Title:
Innovative Care Delivery of Acute Rehabilitation for Patients With COVID-19: A Case Report

RUNNING HEAD: Acute Rehabilitation Care During COVID-19

ARTICLE TYPE: Case Report

SECTION: COVID-19

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Published by Oxford University Press on behalf of American Physical Therapy Association 2020.

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KEYWORDS: Acute Care, Rehabilitation, Patient-Centered Care, Technology

ACCEPTED: November 27, 2020

SUBMITTED: May 31, 2020

ABSTRACT

Objectives: The novel coronavirus 2019 (COVID-19) has impacted acute rehabilitation delivery by challenging the reliance on in-person care and the standard practice of delivering separate physical and occupational therapy services. Healthcare systems are rapidly developing innovative models of care that provide essential acute rehabilitation services while mitigating viral spread. We present two case reports to illustrate how we used technology and COVID-19 specific decision-making frameworks to deliver acute rehabilitation.

Methods: We iteratively developed two decision-making models regarding care delivery and discharge planning in the context of the challenges to delivering care in a pandemic. We leveraged use of video communication systems installed in all COVID-19 rooms to reduce the number of in-room providers and frequency of contact. Two patients were admitted to the hospital with symptomatic COVID-19 (males, ages 65 and 40 years).

Results: With the use of video communication system and the decision-making frameworks for care delivery and discharge planning, we avoided 7 in-person sessions. Both patients demonstrated functional gains and were discharged home.

Conclusion: The two case reports highlight the innovative use of a technology and COVID-19 specific decision-making processes to provide patient-centered care given the challenges to care delivery during the COVID-19 pandemic.

Impact Statement: The use of technology and decision-making models allows for delivery of safe acute rehabilitation care that minimizes contact, conserves personal protective equipment, and prepares for COVID-19 surges. The discussion points raised have applicability to patients without COVID-19 and other healthcare systems. Future research is needed to determine the effectiveness, costs, and downstream effects of our novel approach to acute rehabilitation for patients with COVID-19.

[H1] **BACKGROUND AND PURPOSE**

Physical therapists (PTs) and occupational therapists (OTs) are needed on the frontlines of the novel coronavirus 2019 pandemic (COVID-19) to delay, prevent, or recover the loss of function due to prolonged hospitalization.[1-5] The typical functional declines observed may be exacerbated during a COVID-19 hospital admission due to the necessary precautions to mitigate viral spread such as keeping patients confined to their rooms and minimizing contact with providers. As a result, PTs and OTs in the hospital setting are faced with daily challenges and complex decisions regarding how to deliver rehabilitation services efficiently. Prior to the pandemic, standard acute rehabilitation practice at our facility provided PT and OT services as separate sessions. A paradigm of separate PT and OT sessions no longer fits during the COVID-19 pandemic when effective rehabilitation service is needed to maximize function and facilitate discharge planning, while also mitigating viral spread through reduced provider-patient contact, and conserving personal protective equipment (PPE).

A solid literature base exists citing rehabilitation approaches effective for the treatment and management of patients with COVID-19.[6-8] However, answers to clinical decisions regarding how rehabilitation services should be delivered during hospitalized care of patients with COVID-19 is evolving and largely unknown. We present two case reports to illustrate how we used technology and developed COVID-19 specific decision-making processes for care delivery. Both patients signed forms regarding permission to release information and the information presented meets the Health Insurance, Portability, and Accountability Act requirements for disclosure of protected health information.

[H1] Overview of Infrastructure Changes to Treat Patients with COVID-19

The Minneapolis Veterans Affairs Health Care System converted clinic space to COVID-19 units and assigned providers to COVID-19 teams. All rooms on the COVID-19 unit had video communication equipment (Cisco DX70 or DX80; Cisco Systems, Inc, San Jose, CA, USA) installed, consisting of movable cameras and monitors that allowed for bi-directional audio and

visual capabilities. All staff were trained on the video communication system for use in service delivery. For rehabilitation sessions, the in-room camera and monitor were positioned with the camera and monitor facing the patient. A matching, moveable monitor and camera were located outside the patient's room. Sessions occurred in real-time and were not recorded. A standard combined PT/OT evaluation template was created to include measures of physical performance (4 stage balance test[11] and 30 second sit to stand[12]) and a cognitive screen (Short Blessed Test[13]). All PTs and OTs on the COVID-19 unit completed competencies on all measures to ensure reliability. If additional measures were required during the evaluation, the in-room clinician completed the assessment within their scope of practice and the outside clinician directed the in-room clinician.

[H1] CASE 1 DESCRIPTION

A 65-year-old, male was admitted to the hospital with symptomatic COVID-19. The plan of care, consistent with evidence-based practices,[7,8] is presented in the Table. In Figure 1, we outlined our decision-making process for determining which rehabilitation providers are necessary for in-room sessions. The PT/OT team reviewed the chart and determined the patient was appropriate for evaluation.[9,10] Next, they reviewed nursing notes that indicated the patient was using an assist of one for out of bed mobility and determined that the OT would be in the room for the evaluation with the PT outside**.**

[H2] INTERVENTION AND PLAN OF CARE

We used the International Classification of Functioning, Disability and Health model (ICF)[14] to prioritize patient needs and determine a combined plan of care of five days per week with 30-60-minute PT/OT co-treatment sessions during acute care, and 30-60 minutes of separate PT and OT sessions in the COVID-19 acute rehabilitation unit (CRU). The plan of care carried over when the patient was discharged from the hospital to CRU for a total of 16 sessions (3 acute care, 13 CRU). Following the evaluation, the PT/OT team listed and prioritized impairments and activity limitations in the context of the patient's presentation, prognosis, and

needs for return to his prior level of participation (Figure 1). The patient presented with significant limitations in aerobic capacity for in-room ambulation (<50 feet at a Rate of Perceived Exertion [RPE] ≥5/10) and standing balance. Findings suggested PT and OT were both indicated with needs weighted towards PT; therefore, the PT was in the room for sessions with OT present via the video communication system (Figure 1). The use of technology allowed clinicians to avoid 3 in-person sessions (1 PT, 2 OT).

Video co-treatments for treating patients with COVID-19 impacted clinician time by using a combined PT/OT note and having only one clinician versus two apply/remove PPE. In addition, PT/OTs could perform nursing cares (eg, deliver meals, changing bed linens) to minimize nursing staff exposure and use of PPE for brief tasks. Nursing staff promoted activity recommendations prescribed by PT/OT throughout the day via the video communication system or during direct care.

[H2] CASE 1 OUTCOMES

Outcomes are presented in the Table, and functional scores at discharge exceeded minimal clinically important differences. Given the complexities of discharging patients from the hospital to post-acute care facilities in the context of a pandemic, our discharge planning process has evolved. To address this, an interdisciplinary team, including rehabilitation, formed a consensus on criteria for admission to the newly created, on-site COVID-19 acute rehabilitation unit (CRU) (Figure 2) to eliminate the need for transfer to an outside facility for further rehabilitation following hospitalization. At the time, these admission criteria were considered indicators of low viral load.[18,19] At evaluation, PT/OT recommended the patient in Case 1 discharge to CRU; however, by hospital discharge the patient met all but one intake criteria (not tolerating ≥2 hours of daily rehabilitation). The interdisciplinary team discussed the case and decided admission to CRU was appropriate because the patient was steadily improving his aerobic capacity and demonstrated adherence to daily activity recommendations (i.e., ambulation in the room with nursing three times per day at RPE <5/10). Patient rooms in

the CRU had video communication capability, yet it was used less as viral load was considered lower. The patient discharged from the hospital after 24 days (7 days acute care, 17 days CRU) to his assisted living facility with prior services and a progressive home exercise program.

[H1] CASE 2 DESCRIPTION

A 40-year-old, male was admitted to the hospital with a positive COVID-19 test (Tab.). Based on our decision-making process (Figure 1), chart review revealed the patient required assist of one as he fatigued easily with minimal activity and, thus, for the evaluation, the PT was in the room and the OT remained outside.

[H2] INTERVENTION AND PLAN OF CARE

The plan of care is outlined in the Table. We used the ICF model to prioritize the patient's needs and determined a combined rehabilitation plan of care of 5 days per week (30-60-minute PT/OT treatment sessions). The team prioritized the list of problems and determined that the patient's decreased aerobic capacity—defined by an RPE ≥5/10 during basic mobility--indicated both PT and OT were weighted equally and would alternate days of service in-room versus via video communication (Fig. 1). The use of technology allowed rehabilitation clinicians to avoid 4 in-person sessions (2 PT, 2 OT).

[H2] CASE 2 OUTCOMES

Outcomes are presented in the Table and demonstrated improvement. We initially recommend the patient discharge to CRU due to fatigue with minimal in-room mobility (RPE ≥5/10) and difficulty weaning off supplemental oxygen (Fig. 2). However, he expressed a strong desire to return home. Based on the patient's medical and functional improvements the discharge recommendation changed to home with outpatient, virtual PT. The patient was issued a tablet after PT/OT agreed he was cognitively intact (determined by a combination of cognitive status, availability of social support, and clinical judgement) and familiar with the use of tablet devices. At the time the tablet was issued, the patient needed to call to schedule a virtual PT appointment after hospital discharge. In this case, the patient did not call to schedule a virtual

PT appointment but did have a phone visit with his primary care physician. The patient discharged from the hospital to home after 17 days (11 days in the ICU).

[H2] Role of the Funding Source

The funder played no role in the design, implementation, analysis, or interpretation of results or the decision as to whether or where to publish papers.

[H1] DISCUSSION

The COVID-19 pandemic has challenged acute rehabilitation to move beyond traditional in-person sessions and embrace a different model of service across PT/OT disciplines to deliver essential care. The two case reports highlight a model of care that used technology and two COVID-19 specific decision-making processes to provide safe and patient-centered care. Both patients with COVID-19 demonstrated functional gains after 2-4 weeks of acute rehabilitation and discharged home.

To our knowledge, this case report is the first to outline how rehabilitation providers leveraged technology to deliver acute rehabilitation services. The use of in-room video communication system and PT/OT co-treatment strategies enabled patients to receive both PT and OT services, while concurrently conserving PPE and reducing provider contact. Furthermore, the capability for virtual rehabilitation following hospital discharge allowed the rehabilitation team and patient to comfortably make an informed decision to discharge the patient from the hospital to home (Case 2). However, we experienced potential barriers (eg, scheduling difficulty) to successful adherence to recommended rehabilitation following hospitalization. Virtual rehabilitation is a new program at our facility, and we are currently revising the scheduling process and developing resources to facilitate improved transition of care.[20-23]

To our knowledge, this case report is the first to outline a decision-making model used to inform the delivery of acute rehabilitation services. The complex decision-making integral to

rehabilitation in acute care is intensified by the COVID-19 pandemic when PPE is scarce, minimal contact is recommended, and transfers to post-acute facilities is conservative. All the aforementioned factors greatly impact the delivery of acute rehabilitation services, which often require close patient contact, frequent interaction, and the need to make timely, patient-centered discharge recommendations. Thus, our decision-making model provided structured guidance and standardization to our clinical decisions in the context of providing acute rehabilitation during a pandemic.

While the changes in service delivery outlined in this case report were a practical necessity during a pandemic, a need exists to evaluate and determine what elements to maintain beyond the pandemic's end. First, the role of acute rehabilitation clinicians has traditionally served as a consultation service for discharge planning.[5] However, the increased hospital length of stays and difficulty discharging to outside post-acute rehabilitation facilities has expanded the role of acute PT/OT to providing rehabilitation models of care in our facility,[5] which has implications for changes in staffing structures. Second, the use of our collaborative decision-making models and technology appeared to remove PT and OT silos in our facility. By actively collaborating between disciplines, PTs and OTs gained greater insight into discipline-specific approaches and integrated these elements to help patients progress synchronously towards both PT and OT goals. Third, the increased use of technology has the potential to expand options to deliver acute rehabilitation care in remote areas that serve our patient population and lack adequate rehabilitation workforces at our facility.

This case report is not generalizable. However, the two cases illustrate our rapid change to delivering acute rehabilitation services in the context of the COVID-19 pandemic. We believe the treatment delivered and discussion points raised have applicability to other patients with COVID-19 and other healthcare systems. A second limitation is the lack of formal satisfaction data regarding patient or clinician satisfaction with the technology and delivery of acute

rehabilitation services. However, the COVID-19 PT/OT team consists of four clinicians who worked together to develop the model, suggesting acceptability by providers.

The COVID-19 pandemic continues to confront the healthcare system and rehabilitation profession with challenges to delivering care. Importantly, the innovative models created in response to the unique challenges of the pandemic are unlikely to cease once the pandemic ends. Future research is needed to determine the effectiveness, costs, scalability, and downstream effects of our approach to acute rehabilitation for patients hospitalized with COVID-19. Furthermore, the application and evaluation of this framework to other non-infectious patient populations in our facility is needed to address the iatrogenic impact of COVID-19 on the delivery of acute care rehabilitation, specifically prolonged hospital stays given barriers to transfers to outside facilities for rehabilitation.

Author Contributions

Concept/idea/research design: T. Livingston, E. Sullivan, A. Gustavson
Writing: T. Livingston, E. Sullivan, A. Gustavson
Data collection: T. Livingston, E. Sullivan
Data analysis: T. Livingston
Providing subjects: T. Livingston
Consultation (including review of manuscript before submitting): T. Livingston, G. Wilske

Acknowledgments

We acknowledge Dr. Alisha Beckett, PT, DPT, for providing information on the CRU admission process and criteria.

Funding

This project was funded in part by the Veterans Health Administration Office of Academic Affiliations Advanced Fellowship in Clinical and Health Services Research (TPH 67-000) [AMG],

and the Minneapolis Center of Innovation, Center for Care Delivery and Outcomes Research (CIN 13-406). The views expressed in this article are those of the authors and do not necessarily reflect the position or policy of the Department of Veterans Affairs or the United States Government.

Disclosures

The authors completed the ICMJE Form for Disclosure of Potential Conflicts of Interest and reported no conflicts of interest.

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Table.

Case Descriptions[a]

	Case 1	Case 2
Patient history	65-year-old male admitted to the hospital from an assisted living facility. At baseline, patient was independent for activities of daily living (ADLs) and ambulation without an assistive device. He required intermittent assist for IADLs.	40-year-old male admitted to the hospital from home. The initial rehabilitation evaluation took place 3 days after the patient transferred to the COVID-19 unit following 11 days in the Intensive Care Unit (ICU), where he required high-flow supplemental oxygen. At baseline, patient was independent for all ADL/IADLs and community distances without an assistive device. Patient works and attend school full-time.
Systems review	**Cardiovascular/pulmonary:** respiratory rate at < 30 breaths per minute, O_2 saturation >90% on-room air at rest **Cognition:** emotionally liable at times; alert and oriented to person, place, and time **Musculoskeletal:** decreased functional lower extremity strength (see test and measures) **Neuromuscular:** standing balance deficits (see tests and measures) **Integumentary:** light touch sensation intact	**Cardiovascular/pulmonary:** 3LPM, respiratory rate at <30 breaths per minute, O_2 saturation 91% at rest and 82% with activity on 3 LPM O_2 delivery **Cognition:** emotionally frustrated with prolonged hospitalization and inability to wean off supplemental O_2; alert and oriented to person, place, and time **Musculoskeletal:** decreased functional lower extremity strength (see test and measures) **Integumentary:** exposed skin intact

Examination Test and Measures

	Acute Care Evaluation	Acute Care Discharge	CRU Evaluation	CRU Discharge	Acute Care Evaluation	Acute Care Discharge
Functional mobility	Transfers FIM:[15] 4 Ambulation on FIM:[15] 1 Stairs on FIM:[15] 1	Transfers FIM:[15] 6 Ambulation FIM:[15] 5 Stairs FIM:[15] 1	Transfers FIM:[15] 6 Ambulation FIM:[15] 5 Stairs FIM:[15] 1	Transfers FIM:[15] 7 Ambulation FIM:[15] 7 Stairs FIM:[15] 6	• Modified independent to stand-by-assist for bed mobility, transfers, and ambulation. • Ambulation distance limited to 25 feet without an assistive device	• Independent for all mobility • Ambulation distance increased to 120 feet without an assistive device

Strength	30-Second Sit to Stand Test, [12] 0 repetitions	30-Second Sit to Stand Test, [12] 0 repetitions	30-Second Sit to Stand Test, [12] 1 repetition	30-Second Sit to Stand Test, [12] 7 repetitions	30-Second Sit to Stand test, 8 repetitions on 3 LPM O_2 (O_2 desaturation to 82%)	• Improved based on ability to progress intensity—measured by muscle failure—on exercise program • 30-Second Sit to Stand Test, [12] 8 repetitions on room air (O_2 desaturation to 86%)
Aerobic capacity	2-minute Step Test, [24] 60 repetitions	Not retested	6-Minute Walk Test, [17] 252 meters	6-Minute Walk Test, [17] 437.7 meters		
Balance	4-Stage Balance Test, [11] 2 out of 4	4 Stage Balance Test, [11] 2/4	Berg Balance Test, [16] 38/56	Berg Balance Test, [16] 53/56	4 Stage Balance Test, 4/4	Not retested
Cognition	Short Blessed Test, [13] 0 points (normal cognition)	Not retested				
Clinical impression: evaluation	The patient presents with generalized deconditioning and functioning below baseline mobility level following prolonged hospitalization. Recommend short term rehabilitation prior to discharge home to maximize functional recovery.				The patient presents with generalized deconditioning, poor aerobic capacity, and functioning below baseline mobility level following prolonged hospitalization. Recommend short term rehabilitation versus home pending ability to wean from supplemental O_2 delivery and maintain adequate O_2 saturation with activity	

Clinical impression: diagnosis	Decreased functional strength; impaired standing balance; decreased aerobic capacity; gait abnormalities with reduced gait speed indicating increased risk for falls.	Decreased functional strength; decreased exercise capacity
Clinical impression: prognosis	Patient demonstrates good rehabilitation potential given prior level of function. Barriers to discharge home include current level of function that requires assist, emotional hardship, and his prior assisted living facility not accepting patients testing positive for COVID-19 back into the facility	Patient demonstrates good rehabilitation potential given prior level of function, age, and mobility status at evaluation. Barriers to discharge home included difficulty weaning supplemental from O_2 and need to return to high level of function for return to work and household roles.
Intervention and plan of care		
Self-care/patient education	• Education on energy conservation • ADL training	• Education on energy conservation • Education on pursed lip breathing technique • Education regarding technology use for virtual appointments • Education on self-monitoring of O_2 with pulse oximeter and self-management techniques • ADL training
Therapeutic exercise	• Ambulation without an assistive device • Standing exercises • Upper body ergometer	• Ambulation without assistive device for progressively increasing distances • Seated upper extremity exercises • Standing lower and upper extremity exercises
Neuromuscular re-education	• Static and dynamic standing activities • Walking balance • Stepping strategies	
Therapeutic activity	• Functional activity in standing • Sit to stand transfers • Tub and toilet transfers with equipment	• Standing ADLs • Sit to stand transfers
Gait training	• Cueing for speed and technique for efficient gait	
Safety parameters	The RPE (1-10) scale used for all exercise/ activity with a target of 4-5/10. Rest breaks were initiated if O_2 saturation < 90%, we noted increase	The RPE was not used as patient consistently rated self at 0-2/10 despite O_2 saturation <88%. Rest breaks were initiated if O_2 saturation <88%, we noted

	in accessory muscle breathing, or the patient was unable to talk during activity due to breathlessness (respiratory rate >30 breaths per minute).	increase in accessory muscle breathing, or the patient was unable to talk during activity due to breathlessness (respiratory rate >30 breaths per minute).
Response to treatment	Fatigue with stable vitals and no adverse reactions	Fatigue and rapid O_2 desaturation with limited activity; recovered appropriately with seated rest breaks and pursed-lip breathing
Duration of treatment sessions	• For acute care rehabilitation sessions started at 30 minutes and were co-treatments between physical therapists and occupational therapists. • While on CRU, session duration increased to 40-60-minute separate sessions per physical therapy and occupational therapy.	30 co-treatment minutes with a physical therapist and occupational therapist
Avoided in-person sessions	3 (1 physical therapy, 2 occupational therapy)	4 (2 physical therapy, 2 occupational therapy)
Inpatient referrals	Mental health team (rehabilitation psychologist)	None
Outcomes		
Discharge location	Assisted living facility (prior living environment)	Home with family
Length of stay	7 days acute, 7 days CRU	17 days (11 days in ICU)
Discharge follow-up	Continue with prior services at assisted living facility; issued progressive home exercise program; no additional rehabilitation referrals	Virtual outpatient physical therapy; issued progressive upper and lower extremity home exercise program

[a] ADLs = activities of daily living; COVID-19 = coronavirus 2019; CRU = COVID-19 acute rehabilitation unit; FIM = Functional Independence Measure; IADLs = instrumental activities of daily living; LPM = liters per minute; O_2 = oxygen; RPE = rate of perceived exertion

Figure 1.

Decision making model for rehabilitation care delivery in acute care for patients with COVID-19. PT: Physical therapy or physical therapist; OT: Occupational therapy or occupational therapist Asterisks (*) indicate resting heart rate <50 or >140 beats per minute; arterial pH <7.25; mean arterial pressure <55 or >100 milimeters of mercury (mmHg); resting systolic blood pressure <90 or >180 mm Hg; unstable or unsafe airway; hemodynamically unstable or active bleeding; angina or signs of ischemial; Richmond Agitation-Sedation Scale >2+ or <-1

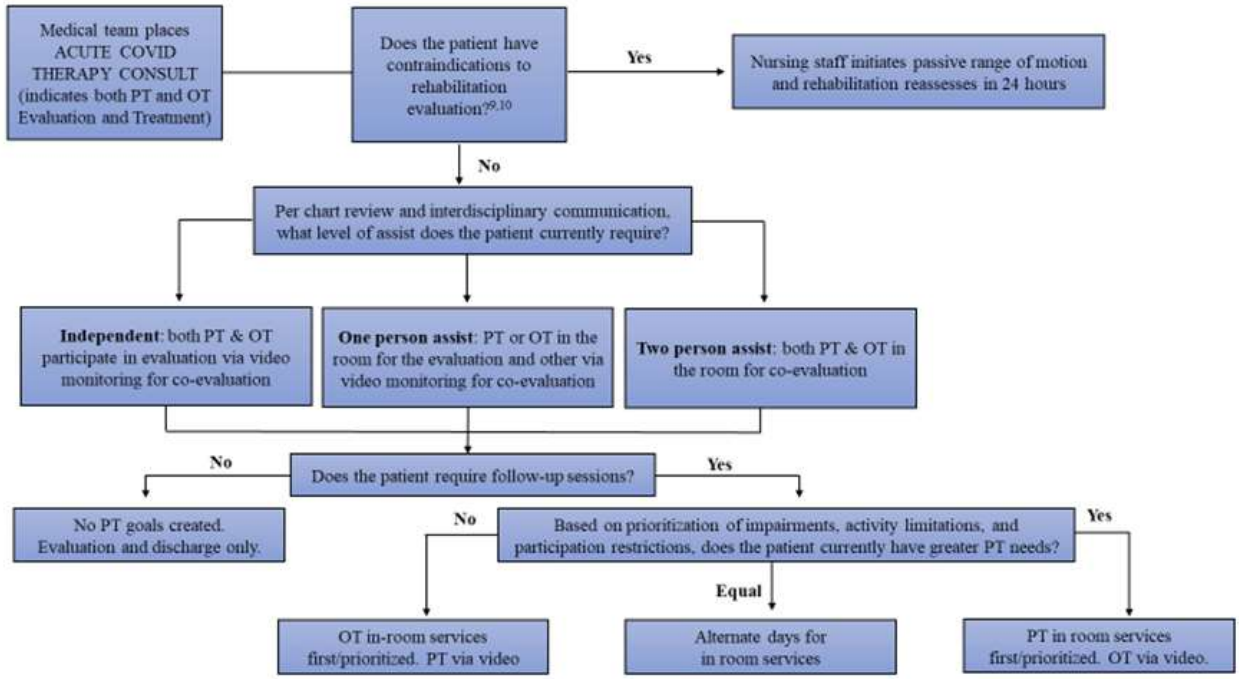

Figure 2. Decision making model for discharge planning for patients with COVID-19. CRU = COVID-19 acute rehabilitation unit. Asterisks (*) indicate current overview of CRU admission criteria: history of a positive COVID-19 test and at least 10 days out from first reported symptoms; agreeable to participate in rehabilitation; medically stable and no fever for >72 hours; maintains oxygen saturation on ≤3 liters per minute at rest; does not require restraints or one to one supervision; demonstrates capacity to tolerate ≥2 hours total of rehabilitation per day; and demonstrates potential for discharge outside of the institutional setting.