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Inpatient Rehabilitation For A 75-Year-Old Female Following A Left-Sided Pontine Infarct: A Case Report

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1 **Inpatient Rehabilitation For a 75-year-old Female Following a Left-Sided Pontine Infarct:**
2 **A Case Report**

3
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8
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12 The patient gave written and verbal consent for her medical history to be discussed. The
13 patient received information regarding the University of New England's Health Insurance
14 Portability and Accountability Act (HIPAA) policies and agreed to be the subject of this case
15 report.

16
17 Key words: pontine infarct, gait training, functional mobility, balance training

20 **ABSTRACT**

21 Background and Purpose: Although cerebrovascular accidents (CVAs), or strokes, occur often in
22 the United States, only 7% of those strokes affect the pons, an area of the brainstem that provides
23 life-sustaining functions. Due to the rarity of pontine strokes, there is insufficient evidence
24 supporting successful interventions that yield functional benefits for patients admitted to
25 inpatient rehabilitation units (IRU). The purpose of this case report was to examine gait, balance
26 and functional mobility interventions on the restoration of mobility and functional independence
27 of a patient within an IRU.

28 Case Description: The patient was a 75-year-old female 3 days status post a pontine stroke who
29 was admitted into the IRU to improve independence and functional mobility after presenting
30 with dysphagia, right-sided weakness and impaired functional mobility. Her plan of care
31 included lower extremity (LE) strengthening, gait training with and without body-weight
32 support, balance training and functional transfer training. Outcome measures used were the Five
33 Times Sit to Stand (5xSTS), 10-Meter Walk Test (10MWT), Functional Gait Assessment (FGA),
34 Inpatient Rehabilitation Unit-Performance Assessment Inventory (IRU-PAI), manual muscle
35 testing (MMT), sensation and coordination testing.

36 Outcomes: The patient improved right LE strength averaging 4/5, increased gait speed from 0.13
37 m/s to 0.4 m/s on the 10MWT, improved functional transfers from minimal contact assistance to
38 supervision and improved ambulation from 35 feet to 350 feet without an assistive device and a
39 contact guard assist by time of discharge.

40 Discussion: LE strengthening, balance, gait training and transfer training were beneficial for
41 restoring functional mobility in this patient with subacute pontine stroke. Further research should
42 be performed to assess interventions for patients of varying demographics and stroke types
43 within IRUs.

44 Word count: 3,163

45 **INTRODUCTION/BACKGROUND and PURPOSE**

46 Each year, *cerebrovascular accidents* (CVA), commonly known as strokes or infarcts,
47 affect nearly 795,000 people in the United States.¹ CVAs are among the top five leading causes
48 of mortality in the US, currently affecting 3.0% of the population with projections delineating an
49 increase up to 4% by the year 2030. Individuals who survive a stroke may have disablement and
50 functional mobility deficits that last throughout their lifetime.¹ Strokes can be categorized two
51 ways; *hemorrhagic*, a ruptured blood vessel in the brain causing excessive bleeding, or
52 *ischemic*, insufficient blood flow to a vessel causing lack of oxygen to the affected area of the
53 brain.²

54 Ischemic strokes can affect cortical structures as well as the brainstem. Approximately
55 7% of strokes affect the pons, (pontine infarct), which affects life-sustaining functions such as
56 breathing, heart rate and blood pressure regulation.³ Lack of oxygen to the pons compromises
57 these vital functions and can also lead to *hemiparesis*, or paralysis of one side of the body.^{3,4}

58 Patients presenting with ischemic strokes often are admitted into inpatient rehabilitation
59 facilities to restore function and improve safety prior to returning home. Jette et al⁵ reported that
60 patients admitted for an inpatient stay benefited from functional mobility training that
61 emphasized balance, gait, postural awareness and motor learning concepts. Another technique
62 found to be beneficial for gait and balance was body-weight support to improve gait mechanics
63 and help restore functional mobility.⁶ In addition, balance training interventions using cable
64 systems for perturbation training have been found to improve stepping strategies in patients who
65 have previously had a stroke.⁷

66 While therapy interventions have been researched and utilized to help patients regain
67 functional mobility following a stroke, there is limited research describing subacute

68 rehabilitation in an inpatient facility for patients who have had a stroke affecting the brainstem.
69 The purpose of this case report was to examine gait, balance and functional mobility
70 interventions on the restoration of mobility and functional independence in a 75-year-old patient
71 with a subacute pontine infarct.

72 **Patient History and Systems Review**

73 The patient gave written and verbal consent for this case report. The patient was a 75-
74 year-old Caucasian female referred to the inpatient rehabilitation unit (IRU) three days after
75 being admitted to the Emergency Department (ED) of the hospital following a left-sided
76 paracentral pons infarct. She presented to the ED with symptoms of right arm weakness, diffuse
77 right lower extremity weakness and difficulty speaking. Upon arrival to the hospital, the patient
78 was found to have subtle right facial droop, dysarthric speech, right sided pronator drift and
79 diminished strength throughout the right side of her body. Magnetic resonance imaging (MRI)
80 was performed and determined the distribution of the infarct included the left paracentral pons as
81 well as traces of lacunar infarcts within the corona radiata, right external capsule and left
82 thalamus.

83 The patient had a past medical history of a left bundle branch block, multiple abdominal
84 surgeries and small bowel obstruction. Comorbidities included hypertension, hyperlipidemia,
85 hypothyroidism, a family history of depression, coronary artery disease and pancreatic cancer.
86 There was no history of familial stroke or neurological conditions. Patient medications can be
87 found within Appendix 1.

88 The patient was unmarried and lived alone with her small indoor dog. Her home was a
89 single level condominium with no stairs to enter. She did not have any family members who
90 lived nearby, but had intermittent social support from several neighbors and friends. She was a
91 retired lawyer who enjoyed reading, walking her dog and frequenting local art galleries.

92 Upon admission to the IRU, the patient underwent an initial evaluation by physical
93 therapy. The patient presented with right-sided hemiparesis, dysarthria and impaired functional
94 mobility. Please see Table 1 for a detailed systems review.

95 During the functional assessment, the patient performed bed mobility with supervision
96 and required minimal assistance to transition from supine to seated. She was able to maintain a
97 static seated position at midline for five minutes, but required moderate assistance to correct a
98 posterior right-sided loss of balance during lower body dressing. Wearing a gait belt, the patient
99 transferred from sitting to standing using a front-wheeled walker (FWW) with moderate
100 assistance. She was then able to ambulate 35 feet with the walker and moderate contact
101 assistance. While walking, the patient demonstrated right hip circumduction, right foot drop,
102 right knee hyperextension thrust, short step length of the right foot and decreased dorsiflexion
103 with diminished right heel strike.

104 Following the gait analysis, further examination was performed. The patient
105 demonstrated decreased right-sided strength, impaired motor planning, reduced coordination,
106 impaired standing balance and impaired gait. A full list of the results for the initial evaluation
107 and examination can be found in Table 2.

108 Throughout the evaluation, the patient's chief complaints were her impaired balance, gait
109 and dysarthric speech. She perseverated on the concern that she might never return to her
110 baseline of independence with mobility and would have to rely on others to accomplish her daily
111 needs.

112 The patient was a good candidate for this case report due to her high motivation to regain
113 full independence with all activities of daily living (ADLs) and functional mobility despite her
114 significant balance and gait impairments.

115 **Examination – Tests and Measures**

116 During the initial evaluation, the following tests and measures were performed to assess
117 functional impairments the patient presented with: Five Times Sit to Stand (5xSTS), 10-Meter
118 Walk Test (10MWT), Functional Gait Assessment (FGA), Inpatient Rehabilitation Unit-
119 Performance Assessment Inventory (IRU-PAI), manual muscle testing (MMT) and sensation and
120 coordination testing. All psychometric properties for tests and measures can be found in
121 Appendix 2.

122 The 5xSTS test is a core outcome measure utilized to assess the patient’s ability to
123 perform functional transfers and can assess risk for premature mortality and balance
124 impairments.^{8,9,10} This standardized test was performed with standard height chair (17-18 inches)
125 and a stopwatch to assess the patient’s ability perform multiple sit-to stand transfers as safely and
126 quickly as possible. Patient results can be viewed in Table 2. Following the assessment of
127 functional transfers, gait speed was measured.

128 The 10MWT, another core outcome measure, was performed to assess gait speed and
129 evaluated the patient’s ability to be a “community ambulator.” This test also predicted the
130 likelihood of being able to participate in safe ambulation within the community or residence.^{8,11}
131 The patient ambulated down a standardized 10-meter runway with the middle six meters being
132 timed.¹² The two meters on each end of the runway were for the acceleration and deceleration
133 phases of gait. The patient performed two trials using a FWW at both a “comfortable speed” but
134 was unable to complete a trial at the “fast speed,” due to fatigue. Trial times were averaged for
135 the “comfortable speed”, which was calculated to be 45 seconds. Gait speed calculations can be
136 seen in Table 2. The patient’s “comfortable speed” corresponded to a “household ambulator” as
137 distinguished by Perry.¹³

138 Once gait speed was assessed, further balance related measures were attempted. The FGA
139 is a recommended test to assess dynamic balance during gait.⁸ Although attempted, the FGA was

140 not fully performed due the inability of the patient to ambulate without assistance from the
141 student physical therapist, resulting in a score of 0/30 for baseline measurement. Patient results
142 can be seen in Table 3. The FGA was completed using a standardized 20-foot path with a width
143 of 15 inches.¹⁴ The patient was assessed on her ability to maintain a consistent gait speed, avoid
144 deviations outside of the 15-inch path while performing each balance task provided by the test.

145 After the assessment of dynamic balance, a comprehensive functional mobility
146 assessment was performed. As regulated by Medicare guidelines, the IRU was required to
147 complete the IRF-PAI for each patient that entered the rehabilitation facility. The IRF-PAI
148 assessed all aspects of functional mobility and was a daily assessment to measure the quality of
149 care the patient received to justify the medical necessity of therapy to insurance. The physical
150 therapy discipline was responsible for documenting only mobility aspects of the IRF-PAI.¹⁵
151 Results from the IRF-PAI can be seen in Table 4.

152 The completion of strength testing was performed using the MMT guidelines set forth by
153 Kendall et al.¹⁶ Right upper and lower extremity strength scores were measured to determine the
154 patient's strength impairments and were utilized as a baseline measure to assess if strength
155 improvements occurred. The student physical therapist performed the MMT with results shown
156 and described in Table 2.

157 Finally, sensation and coordination testing was performed following the protocols set
158 forth by O'Sullivan et al.¹⁷ Sensation and coordination results can be seen in Table 2.

159
160 **Clinical Impression: Evaluation, Diagnosis, Prognosis**
161

162
163 Based on the examination data, the patient's presentation corresponded with the initial
164 clinical impression in regards to her diminished balance, motor control, and right-sided strength
165 as well as her impaired gait. The patient continued to be appropriate for this case report due to

166 her decreased functional mobility and motivation to return to her fully independent baseline. The
167 clinical decision was to continue with treatment to address all functional mobility deficits.

168 During the IRU stay, the proposed plan of care involved three hours of therapy per day,
169 consisting of physical therapy to address functional mobility limitations, consultation from
170 speech therapy (ST) to address dysarthric speech and occupational therapy (OT) to increase
171 independence with ADLs. No outside referrals were needed at this time. Due to the patient’s left-
172 sided pontine infarct, the medical diagnosis was a “brainstem stroke syndrome” classified by the
173 ICD- 10 code of *ICD-10 G46.3*.¹⁸ The patient’s physical therapy diagnosis was *ICD-10 I69.851*
174 “Hemiplegia and hemiparesis following other cerebrovascular disease affecting right dominant
175 side.”¹⁸ A formal re-evaluation did not occur, as the patient was only at the IRU for three weeks,
176 however, daily assessments of patient status were done and the plan of care was altered
177 accordingly.

178 The patient had a good prognosis due to her high levels of motivation, independent prior
179 level of function and active movement in her affected right upper and lower extremities.
180 Another positive prognostic indicator for a more favorable outcome was based on research by
181 Deutch et al¹⁹ stating inpatient rehabilitation stays following a stroke improved functional
182 outcomes and increased the patient’s ability to be discharged back home.

183 The initial length of stay determined by all disciplines was three weeks. The primary
184 impairments addressed during physical therapy were impaired strength, endurance, balance, gait
185 deviations and decreased ability to perform functional transfers without assistance. Planned
186 interventions also included the use of the ZeroG Body Weight Support System (BWS) (ZeroG
187 Ashburn, VA) for functional gait training with and without an assistive device.

188 Short- and long-term goals were created based on the initial impairments and were set to
189 address bed mobility, transfers, gait and balance. Goals can be found in Table 5.

190 **Intervention and Plan of Care**

191 Patient care was coordinated with OT, ST, nursing, case management and the IRU physician
192 at weekly team conferences. At each conference, the interdisciplinary team discussed functional
193 improvements, barriers to discharge and potential benefits of transitioning to a skilled-nursing
194 facility for continued improvements to ensure a safe return home. All communication and
195 documentation regarding patient progress and interdisciplinary team meetings were recorded into
196 the electronic medical record, EPIC (Epic Systems Cooperation, Verona, WI.)

197 The interdisciplinary team educated the patient on the etiology of her stroke and the plan of
198 care to improve functional mobility with goals to restore functional independence back to
199 baseline. She was informed about the intensive daily therapies between PT, OT and ST each for
200 one hour per day and was committed to attending all scheduled sessions. The patient was
201 compliant with attendance and educated regarding her planned discharge date. Further patient
202 education was provided at weekly stroke classes, which were led by an OT, PT or ST regarding
203 common impairments, post-stroke and interventions to yield functional improvements.

204 Interventions focused on therapeutic exercise for LE strengthening, balance and gait training,
205 endurance, and functional mobility training in order to improve independence and decrease risk
206 of falls. Please see Table 6 and Appendix 3 for more detailed weekly intervention parameters.

207 **Therapeutic Exercise**

208 Initial interventions focused on supine exercises targeting the hip extensors, hip flexors, knee
209 extensors, ankle dorsiflexors and ankle plantarflexors which were later progressed to seated and
210 standing exercises with additional balance tasks. LE strengthening exercises were essential to
211 retraining motor recruitment and accurate firing rates to ensure proper biomechanics.²⁵ Emphasis

212 on re-training of the hip flexors, knee flexors and ankle plantarflexors were shown to correlate to
213 improvements in gait speeds in patients post-stroke.²⁶ As the patient made improvements in LE
214 musculature, balance interventions were integrated.

215 **Balance Training**

216 The patient presented with both reactive and anticipatory control deficits, both of which are
217 essential to maintain static and dynamic balance during functional tasks.¹⁷ Static and dynamic
218 standing exercises were initiated with the use of parallel bars, Airex foam pad (Airex AG,
219 Somersworth, NH), and perturbation training using ZeroG BWS (ZeroG, Ashburn, VA)(please
220 see Appendix 4) to improve ankle and stepping strategies. Balance training interventions were
221 performed during each session for approximately 15-45 minutes depending on other priority
222 interventions. Balance training frequencies of five times per week for 45-60 minutes was found
223 to be beneficial for patients after an acute stroke.²⁷ As the patient improved in static and dynamic
224 balance, more vigorous gait training with ZeroG BWS was performed.

225 **Gait Training**

226 Gait training was integrated using ZeroG BWS to allow the patient to restore normalized gait
227 mechanics and improve functional mobility using the least restrictive device. For the first
228 session, BWS of 15% was trialed with final sessions decreasing to 9%. An ACE wrap (ACE
229 brand, Maplewood, MN) was used on the right foot as a dorsiflexion assist due to decreased
230 strength and toe clearance during ambulation, which was later discontinued following improved
231 right dorsiflexion strength. The patient began gait training using a FWW, which was quickly
232 discontinued as it caused the patient to become uncoordinated and frustrated. Next, a narrow-
233 based quad cane (NBQC) was utilized but again, discontinued due to the patient's inability to
234 adequately sequence the device and alternate LEs. It was determined that more normalized gait
235 mechanics occurred when the patient was not using any assistive device(AD) during overground

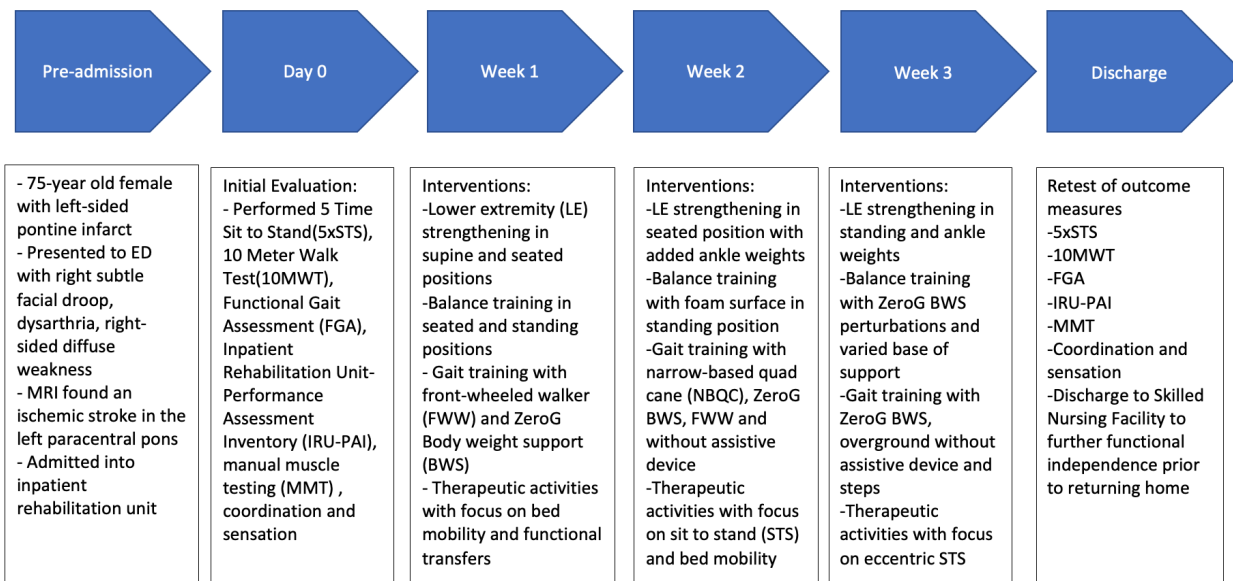
236 ambulation with the ZeroG BWS. Task-specific training was achievable at higher intensities with
237 the use of ZeroG BWS and facilitated more normalized gait mechanics and automaticity for
238 functional gait.¹⁷ By achieving high intensities of training using the ZeroG BWS system, the
239 patient had improvements in unsupported overground walking as well. Overground gait training
240 was continued without an AD to progress the demands on patient balance and reactive strategies,
241 as well as improve functional mobility. The patient wore a gait belt during all overground
242 attempts for improved safety. Complete interventions for gait training with parameters and
243 progressions can be seen in Table 6.

244 **Therapeutic Activities**

245 Therapeutic activities emphasized transfers and bed mobility. Transfer training was essential
246 for safe mobility during toileting, sit-to stand tasks and to move from one support surface to
247 another. Repetitions of transfers varied through alterations to surface heights, support equipment
248 (bedrails, cushion, chair armrests), and levels of assistance from the therapy team. The patient
249 better utilized the concentric and eccentric control of her muscles, rather than requiring the
250 assistance of momentum, as her strength and motor planning improved. Bed mobility training
251 integrated the use of proprioceptive neuromuscular facilitation (PNF) techniques and bridging
252 exercises to improve scooting ability and assist the patient with self-positioning into
253 biomechanically sound positions necessary for supine-to sit transitions.¹⁷

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265 **TIMELINE**
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267
268 **OUTCOMES**

269 Following three weeks of inpatient physical therapy, the patient demonstrated improvements
270 in LE strength, balance, gait speed and functional transfers. Please see Tables 2, 3 and 4 for
271 results of functional outcome measures. Although she had improvements in functional mobility,
272 she continued to require contact guard assistance during ambulation without an AD, most
273 notably when turning around corners and when distracting stimuli were present. She performed
274 all functional transfers with supervision, but occasionally required steadying assistance for
275 balance. The patient opted for continued therapy at a skilled nursing facility (SNF) to further
276 increase independence, as she lived alone and did not have the ability to hire caregivers to assist
277 with safety in her home. The patient and care team at the IRU agreed on this choice to ensure
278 safety and confidence upon returning home independently to care for herself and her dog.

279 During her stay, the patient did not have any adverse or unanticipated events and tolerated all
280 therapy sessions. Patient tolerance and adherence was assessed through subjective assessments.

281 At the time of discharge, the patient had met three out of four short-term goals and one out of
282 four long-term goals. Please see Table 5 for specific goals.

283 **DISCUSSION**

284 The purpose of this case report was to examine gait, balance and functional mobility
285 interventions on the restoration of mobility and functional independence in a 75-year-old patient
286 with a subacute pontine infarct. This report demonstrated the intended purpose by delineating
287 how task-specific LE strengthening, balance training, gait training and functional transfer
288 training is beneficial following a subacute ischemic stroke. LE strengthening was found to be
289 beneficial to improve gait mechanics and gait speed, which was also demonstrated by this
290 patient.^{25,26} Balance training interventions were also utilized and found to be beneficial in
291 retraining stepping strategies when performed at higher intensities following the acute stroke.²⁷
292 The patient also improved her gait mechanics, with noted decrease in right knee hyperextension,
293 resolved right foot drop, decreased right hip circumduction and increased gait speed, as a result
294 of the high intensity of task-specific gait training and the use of body-weight support training.¹⁷
295 By the end of her IRU stay, the patient was able to ambulate with contact guard assist without an
296 AD for approximately 350 feet, and with supervision for approximately 20 feet. At the time of
297 discharge, the patient was able to perform all functional mobility with contact guard or
298 supervision assistance levels, however chose to continue therapy at a nearby SNF to continue
299 progressing towards her baseline level of full independence.

300 There were several factors that influenced the patient's functional improvements
301 including her level of independence and activity prior to the stroke, her motivation to return to an
302 independent level and high intensity multidisciplinary therapy within the IRU. Potential factors
303 that hindered improvements were severity of deficits upon admission and lack of social and
304 familial support needed to return home at a supervision level.

305 Despite the functional improvements noted in this particular patient, limitations to this
306 case report include individualized patient demographics, type of ischemic stroke and equipment
307 used in this IRU. Overall, this case report demonstrates the functional improvements in a 75-
308 year old patient following a pontine infarct. This case offers insight into how the admission into
309 an IRU for early rehabilitation following a subacute stroke allowed for a multi-disciplinary
310 approach to care to increase functional mobility. Further research should be performed to
311 determine therapy interventions for a more varied population of stroke survivors of differing
312 ages, stroke types, stroke locations and comorbid factors that are admitted into IRUs.

313
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392 **TABLES and FIGURES**

393 **Table 1: Systems review at initial evaluation**

Cardiovascular/Pulmonary	<ul style="list-style-type: none"> • Normal heart rate • Normal respiratory rate Impaired: <ul style="list-style-type: none"> • Decreased activity tolerance, endurance
Musculoskeletal	<ul style="list-style-type: none"> • Passive range of motion in right extremities within normal limits Impaired: <ul style="list-style-type: none"> • Decreased strength in right upper extremity and lower extremities • Decreased active range of motion in right upper and lower extremities • Right knee hyperextension during gait

Neuromuscular	Impaired: <ul style="list-style-type: none"> • Partial deficits in right lower extremity with light touch and sharp/dull distinction at dermatomal levels L5 and S1 • Decreased coordination in right upper and lower extremities, potentially due to decreased strength and motor recruitment
Integumentary	Intact
Communication	Impaired: <ul style="list-style-type: none"> • Dysarthric speech
Affect, Cognition, Language, Learning Style	<ul style="list-style-type: none"> • Orientation: Alert and oriented x 4 • Affect: Emotional, depressed

394

395 **Table 2: Tests and Measures**

Tests & Measures	Initial Evaluation Results	Discharge Results
Sensation	<ul style="list-style-type: none"> • Diminished light touch and sharp/dull sensation in right lower extremity at dermatomes L5 and S1 	<ul style="list-style-type: none"> • Diminished light touch and sharp/dull sensation in right lower extremity at dermatomes L5 and S1
Coordination	<ul style="list-style-type: none"> • Attempted rapid alternating movements (RAMs) to assess coordination, patient unable to perform, likely due to decreased strength and motor recruitment in RUE/RLE 	<ul style="list-style-type: none"> • Not assessed
Gait	<ul style="list-style-type: none"> • 2 x 35 feet with front-wheeled walker and minimal contact assistance 	<ul style="list-style-type: none"> • 350 feet without AD, contact guard assist
Transfers	<ul style="list-style-type: none"> • Minimal contact assistance with use of front-wheeled walker 	<ul style="list-style-type: none"> • Supervision without AD
Bed mobility	<ul style="list-style-type: none"> • Supervision with sit to supine and supine to sit transfers, with extra time required for safety • Minimal assistance for rolling to left and right sides and scooting in bed 	<ul style="list-style-type: none"> • Independent
5 Times Sit to Stand	<ul style="list-style-type: none"> • 32.59 seconds 	<ul style="list-style-type: none"> • 13.08 seconds
Gait speed	<ul style="list-style-type: none"> • 10MWT using front-wheeled walker: Comfortable=0.13 m/sec (household ambulator) 	<ul style="list-style-type: none"> • 10MWT without AD and CGA: Comfortable=0.4 m/sec Fast=0.5 m/sec

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		(Limited community ambulator)
Manual Muscle Testing		
Right Upper Extremity	Initial Evaluation	Discharge
Shoulder flexion	2+/5	3+/5
Shoulder abduction	2+/5	3+/5
Elbow flexion	3/5	4-/5
Elbow extension	3/5	4-/5
Grip strength	3/5	4-/5
Right Lower Extremity		
Hip flexion	3+/5	4/5
Hip abduction	3+/5	4/5
Hip adduction	4-/5	4/5
Knee extension	4/5	5/5
Knee flexion	3+/5	4/5
Ankle dorsiflexion	2+/5	4-/5
Ankle plantarflexion	3/5	4-/5

397 MMT scoring: 0/5, no contraction; 1/5, gravity eliminated, trace of contraction; 2-/5 poor minus,
 398 gravity eliminated, partial ROM; 2/5, poor, gravity eliminated, full ROM; 2+/5 poor plus, gravity
 399 eliminated, full ROM, minimal resistance; 3-/5, fair minus, against gravity, greater than 50%
 400 ROM, no resistance; 3/5, fair, against gravity, full ROM, no resistance; 3+/5, fair plus, against
 401 gravity, full ROM, “breaks with resistance”; 4-/5, good minus, against gravity, full ROM, less
 402 than moderate resistance; 4/5, good, against gravity, full ROM, moderate resistance; 5/5 normal,
 403 against gravity, full ROM, maximum resistance ¹⁶, AD=assistive device, CGA=contact guard
 404 assist
 405
 406

Table 3: Functional Gait Assessment Scores

Test Item	Initial Evaluation	Discharge
Gait on level surface	0	2
Change in Gait Speed	0	2
Gait with Horizontal Head Turns	0	1
Gait with Vertical Head Turns	0	1
Gait with Pivot Turn	0	1
Step over Obstacle	0	1
Gait with Narrow Base of Support	0	0
Gait with Eyes Closed	0	0
Ambulating Backwards	0	0
Steps	0	2
Total Score	0	10/30

407 Scoring: 0=severe impairment, cannot walk without assistance; 1=moderate impairment, slow
 408 speed, deviates 10-15 inches in path; 2=mild impairment, uses assistive device, slower speed,
 409 deviates 6-10 inches in path; 3=normal, no assistive device, good speed, no deviation in path
 410

411 **Table 4: Inpatient Rehabilitation Facility Performance Assessment Inventory (IRF-PAI)¹⁵**

Mobility Task	Admission Performance	Discharge Performance
Rolling to Left and Right	03-partial/moderate assistance	06-Independent
Sit to Lying	03-partial/moderate assistance	06-Independent
Lying to Sitting on side of bed	03-partial/moderate assistance	06-Independent
Sit to stand	03-partial/moderate assistance	04-Supervision
Chair/bed-to-chair transfer	03-partial/moderate assistance	04-Supervision
Toilet transfer	03-partial/moderate assistance	04-Supervision
Car transfer	10-Not attempted due to environmental limitations	10-Not attempted due to environmental limitations
Walk 10 feet	03-partial/moderate assistance	04-Supervision
Walk 50 feet with two turns	88- Not attempted due to medical condition or safety concerns	04-Supervision
Walk 150 feet	88- Not attempted due to medical condition or safety concerns	04-Supervision
Walking 10 feet on uneven surfaces	88- Not attempted due to medical condition or safety concerns	03-partial/moderate assistance
1 step (curb)	88- Not attempted due to medical condition or safety concerns	03-partial/moderate assistance
4 steps	88- Not attempted due to medical condition or safety concerns	03-partial/moderate assistance
12 steps	88- Not attempted due to medical condition or safety concerns	03-partial/moderate assistance
Picking up object	88- Not attempted due to medical condition or safety concerns	04-Supervision
Wheel 50 feet with two turns	1-Dependent	N/a
Wheel 150 feet	1-Dependent	N/a

412 06. Independent - Patient completes the activity by him/herself with no assistance from a helper.
 413 05. Setup or clean-up assistance - Helper sets up or cleans up; patient completes activity. Helper
 414 assists only prior to or following the activity. 04. Supervision or touching assistance - Helper
 415 provides verbal cues and/or touching/steadying and/or contact guard assistance as patient
 416 completes activity. Assistance may be provided throughout the activity or intermittently. 03.
 417 Partial/moderate assistance - Helper does LESS THAN HALF the effort. Helper lifts, holds or
 418 supports trunk or limbs, but provides less than half the effort. 02. Substantial/maximal assistance
 419 - Helper does MORE THAN HALF the effort. Helper lifts or holds trunk or limbs and provides
 420 more than half the effort. 01. Dependent - Helper does ALL of the effort. Patient does none of
 421 the effort to complete the activity. Or, the assistance of 2 or more helpers is required for the
 422 patient to complete the activity. If activity was not attempted, code reason: 07. Patient refused
 423 09. Not applicable - Not attempted and the patient did not perform this activity prior to the
 424 current illness, exacerbation, or injury. 10. Not attempted due to environmental limitations (e.g.,
 425 lack of equipment, weather constraints) 88. Not attempted due to medical condition or safety
 426 concerns.¹⁵
 427

428 **Table 5: Short and Long Term Goals for IRU Stay**

Short Term Goal	Assist Level	Device	Time Frame to Reach	Goal Status
Supine to sit, sit to supine, rolling	Supervision	Progress to most appropriate device	10 days	Met
Sit↔stand	Supervision	Progress to most appropriate device	10 days	Met
Ambulate 100 ft	Supervision	Progress to most appropriate device	10 days	Not Met, required CGA
Balance: Stand unsupported for one minute with no losses of balance	Supervision	None	10 days	Met
Long Term Goals	Assist	Assistive Device	Time Frame to Reach	Goal Status
All bed mobility	Independent	None	21	Met
Sit to stand, stand to sit, chair to bed transfer	Independent	Progress to most appropriate device	21	Not met, required SUP
Ambulate 200 ft	Independent	Progress to most appropriate device	21	Not met, required CGA
5 Time Sit to Stand in <15 seconds with no assistive device	Independent	None	21	Not met, required SUP
Increased gait speed to 0.5 meters/second or greater	Independent	Progress to most appropriate device	21	Not met, required CGA
Patient Goals	Assist	Assistive Device		
Ambulate around home	Independently	None		Not met, required CGA
Perform toileting and bathing	Independently	None		Not met, required SUP

429 CGA=contact guard assist, SUP=supervision, AD=assistive device

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Table 6: Interventions

	Rx Week 1	Rx Week 2	Rx Week 3
LE Strengthening	<p>Supine:</p> <ul style="list-style-type: none"> • Ankle pumps • SAQ over 3” half bolster* • hip abduction • SLR • hooklying hip adduction into therapy ball** • bridges <ul style="list-style-type: none"> • 3 x 10 • 4 days/week <p>Seated:</p> <ul style="list-style-type: none"> • LAQ • seated marches • hip adduction with therapy ball** • hip abduction with level 1 TB** • heel raises • toe raises <ul style="list-style-type: none"> • 3x10 bilaterally • 4 days/week 	<p>Seated:</p> <ul style="list-style-type: none"> • LAQ with 2# ankle weight*** • hip adduction with therapy ball** • hip abduction with level 2 TB** • heel raises with 2# ankle weight*** • toe raises with level 1 TB** • hamstring curl with level 1 TB <ul style="list-style-type: none"> • 3x15 bilaterally • 5 days/week 	<p>Standing:</p> <ul style="list-style-type: none"> • Hip abduction • hip adduction • heel raises • Marches • hamstring curls • side-stepping with 2# ankle weights*** <ul style="list-style-type: none"> • 3 x 10 • 4 days/week
Balance	<p>Seated:</p> <ul style="list-style-type: none"> • Trunk leans into large therapy ball (backward, R/L, backward diagonals) <p>Standing:</p> <ul style="list-style-type: none"> • WS in parallel bars • static standing without use of 	<p>Standing:</p> <ul style="list-style-type: none"> • feet together, shoulder width apart, tandem on Airex foam pad***** (CGA) • feet together on foam with: Sh. FL, chest press, ball toss, trunk rotations with 2# MB 	<p>Standing:</p> <ul style="list-style-type: none"> • Toe taps onto 4” step (alternating feet) • Perturbation training using ZeroG BWS 9%- power level 2-8 forward/backward/lateral during ambulation/side-stepping

	<p>UEs (minA-modA)</p> <ul style="list-style-type: none"> ○ feet together/feet shoulder width apart ● 15-20 minutes ● 4 days/week 	<ul style="list-style-type: none"> ● 20-30 minutes ● 3 days/week 	<ul style="list-style-type: none"> ● Tandem stance on foam lateral head turns ● feet together on foam with lateral head turns, up/down nods ● picking up object from ground <ul style="list-style-type: none"> ● CGA-minA throughout ● 15-20 minutes ● 4 days/week
Gait training	<ul style="list-style-type: none"> ● FWW x 50' with modA, ZeroG BWS**** 15% BWS 3 x 50' (minA and Ace wrap for assist with DF of R foot) ● 15% BWS 6 x 100' (CGA and no AD) <ul style="list-style-type: none"> ● 30-40 minutes ● 3 days/week 	<ul style="list-style-type: none"> ● NBQC x 75' with minA ● ZeroG BWS**** 15% BWS 6 x 100' (CGA and no AD), 9% BWS 4 x 100' ● FWW x150' with SUP, no AD 2 x 150' with CGA to mina ● 4 x 6inch steps with minA <ul style="list-style-type: none"> ● 30-40 minutes ● 4-5 days/week 	<ul style="list-style-type: none"> ● ZeroG BWS 9% BWS no AD 6 x 150' ● overground with no AD 3 x 150' CGA ● 4 x 20' no AD SUP ● 350' uneven surface no AD CGA ● 4 x 6 inch steps with CGA <ul style="list-style-type: none"> ● 30-40 minutes ● 4-5 days/week
Therapeutic Activities	<ul style="list-style-type: none"> ● Rolling in bed to R/L ● sit to supine, supine to sit with prop on R/L elbow for increased WB through Sh ● Hooklying bridge for lateral scooting ● STS from hospital bed/ w/c/mat table ● squat pivot from w/c to bed, bed to w/c ● stand pivot from w/c to bed, bed to w/c <ul style="list-style-type: none"> ● minA to modA 	<ul style="list-style-type: none"> ● STS from varying surface heights (17", 15", 14" to challenge mechanics/strength), ● rolling in bed, ● supine to sit ● sit to supine <ul style="list-style-type: none"> ● SUP ● 10-15 minutes ● 3 days/week 	<ul style="list-style-type: none"> ● STS without use of UEs/focus on eccentric control, STS x 10 with level 2 TB around waist for resistance <ul style="list-style-type: none"> ● SUP-CGA ● 10-15 minutes ● 3 days/week

	<ul style="list-style-type: none"> • 5-15 minutes • 5 days/week 		
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- 432 *Skillbuilders, Fabrication Enterprises INC., White Plains, NY
- 433 **Thera-band, Akron, OH
- 434 ***The Cuff Original, Cuff, Fabrication Enterprises INC., White Plains, NY
- 435 **** ZeroG BWS, ZeroG Support System, Ashburn, VA
- 436 ***** Airex AG, Somersworth, NH
- 437 Key: SAQ=Short arc quad, PNF= proprioceptive neuromuscular facilitation LAQ= long arc quad, SLR= straight leg raise #=pound,
- 438 TB=Theraband, WS=weight shifts, UEs= upper extremities, minA=minimal contact assistance, modA= moderate contact assistance,
- 439 BWS=body weight support, FWW=front-wheeled walker, CGA=contact guard assist, SUP= Supervision Sh= shoulder FL= flexion, MB=
- 440 medicine ball, R/L=right/left, DF=dorsiflexion , STS=sit to stand, w/c=wheelchair, NBQC=narrow based quad cane, AD=assistive device

441 **APPENDICES**

442 **Appendix 1: Medication List during Inpatient Rehabilitation Stay**

Medications	Amount and frequency	Purpose
Acetaminophen (Tylenol)	500 mg tablet; take one tablet by mouth every six hours as needed	To decrease pain
Alprazolam (Xanax)	0.25 mg tablet; take one tablet by mouth three times daily as needed	To decrease anxiety
Aspirin	81 mg chewable tablet; chew 1 tablet by mouth daily	To prevent blood clots
Atorvastatin (Lipitor)	80 mg tablet; take 1 tablet by mouth nightly	To reduce low-density lipoprotein (LDL) levels
Enoxaparin (Lovenox)	40 mg/0.4 mL syringe	To prevent blood clots
Fenofibrate (Tricor)	54 mg tablet; take 2.5 tablets daily	To reduce triglycerides and cholesterol
Levothyroxine (Synthroid)	50 mcg tablet; take one tablet daily at 6:30 AM	To restore thyroid levels
Lisinopril (Prinivil)	5 mg; take one tablet by mouth daily	To decrease blood pressure
Trazadone (Desyrel)	100 mg tablet; take one tablet by mouth nightly as needed	To improve sleep

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Appendix 2: Validity, Reliability and Cut-off scores for Stroke Population Outcome Measures

Outcome Measure	Validity	Reliability	Cut-off score
5 Times Sit to Stand	Excellent correlation to knee flexor bilateral lower extremity strength $r = -0.753$ to -0.830 , $P < 0.00556$ ²⁰	Test-retest ICC=0.994 Interrater: ICC=0.970 Intrarater: ICC=0.999 ²⁰	12 seconds ²⁰
10 Meter Walk Test (10MWT)	Excellent correlation between 10MWT comfortable speed and Timed Up and Go (TUG) (ICC=-0.84) ²¹	-Test-retest reliability; excellent with ICC=0.94 for comfortable speed and ICC=0.97 for fast speed ²¹ -Excellent interrater	<0.4m/s=household ambulator 0.4-0.8 m/s=limited community ambulator >0.8m/s=community ambulator ¹³

		reliability, ICC=0.998 ²²	
Functional Gait Assessment (FGA)	Excellent correlation to TUG and Postural Assessment Scale for Stroke (PASS) $r = -0.66 - 0.83$ ²³	Excellent test-retest reliability ICC=0.95 ²³	22/30 points indicates fall risk ²⁴

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447 **Appendix 3: Detailed Intervention Descriptions**

Intervention	Purpose
LE Strengthening	<ul style="list-style-type: none"> • All strengthening exercises chosen to promote increased strength in bilateral LEs and improve motor recruitment/coordination for functional mobility tasks • Week 1 exercises began in supine due to decreased strength and endurance • Progressed to seated exercises with increased resistance using ankle weights and Theraband in week 2 and 3 as patient strength improved • Concluded with standing exercises for functional positioning and increasing demand on LE musculature to aid with functional mobility tasks and mechanics
Balance Training	<ul style="list-style-type: none"> • Began with seated balance exercises to engage core musculature with emphasis on right side • Progressed to standing static and dynamic balance tasks to challenge LE/core musculature and reactive and anticipatory strategies • Further progressed to perturbation training using ZeroG BWS for improved patient safety and confidence • Concluded with more functional tasks such as picking up objects from floor and performing head turns during ambulation to further enhance reactive stepping strategies
Gait Training	<ul style="list-style-type: none"> • Began using FWW for gait training but concluded that sequencing and dyscoordination impairments led to decreased safety with device • Utilized ZeroG BWS to improve confidence with ambulation and allow high repetitions • After improved gait mechanics and less therapist support required, trialed NBQC and FWW again to increase independence but patient was unable to perform for longer distances and without supervision to contact guard assist • Patient was able to ambulate with more normalized gait mechanics without use of AD but continued to require contact guard assist for longer distances • Patient was able to ambulate 20 feet without AD and with supervision from therapist
Therapeutic Activities	<ul style="list-style-type: none"> • Patient required verbal cues to perform rolling, initially requiring use of bedrails • Progressed to performing rolling and scooting in bed via hooklying position with supervision

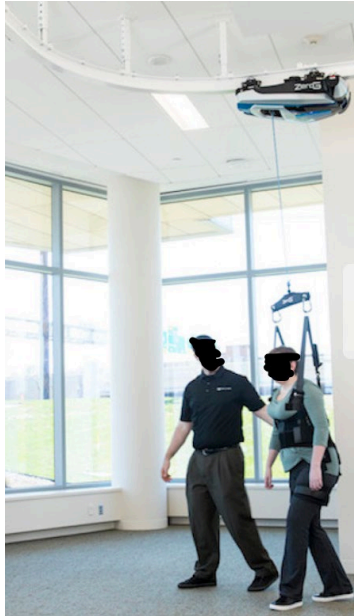
	<ul style="list-style-type: none"> • Patient was able to perform sit to stand transfer with minimal contact assistance that improved to supervision by end of stay
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448 Key: LE=lower extremity, FWW=front-wheeled walker, NBQC=narrow based quad cane, AD=
 449 assistive device

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451 **Appendix 4: ZeroG Body Weight Support System**

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 454 Photo courtesy of Aretech, LLC

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456 **CARE Checklist**

457 *Final Parts One & Two, PTH708:* Completed for the final submission to document the locations of key case report components.

CARE Content Area	Page
1. Title – The area of focus and “case report” should appear in the title	1
2. Key Words – Two to five key words that identify topics in this case report	1
3. Abstract – (structure or unstructured) <ul style="list-style-type: none"> a. Introduction – What is unique and why is it important? b. The patient’s main concerns and important clinical findings. c. The main diagnoses, interventions, and outcomes. d. Conclusion—What are one or more “take-away” lessons? 	2
4. Introduction – Briefly summarize why this case is unique with medical literature references.	3-4
5. Patient Information <ul style="list-style-type: none"> a. De-identified demographic and other patient information. b. Main concerns and symptoms of the patient. c. Medical, family, and psychosocial history including genetic information. d. Relevant past interventions and their outcomes. 	4-5
6. Clinical Findings – Relevant physical examination (PE) and other clinical findings	5-7

<p>7. Timeline – Relevant data from this episode of care organized as a timeline (figure or table).</p>	<p>12</p>
<p>8. Diagnostic Assessment</p> <ul style="list-style-type: none"> a. Diagnostic methods (PE, laboratory testing, imaging, surveys). b. Diagnostic challenges. c. Diagnostic reasoning including differential diagnosis. d. Prognostic characteristics when applicable. 	<p>7-9</p>
<p>9. Therapeutic Intervention</p> <ul style="list-style-type: none"> a. Types of intervention (pharmacologic, surgical, preventive). b. Administration of intervention (dosage, strength, duration). c. Changes in the interventions with explanations. 	<p>9-11, 22-24</p>
<p>10. Follow-up and Outcomes</p> <ul style="list-style-type: none"> a. Clinician and patient-assessed outcomes when appropriate. b. Important follow-up diagnostic and other test results. c. Intervention adherence and tolerability (how was this assessed)? d. Adverse and unanticipated events. 	<p>12-13</p>
<p>11. Discussion</p> <ul style="list-style-type: none"> a. Strengths and limitations in your approach to this case. b. Discussion of the relevant medical literature. c. The rationale for your conclusions. d. The primary “take-away” lessons from this case report. 	<p>13-14</p>
<p>12. Patient Perspective – The patient can share their perspective on their case.</p>	
<p>13. Informed Consent – The patient should give informed consent.</p>	<p>1</p>