare in the area of assistive technology, primarily seating and positioning. While employed at Gillette Children's Specialty Healthcare she participated in research and developed staff competency-based tutorials. In February 2020, she was awarded a PhD in Rehabilitation Science from the University of Minnesota, after completing research focused on sleep and sleep positioning for persons with cerebral palsy. She specifically examined 1) assessments used to measure sleep-based intervention changes and 2) caregiver's perceived and observed competence to implement nighttime postural care after receiving online training. Next, she plans to investigate the health effects of nighttime postural care, examining factors such as quality of life, sleep, pain and body shape and experiences of sleep contexts for children with mobility impairments.

Kourtnei Bopes, OTD, OTR/L

Occupational Therapist, Central Wisconsin Center

Kourtni Bopes, OTD, OTR/L is an Occupational Therapist at Central Wisconsin Center (CWC) in Madison, Wisconsin. While in the Doctor of Occupational Therapy program at St. Ambrose University, Kourtni completed both her research and doctoral work on LPCM. Kourtni completed her Doctoral Experiential Component (DEC) at an Intermediate Care Facility for Individuals with Intellectual Disability (ICF/ID) where residents receive 24-hour posture care management including lying orientation positioning programs. During this experience, Kourtni gained hands-on experience creating, implementing, modifying, and supporting positioning programs in the lying orientation. While on her DEC, Kourtni also created resource materials and educated staff in order to enhance their existing program. Kourtni credits her nephews, Carter and Bastian, for teaching her the importance of LPCM.

Appendix C

Competent Workforce

LPCM providers are typically occupational therapists and physical therapists with advanced training. LPCM referral sources, while essential members of the team, do not require assessment and implementation skills, only screening skills. For example, a client who is recently injured and now cannot change their position in bed or a post-premature infant who is not meeting milestones at a home visit should both be referred for assessment. Providers require training that is multifactorial (McGuire et al., 2022) and covers LPCM-relevant content including LPCM purpose and evidence, ways of managing health risks, positioning the person, how to choose from the available AT, how to select appropriate assessments (Hutson et al., 2021). Additional knowledge that will assist providers ability to support LPCM candidates through service delivery includes foundational knowledge of human anatomy/physiology, developmental milestones, biomechanics, diagnosis-specific criteria as well as skills for screening & observation, goal setting, communication, problem-solving and modifying intervention (Castle et al., 2014, Lange & Minkel, 2024).