Proposal for Meeting Requirements for 803B Case Report

Case report: Contextual implications of an evidence-based falls intervention in a sub-acute setting for a frail, elderly patient with rhabdomyolysis

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Abstract

Background and Purpose: Falls in elderly can result in rhabdomyolysis from muscle damage. The Otago Exercise Program (OEP) is an evidence-based falls program that helps frail elderly over the age of 80 regain balance, strength, and walking. Subacute settings have a high falls risk population and skilled therapy. The purpose of this theory to practice case report is to expand on the contextual factors of a subacute setting that limit fidelity to an evidence-based falls intervention while postulating the benefits of a sustainable falls prevention network.

Case Description: The patient was an 86-year-old community dwelling adult who met the criteria for the OEP after she fell and was diagnosed with rhabdomyolysis and subsequent exacerbation of chronic obstructive pulmonary disease. She was admitted to a sub-acute setting for therapy due to deficits in mobility. She had previously been independent with ambulation.

Outcomes: The OEP protocols were not followed. Though her Six Minute Walk Test, Timed Up and Go, 30 second Chair Stand Test and Four Stage Balance Test had clinically significant improvements, she was discharged to an assisted living facility.

Discussion: The fidelity to the OEP was not maintained. Function drove the exercise prescription. The focus on profit in subacute facilities appears to impact delivery of evidence-based falls programs. An opportunity exists for these facilities to be part of a unique healthcare delivery model for falls prevention. A falls prevention network could facilitate this and serve as a repository of programs, promote collaboration amongst healthcare professionals, and facilitate patient transitions. (4,064)
Background and Purpose

Falls are the number one cause of injuries\(^1\) and a common cause of decline in the elderly.\(^2\) The Centers for Disease Control (CDC) reports among adults surveyed, falls incidence significantly increased with age ranging from 26.7% among persons aged 65–74 to 36.5% in those over 85 years old.\(^1\) Elderly who fall are ten times more likely to be placed in a nursing home compared to non-fallers, and if unable to get up from the ground, are more likely to die within the year.\(^2\)

Rhabdomyolysis is the rapid disintegration of skeletal muscle and release of cellular toxins into the circulatory system that can result in life-threatening conditions. Muscles experience compressive tissue injuries and subsequent oxygen deprivation in fall injuries.\(^3\) Diagnoses of rhabdomyolysis is by serum creatine kinase (CK) values at five times normal or 1000 U/L, with rising values being a concern for AKI.\(^4\) Wongrakpanich et al found the most common cause of rhabdomyolysis in elderly is falls, both with and without immobilization. This retrospective four-year study found 56.9% of rhabdomyolysis cases were attributable to falls with a 68.9% incidence of acute kidney injury (AKI).\(^3\) One of the most important treatment goals after diagnosis of rhabdomyolysis is to manage CK levels through aggressive intravenous fluid therapy to preserve renal function.\(^5\) A systematic review by Chavez et al emphasizes regardless of the etiology of the rhabdomyolysis the pathology is the same.\(^4\) Therefore, when considering rehabilitation after any diagnosis of rhabdomyolysis, the steps for recuperating from exertional rhabdomyolysis can serve as a guide.\(^5\) Assignment of exercises must prevent energy deficiency and muscle damage; this requires being respectful of an individual’s activity tolerance level and avoiding eccentric exercises or overload of muscle groups that are already deficient.\(^5\)

The evidence-based Otago exercise program (OEP) is a one of the best-documented community falls reduction exercise programs in the world, most effective in frail populations over the age of 80 years. A 2002 meta-analysis of the original four trials involving 1,016 people aged 65 to 97 with a wide range of physical abilities, revealed falls and injuries were decreased 35%; in one RCT falls were reduced 46%\(^6\).\(^7\) The approach is geared toward community dwelling elderly who can walk in their own home, with or without an assistive device.\(^8\) After assessment, the patient is assigned to one of
four levels from which to progress exercise. The complementary walking component, may be delayed based on readiness. The original OEP was administered by a physical therapist (PT) over 12 months with five home visits to ensure quality of exercise prescription.\textsuperscript{8} Despite a call for widespread implementation by National Council on Aging this program has struggled to obtain reimbursement in the United States due in part to the year-long compliance required.\textsuperscript{6,8,9} Interestingly, a 2010 systematic review found when fidelity to the OEP program was observed over the year’s period, not only were falls rates reduced as reported, but mortality was also significantly reduced.\textsuperscript{10}

The American Geriatrics Society General Practice Guidelines specify a multifactorial approach can reduce falls by 24%.\textsuperscript{1} A multifactorial approach involves identifying people at risk of falls and arranging referrals to address deficits in such areas as nutrition, vision, medication, movement.\textsuperscript{1} CDC’s multifactorial program, stop elderly accidents deaths and injuries (STEADI) uses OEP protocols to evaluate falls risk.\textsuperscript{1} The Administration for Community Living, an arm of US Department of Health and Human Services, advocates building partnerships between the community and health care sectors to identify arrangements to support evidence-based falls prevention programs.\textsuperscript{11} Medicare funds $30 billion annually in falls related healthcare, yet will not reimburse falls prevention programs.\textsuperscript{1,8} A review of the literature identifies novel partnerships with community agencies to make OEP accessible to the homebound\textsuperscript{12} and the OEP has been validated for group delivery as well.\textsuperscript{13} There are no studies investigating the utilization of OEP in subacute settings. A subacute setting, such as a skilled nursing facility (SNF), offers skilled therapeutic interventions to facilitate patient independence and discharge to the least restrictive living environment. Given that OEP has been successful inside and outside the home-setting and if coupled with the idea that a SNF acts as a temporary extension of the home then applying OEP in this setting has merit. Embedding the OEP earlier as treatment, where falls risk patients are readily identified, such as in a SNF, has the benefits of a multifactorial approach, access to skilled therapy, and demonstrates an innovative use of Medicare funding for evidence-based falls program as the person is rehabilitated. To ensure consistent care across subacute and home settings there may be potential to create a falls prevention network that ensures availability and transition of the treatment.
The purpose of this theory to practice case report is to expand on the contextual factors in a subacute setting that can limit fidelity to an evidence-based falls intervention while identifying an opportunity to build a sustainable falls prevention network across the health care settings using the same evidence-based program.

*Case Description: Patient History and Systems Review*

The patient was a community dwelling 86-year-old widow admitted to the hospital and diagnosed with rhabdomyolysis after lying on the floor of her home Christmas day for 17 hours after a fall. Her CK levels were reported as 14,752 mg/mL. Her CT scan revealed edema throughout her left side and a chest X-ray showed possible pneumonia. She was subsequently diagnosed with a COPD exacerbation.

Following a nine-day hospital stay, the patient was admitted to the subacute facility. A review of her records indicated “serial myoglobin and CK level improvement.” A chart review disclosed a history of COPD, hypertension, hepatitis, hypothyroidism, urinary tract infection (UTI), osteoporosis, prior rib and wrist fractures, knee and hand osteoarthritis, low vision and hearing loss.

The subjective exam revealed she had been independent in all activities of daily living (ADL’s) and ambulation. She no longer drove and relied on friends to help her with shopping. She used a hand rail to negotiate five steps to enter her home and nine to her basement. In the community, she periodically used a rollator or a store scooter. She reported she “just slipped and fell forward coming up from the stairs from the basement and was not able to get up”. She acknowledged two previous times during the year when her “feet got tangled,” but had been able to “catch herself and not actually go on the floor.” She recalled she had been on four regularly prescribed medications, Synthroid, Lotrel, Crestor, and Atenolol, prior to her hospitalization, with further details contained in Table 1, medication review. She self-described her health as having been excellent; a systems review is contained in Table 2. Of note, there was a report of a previous fall that resulted in a radial fracture and subsequent home assessment. She had been undergoing treatment for a UTI before she fell.

Clinical examination results can be found in Table 3. She maintained functional range throughout with ability to hold against resistance (manual muscle test [MMT])
Postural observation indicated thoracic kyphosis. Static standing balance required upper extremity (UE) support. Transfers required minimum assistance with poor eccentric control of her extensors as she lowered herself to sit. She required maximum verbal and tactile cues for front wheeled walker (FWW) safety. She walked nine meters (m) with a narrow-based, shuffling gait and reduced hip flexor strength in swing phase. The patient was anxious about her need for oxygen, her belongings, meals, and toileting. She denied shortness of breath (SOB) throughout all activities.

The patient demonstrated good rehabilitation potential, evidenced by her prior level of function (PLOF), motivation, and ability to follow two-step commands. The patient’s goal was “to return home and get off oxygen.” She was amenable to PT. The patient was assigned to the highest case mix group. This allowed her to have the most therapy available and qualified her for approximately two hours of PT and occupational therapy (OT) a day, six days a week.

Clinical impression 1

It was determined the patient would benefit from skilled PT based on her decreased walking ability, strength, balance and exercise tolerance. The OEP, which allows walking to be delayed, appeared appropriate based on her age, falls history, and need for conservative treatment given the rhabdomyolysis diagnosis and her difficulty walking. Accordingly, she was assessed for frailty, balance confidence, endurance, falls risk, strength, balance, and ability to participate in standing exercises, the results of which are in Table 4.

Examination

The patient was classified mildly frail using the Edmonton Frailty Scale (EFS). The EFS is valid, reliable and feasible for routine use by non-geriatricians.\(^\text{14}\) It samples ten domains with a maximum score of 17 representing the highest level of frailty. Performance based items include the clock test for cognition and the “timed up and go” for mobility. The test has been studied in populations of mean age 80.4 years on an average of 5.4 medications. The EFS has good inter-rater reliability (\(\kappa = 0.77\)). The internal consistency of the EFS using Cronbach’s \(\alpha\) is 0.62.\(^\text{14}\)

The patient’s balance confidence score of 54% on the Activities of Balance Confidence (ABC) was less than 67%, specific to elderly who normally walk
independently, indicating a higher of falls risk.\textsuperscript{15} The ABC assesses fear of falling. A series of 16 detailed item descriptions requires the responder to imagine their level comfort with the activity description despite relevance and rate it on a scale of 0 to 100. Higher scores relate to higher balance confidence. The ABC is reliable and valid for community dwelling older adults and showed good test–retest reliability (95\% CI, intraclass correlation coefficient [ICC] =0.779–0.934) and internal consistency measured by Cronbach’s $\alpha$ of 0.973.\textsuperscript{16}

She obtained 49.4 m on the 6-minute walk test (6MWT) with FWW. Distances less than 350 m are associated with increased mortality.\textsuperscript{17} The 6MWT is reliable and valid to assess exercise tolerance and functional capacity. The patient used a self-selected speed on a continuous 30-m course followed with a measuring wheel to ensure accuracy of distance traveled. The 6MWT has shown strong test-retest reliability (ICC= 0.88-0.91) in cardiac populations.\textsuperscript{18} The minimal detectable change (MDC) for chronic lung disease populations is 54 m (95\% CI, 37 to 71 m).\textsuperscript{17}

She scored 103 seconds on the Timed Up and Go (TUG) with FWW. The TUG is useful at ruling in falls in individuals classified as high risk (>13.5 sec) according to a 2014 systematic review, with a specificity (0.74, 95\% CI 0.52-0.88).\textsuperscript{19} The TUG is reliable and valid to evaluate falls risk. The TUG times how long it takes to rise from being seated in an arm chair to walking to a point 3 m away, turning, and returning to seated. A practice trial was conducted. The TUG was examined in a population of elderly adults with COPD and was found to be responsive to pulmonary rehabilitation with excellent test-retest values (ICC = 0.92-0.99) and MDC of 2.68 seconds (95\% CI).\textsuperscript{20}

She scored zero for the 30 second chair stand test (CST). The CST is reliable and valid to assess leg strength and endurance. The patient is instructed to rise from a 17-inch chair with arms crossed and stand as many times as possible in 30 seconds. The CST has excellent test-retest reliability for women (ICC = 0.92).\textsuperscript{21} Normative data for community dwelling 85-89 year old’s is 11 (95\% CI).\textsuperscript{22}

The patient was unable to maintain 10 seconds for any components of the four-stage balance test (FSBT). The FSBT consists of narrow base support, offset tandem, tandem and one legged stance (OLS).\textsuperscript{8,9} The FSBT is valid for balance.\textsuperscript{23} The test-retest
reliability over three to four months is good (95% CI, ICC= 0.66). Inability to perform the OLS for at least five seconds is considered a falls risk.

Clinical Impression Statement 2

This patient was frail and had low balance confidence. She had poor exercise endurance, balance, LE strength, and was a falls risk. She was hypoxic (85%) during the 6MWT while on oxygen (2L), indicating a risk for energy imbalances that could injure her kidneys or muscles and confirmed that walking should be delayed with treatment focusing on strength and balance. She met the criteria for the OEP and was assigned Level A; the protocol for level A exercises are highlighted in Table 5, Exercise Interventions. The patient was expected to return home, transition to a home-based OEP, return to independence with bed mobility, transfers, and ambulation and regain modified independence with stairs.

Approach

The patient participated in 26 PT interventions during her 33 days at in the SNF with persistent lingering pneumonia. She reviewed the OEP booklet, consented to the protocol, and began the intervention a week after admission to the SNF. The patient was prescribed five OEP warm up exercises as a standardized part of her program that focused on posture with two-hand support using a stable surface; she was progressed to no hand support for four of the five exercises by day 16 (Table 5). Typically, strength and balance were trained three days a week as in Otago programs. Gait was trained using FWW alternately two days a week. Standing and seated breaks were taken as needed with the opportunity to monitor oxygen saturation based on equipment availability. Recovery accounted for 30-50% of her treatment time.

The OEP exercises were used to address functional goals rather than having the exercises be introduced in the specified order as dictated by the program. Appendix A provides the Otago exercise protocol and exercises for convenience. The walking and turning around Otago exercise (Level B) was conducted on day seven of her stay, two days after OEP testing, to address a need the patient had with walker mobility in tight spaces identified by OT. Lateral stepping, also a level B balance exercise, was trained on day nine to accommodate railings she typically encountered with stair negotiation. Further comparisons can be made by referring to the intervention exercises listed in
Table 5. The priority was on function, specifically gait, so any of the Otago exercises that incorporated stepping were promoted in the parallel bars to progress gait without regard for OEP principles. All Otago balance and strength exercises were introduced to the patient to foster self-management.

Outcome

The patient’s outcomes can be compared to those obtained during the initial assessments in Table 4. Her frailty, by EFS, remained mild. Her balance confidence, assessed with ABC, increased from 54% to 71%, which she attributed to the FWW. By day 22 her 6MWT improved 82.32 +/- 25.51 m (MDC 54 m),17 significant even with a learning effect of 7.0- 15%,26 but distance was still at morbid levels (Table 2).17 Her TUG improved 68 seconds (MDC 2.68 sec), however frail elderly scores can have variability.27 Her CST increased to 13 exceeding age matched fitness standards.22 She was able to stand 10 seconds unsupported in both narrow base and semi tandem stances, though was unable to hold tandem or OLS for the FSBT. The patient discharged to an Assisted Living Facility (ALF) requiring supervision for ambulation with FWW, with transfers, and with stairs. In follow-up conversation with the patient five days later she highlighted receiving the same Otago exercise booklet and was continuing to perform her warm up exercises daily. In subsequent phone calls, she reported attending PT which included doing the Otago exercises and stair ambulation. She still maintained her goal to return home. Two months after discharge from the SNF she returned home.

Discussion

The purpose of this theory to practice case report was to delineate the contextual factors in a subacute setting that can limit fidelity to an evidence-based falls intervention while identifying an opportunity to build a sustainable falls prevention network across the health care settings using the same evidence-based program. This patient who had been diagnosed with rhabdomyolysis after a fall, met the criteria for the evidence-based OEP.6,8,25 The pathophysiology of rhabdomyolysis dictated a measured protocol such as the OEP with specific parameters for balance and strength progressions that limit eccentric work. The prescribed walking should have been based only on patient readiness and ideally should have been delayed based on her oxygen desaturation. Though the patient improved in most of her outcome measures in the 33 days of treatment, the
integrity of the program was compromised under the demands of meeting functional goals. Could she have returned home if fidelity to the program had been observed at the SNF? The prospect of using a level 1a evidence based intervention\textsuperscript{10} in creating a sustainable falls prevention partnership across the health care settings was lost as the fidelity to the program was not maintained in the subacute setting. Though direct communication with the patient indicated receipt of the OEP booklet there was no assurance of continuity of care between the SNF or ALF, indicating a need for a falls prevention network to help facilitate these types of transitions for the patient.

There are several contextual implications that exist in the subacute setting that compromise the delivery of evidence base interventions such as the OEP. The rehabilitation experience is influenced by the patient values, evidence-based practice, the facility, and insurance. Each perspective must be explored to appreciate the impact of each on implementing OEP in a SNF.

This patient was expected to require eight weeks to meet the collaborated goal of independence with walking and return to home, a reflection of her prior level of function. Though the patient displayed a lack of readiness to walk based on her oxygen saturation levels, she was driven to return home which, for her, equated to walking and managing stairs. This SNF typically used walking/gait training as therapy to address this functional goal of walking. The OEP preferentially stresses balance and strength exercises and emphasizes the walking component of OEP can be delayed, since walking by itself cannot decrease falls risk.\textsuperscript{7,10,25} The OEP exercises can promote walking and it is here the PT’s skill is of utmost value by being able to reveal the program’s design and explain the progressive nature so the patient is more confident.

The crux of the OEP proports a positive protective effect occurs over the span of 12 months of exercise adherence.\textsuperscript{7,10,25} Shorter rehabilitation programs, such as delivered in a SNF, can result in enhanced confidence and ultimately increase falls risk.\textsuperscript{8,28} Thirty hours of skilled physical therapy were available to this patient during her stay because of her assigned case mix category. Though Sherrington et al’s meta-analysis determined 50 hours of balance activities are required to reduce falls, the review specified the intervention must be delivered over longer periods to reduce falls.\textsuperscript{29} The OEP exercises are designed to be accomplished in 30 minutes three times a week, ideally with minimal
Currently if a patient qualifies for therapy services though the patient must agree to five days of therapy; therapy cannot be delivered for only three days. Additionally, it follows since these programs are lengthy the program must be transitioned with the patient.

The therapy staff of the facility was driven by productivity demands. The dichotomous demands of this subacute facility created an environment of poor research readiness. Though therapists were familiar with the exercises, they were wholly unacquainted with the tenets of Otago and found little time for research. The National Council on Aging advocates use of the Otago program as a falls prevention program, however this institutional setting was unaware of its use in community and other programs as well. They were disappointed by a protocol that was interpreted as “canned” and were concerned it was not demanding or functional enough, especially with regards to meeting Medicare progress guidelines.

As a for profit organization the facility’s goal was to minimize expenses. This facility had a skeletal staff and relied on temporary staffing during high patient loads. Optimizing schedules for the patient was difficult due to inadequate organizational flexibility. Variable therapists jeopardized the continuum of care for the patient. Attempting to retain the patient impacted both the patient and therapist’s schedules. Equipment purchases were minimized and did not meet the demands during peak loads. Due to increased patient loads from the flu, this patient had five therapists all with different interventions. Schedule changes increased the patient’s anxiety. Stacked sessions of OT and PT as a result of rescheduling proved exhausting. The supply of ankle weights, walkers, pulse oximeters, and wheel chairs were strained. The staffing challenges, poor scheduling predictability, and scarcity of equipment reduced efficiency of sessions and adherence to plan of care.

Insurance reimburses based on case mix assignment, but accordingly also heavily scrutinizes patient progress. The patient’s prognosis made her eligible for the highest allotted therapy minutes but in reality, meant she was expected to be rehabilitated much faster and would be discharged sooner since insurance will not typically pay the associated higher rate for lengthy stays. In anticipation of a more limited length of stay it was determined walking must be incorporated early to facilitate her return to community.
She had a two-week targeted goal of walking 60 m using a FWW with supervision (defined as walking an average of 60 m daily over two weeks). As it turned out Medicare only approved 33 days because of the high reimbursement. Delaying walking would not have survived Medicare examination. She would have been labeled “inappropriate for PT” and the facility would have been denied reimbursement. There exists a gap between Medicare funding and the definition of improvement. Physical therapists have a professional obligation to engage insurance companies to act in the best interests of the patient, to ensure the patients receive the benefit of the best evidence, and to be good stewards of resources.

The OEP has been shown to have a 70% return on investment in the home environment. There may be potential to reduce downstream costs associated with injuries from further falls by introducing it earlier in the subacute setting especially since known fallers are 66% more likely to a fall again within 6 months. The subacute setting affords access to skilled therapy. Evidence-based falls programs such as OEP can maximize Medicare spending in a readily identified population who would benefit from such an intervention.

PT’s are bound by core values that demand an understanding of community wide issues, especially ones pertaining to their practice setting such as falls risk. Previously one may have considered OEP inappropriate for the subacute setting due to inability of patients to self-manage. The successful delivery of OEP’s in group settings however indicates supervision can be tolerated with this programs delivery. Over 400 other studies investigating OEP delivery methods demand this evidence-based intervention be considered seriously as treatment in subacute settings. Shubert et al raises a concern of high non-completion rates for those who have received excessive supervision for home based OEP. At a minimum, patients identified as falls risks should be recommended for evidence-based programs upon discharge. Typically, this facility did not recommend follow on home therapy since the goal was for patients to be fully ready for return to community. In this patient’s case a discharge recommendation of PT and OEP was tolerated in support of this case report, but there was no collaboration between therapists.

Future studies should investigate the use of evidence-based falls risk programs in subacute settings in coordination with Medicare with a focus on fidelity, timing of
implementation, and requirement for all therapy staff to be trained in the protocol to ensure a standardized practice pattern that translates to continuum of care for the patients. Given that fall prevention programs are lengthy and there appears to be a gap in knowledge across settings a falls prevention network is necessary. This network would link and seamlessly transition patients to evidence-based falls prevention programs, serve as a resource repository for healthcare professionals and patients, and promote collaboration across settings.

**Limitation**

A limitation was the therapy staff were untrained in OEP and were unfamiliar with any evidence-based falls programs. The student was the only Otago certified therapy member and as a novice clinician had a limited student’s physical therapist’s perspective.

**Conclusions**

Skilled therapy in a sub-acute facility must include knowledge of evidence-based falls prevention programs across settings. There is an opportunity for subacute facilities to participate in unique healthcare delivery models for falls prevention that optimize skilled therapy and resources. Subacute facilities have a vital function in identifying falls risks but may be ill equipped to ensure patients are matched to an appropriate and available falls prevention program upon discharge necessitating a falls prevention network to assist with transitions.
References


12. Shubert TE, Goto LS, Smith ML, Jiang L, Rudman H, Ory MG. The Otago Exercise Program: Innovative delivery models to maximize sustained outcomes for high


### Table 1. Medications

<table>
<thead>
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<th>Condition</th>
<th>Medication</th>
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<tr>
<td>Hypothyroidism</td>
<td>Synthroid</td>
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<td>Hyperlipidemia</td>
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<td>High Blood Pressure</td>
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<td>Urinary Tract Infection (UTI)</td>
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<tr>
<td>Age-related Osteoporosis</td>
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<td>Antibiotic</td>
<td>Ilotycin</td>
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<td>After Hospital Admission</td>
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### Table 2. Systems Review

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<th>System</th>
<th>Problem</th>
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<tbody>
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<td>Pulmonary</td>
<td>COPD, Asthma, Former Smoker (30 years/0.5 pack/day)</td>
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<td>Cardiovascular/Circulatory</td>
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<td>Integumentary</td>
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<tr>
<td>Musculoskeletal</td>
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<td>Neurological</td>
<td>Low vision; hard of hearing</td>
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Table 3. Clinical Physical Therapy Exam

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<td>Pain (numeric)</td>
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<td>Coordination</td>
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<td>Sensation/Reflexes</td>
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<td>Upper Extremity (UE):</td>
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<td>Shoulder Abduction</td>
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<td>Elbow Flexion/extension</td>
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<td>Wrist flexion/extension</td>
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<td>Lower Extremity (LE):</td>
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<td>Knee flexion/extension</td>
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<td>Elbow Flexion/Extension</td>
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<td>WFL</td>
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<td>Wrist Extension/Flexion</td>
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<td>Activities of Balance Confidence Scale (ABC)</td>
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### Table 5. Intervention Exercises

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<tr>
<th>Day/Minutes/Focus</th>
<th>WARM UP EXERCISES</th>
<th>STRENGTH EXERCISES</th>
<th>BALANCE EXERCISES</th>
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<tbody>
<tr>
<td>#1 102’ Fct.</td>
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<td>#2 72’ Ex tol</td>
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<td>#3 46’ G</td>
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| #6 71’          | 1x 5 2HS          | 1x 5 2HS          | 1x 5 2HS          |
| #7 74’ 5/B      | 1x 5 2HS          | 1x 5 2HS          | 1x 5 2HS          | 44x 20 8x 20 |
| #8 76’ G        | 1x 5 2HS          | 1x 5 2HS          | 1x 5 2HS          | 1x 5 2HS |
| #9 74’ 5/B      | 1x 5 2HS          | 1x 5 CGA          | 1x 5 CGA          | 1x 5 2HS |
|                 | 2x 5              | 2x 5 2HS          | 2x 5 2HS          | 2x 5 2HS |
|                 |                   | 5x 10 steps 2HS   |                   | 1x 10” 2HS BLE |
|                 |                   | 4x 30 steps 2HS   |                   | 2x 10” 1HS    |
|                 |                   | 2x 10 steps 2HS   |                   | 2x 10” 1HS    |
|                 |                   | 2x 10 steps 2HS   |                   | 4x 1.5 m 2H   |
|                 |                   |                   |                   | 2x 5 1HS |
| #10 OFF         |                   |                   |                   |                   |
| #11 OFF         |                   |                   |                   |                   |
| #12 74’ 5/B     | 1x 5 1HS          | 1x 5 CGA          | 1x 5 CGA          | 1x 10 2HS |
|                 | 2x 10             | 2x 10             | 4x 5 m (to L) 1HS |                   |
|                 |                   |                   |                   | 1x 1 MinA NS |
| #13 80’ G       | 1x 5 NS           | 1x 5 NS           | 1x 5 2HS          |                   |
| #14 74’ 5/B     | 1x 5 NS           | 1x 5 CGA          | 1x 5 CGA          | 1x 10 2HS |
|                 | 5x 6 m 2HS        | 1x 10” BLE 1HS    | 2x 1.5 m 1HS      |
| #15 80’ G       | 1x 5 NS           | 1x 5 CGA          |                   |                   |

**OTAGO Exercise Prescription: Level A**

<p>| #6 71’          | 1x 5 2HS          | 1x 5 2HS          | 1x 5 2HS          |
| #7 74’ 5/B      | 1x 5 2HS          | 1x 5 2HS          | 1x 5 2HS          | 44x 20 8x 20 |
| #8 76’ G        | 1x 5 2HS          | 1x 5 2HS          | 1x 5 2HS          | 1x 5 2HS |
| #9 74’ 5/B      | 1x 5 2HS          | 1x 5 CGA          | 1x 5 CGA          | 1x 5 2HS |
|                 | 2x 5              | 2x 5 2HS          | 2x 5 2HS          | 2x 5 2HS |
|                 |                   | 5x 10 steps 2HS   |                   | 1x 10” 2HS BLE |
|                 |                   | 4x 30 steps 2HS   |                   | 2x 10” 1HS    |
|                 |                   | 2x 10 steps 2HS   |                   | 2x 10” 1HS    |
|                 |                   | 2x 10 steps 2HS   |                   | 4x 1.5 m 2H   |
|                 |                   |                   |                   | 2x 5 1HS |
| #10 OFF         |                   |                   |                   |                   |
| #11 OFF         |                   |                   |                   |                   |
| #12 74’ 5/B     | 1x 5 1HS          | 1x 5 CGA          | 1x 5 CGA          | 1x 10 2HS |
|                 | 2x 10             | 2x 10             | 4x 5 m (to L) 1HS |                   |
|                 |                   |                   |                   | 1x 1 MinA NS |
| #13 80’ G       | 1x 5 NS           | 1x 5 NS           | 1x 5 2HS          |                   |
| #14 74’ 5/B     | 1x 5 NS           | 1x 5 CGA          | 1x 5 CGA          | 1x 10 2HS |
|                 | 5x 6 m 2HS        | 1x 10” BLE 1HS    | 2x 1.5 m 1HS      |
| #15 80’ G       | 1x 5 NS           | 1x 5 CGA          |                   |                   |
|                 |                   |                   |                   | 1x 10 steps 2HS BLE |</p>
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<th>Day/Minute(s)/Focus</th>
<th>Neck Rotations</th>
<th>Chin Tucks</th>
<th>Trunk Rotations</th>
<th>Back Extensions</th>
<th>Stand FE/DF</th>
<th>Knee Extensor</th>
<th>Knee Flexor</th>
<th>Hip Abductor</th>
<th>Calf Raises</th>
<th>Knee Raises</th>
<th>Knee Bends</th>
<th>Backwards Walking</th>
<th>Walk &amp; Turning Around</th>
<th>Sideways Walking</th>
<th>Pandem Stance</th>
<th>Pandem Walk</th>
<th>One Leg Stand</th>
<th>Heel Walking</th>
<th>Toe Walking</th>
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<th>Sit to Stand</th>
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\(S/B: \text{Strength and balance}; \ G: \text{Gait 2HS}; \ SHS: \text{Two hand support}; \ SH: \text{Single hand support}; \ NS: \text{No support}; \ CGA: \text{Contact guard assist}; \ MinA: \text{Moderate assist}; \ S: \text{Supervision}; \ BLE: \text{Bilateral lower extremity}\)
## Table 6. Intervention Gait Training

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<th>Day</th>
<th>Focus</th>
<th>Minutes</th>
<th>Walking (FWW)</th>
<th>Stair walking</th>
<th>Misc. walking</th>
<th>Seated Bike</th>
<th>Baseline SPO2</th>
<th>SPO2 activity</th>
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<td>17</td>
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<td>GROUP EXERCISE</td>
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<tr>
<td>18</td>
<td>G</td>
<td>74</td>
<td>200’x2 S</td>
<td>Treadmill 2HS 5 min x 2 1.1 MPH</td>
<td>98% RA</td>
<td></td>
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<tr>
<td>19</td>
<td>S/B</td>
<td>63</td>
<td>200’X2 CGA</td>
<td>2HS</td>
<td>94% RA</td>
<td>94% RA</td>
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<tr>
<td>20</td>
<td></td>
<td>0</td>
<td>100’ CGA</td>
<td>4 6’ RHR x 2 S</td>
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<tr>
<td>21</td>
<td>S/B</td>
<td>59</td>
<td>5’ no AD x 3</td>
<td></td>
<td>94% RA</td>
<td></td>
<td></td>
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<tr>
<td>22</td>
<td>G</td>
<td>72</td>
<td>434’ S</td>
<td>400’ uneven surfaces outside Rollator S</td>
<td>98% RA</td>
<td>88% RA 1’ rec</td>
<td>outside ex 96% 2L</td>
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</tr>
<tr>
<td>23</td>
<td></td>
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<tr>
<td>24</td>
<td>G</td>
<td>15</td>
<td>112’ FF S</td>
<td>245’ FWW S weaving</td>
<td>94% RA</td>
<td>87% RA 1’ rec</td>
<td></td>
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<td>25</td>
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<tr>
<td>26</td>
<td>S/B</td>
<td>114</td>
<td>200’x2 S</td>
<td></td>
<td>95% RA</td>
<td>78% RA 1’rec</td>
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<tr>
<td>27</td>
<td>G</td>
<td>76</td>
<td>260’ S</td>
<td>10MWT 0.58m/s 20’ head turns 20’ variable speed</td>
<td>94% RA</td>
<td>88% RA</td>
<td></td>
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<tr>
<td>28</td>
<td>S/B</td>
<td>76</td>
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<tr>
<td>29</td>
<td>G</td>
<td>69</td>
<td>300’ x 3 S</td>
<td>18 min treadmill 0.8-0.9 mph</td>
<td>94% 2’ rec</td>
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<tr>
<td>30</td>
<td>S/B</td>
<td>67</td>
<td>220’ S</td>
<td></td>
<td>95% RA</td>
<td>90%</td>
<td></td>
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<td>31</td>
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<td>GROUP EXERCISE</td>
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<td>Test</td>
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</tbody>
</table>

S/B: Strength and balance; G: Gait 2HS: two hand support; SHS: Single hand support; NHS: no hand support; CGA: Contact guard assist; Mod A: moderate assist; Min A: minimum assist; S: Supervision; RA: room air; BHR: Bilateral hand Rails RHR: right hand rail; LHR: left hand rail; 2L: 2 liters of oxygen; SPO2: oxygen saturation; SS: side step
Appendix A. Otago Exercises

<table>
<thead>
<tr>
<th>Exercise</th>
<th>WARM-UP (FLEXIBILITY) EXERCISES</th>
<th>STRENGTHENING EXERCISES</th>
<th>BALANCE RETRAINING EXERCISES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head Movements</td>
<td>Stand tall, 5 times on each side</td>
<td>Trunk Movements</td>
<td>Stand tall, 5 times each side</td>
</tr>
<tr>
<td>Neck Movements</td>
<td>Stand tall, 5 times</td>
<td>Ankle Movements</td>
<td>Stand or sit, 10 times</td>
</tr>
<tr>
<td>Back Extension</td>
<td>Stand tall, 5 times</td>
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</tbody>
</table>

**Knee Extensor**
ALL 4 LEVELS

**Knee Flexor**
Ankle weights are used to provide resistance; perform 10 repetitions of each exercise, when able to do 2 sets of 10 repetitions add/progress weights.

**Hip Abductor**

**Calf Raises**
LEVEL C
10 repetitions, hold support, repeat

**Toe Raises**
10 repetitions, hold support, repeat

**LEVEL D**
10 repetitions, no support, repeat

---

**LEVEL A**

**LEVEL B**

**LEVEL C**

**LEVEL D**

**Knee Bends**
10 repetitions
Hold support
10 repetitions
No support or 10 repetitions
Hold support, repeat
10 repetitions
No support, repeat
10 repetitions, 3 times
No support

**Backwards Walking**
10 steps, 4 times
Hold support
10 steps, 4 times
Hold support
10 steps, 4 times
No support

**Walking And Turning Around**
Walk and turn around (do a figure 8) twice
Use walking aid
Walk and turn around (do a figure 8) twice
No support

**Sideways Walking**
10 steps, 4 times
Use walking aid
10 steps, 4 times
No support

**Tandem Stance (Heel Toe Stand)**
10 seconds
Hold support
10 seconds, No support
Walk 10 steps
Hold support, repeat
Walk 10 steps
No support, repeat

**Tandem Walk (Heel Toe Walk)**
10 seconds, Hold support
10 seconds, No hold
Walk 10 steps
Hold support, repeat
Walk 10 steps
No support, repeat

**One Leg Stand**
10 seconds, Hold support
10 seconds, No hold
30 seconds, No hold

**Heel Walking**
10 steps, 4 times
Hold support
10 steps, 4 times
No support

**Toe Walk**
10 steps, 4 times
Hold support
10 steps, 4 times
No support

**Heel Toe Walking Backwards**
Walk 10 steps
No support, repeat

**Sit To Stand**
5 stands, 2 hands for support
5 stands, 1 hand or 10 stands, 2 hands for support
10 stands, no support or 10 stands, 1 hand for support, repeat
10 stands
No support, repeat

**Stair Walking**
As instructed
As instructed
As instructed
As instructed, repeat
<table>
<thead>
<tr>
<th>Exercise Description</th>
<th>Instructions</th>
<th>Repetitions</th>
<th>Progression</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Warm up</strong></td>
<td></td>
<td></td>
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<tr>
<td>Neck rotations</td>
<td>Stand tall look ahead. Slowly turn your head as far as you can to the right. Slowly turn your head as far as you can to the left.</td>
<td>Repeat 5 times to each side</td>
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<tr>
<td>Chin Tucks</td>
<td>Stand up tall and look ahead. Place one hand on your chin, Guide your head straight back</td>
<td>Repeat 5 times</td>
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</tr>
<tr>
<td>Back Extension</td>
<td>Stand up tall with feet shoulder width apart and hold onto solid surface in front of you. Gently arch your back, open your chest and look up.</td>
<td>Repeat 5 times</td>
<td>Place your hands on the small of your back.</td>
</tr>
<tr>
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<tr>
<td>Trunk Rotations</td>
<td>Stand up tall with feet shoulder width apart and hold onto solid surface in front of you. Do not move your hips. Turn as far as you can to the right comfortably, Turn as far as you can to the left comfortably.</td>
<td>Repeat 5 times each side.</td>
<td>Place your hands on your hips.</td>
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<tr>
<td>Standing Plantar Flexion Dorsiflexion</td>
<td>Stand up tall. Lift one foot off the ground and while keeping the suspended leg straight pull the foot towards you and then point the foot down.</td>
<td>Repeat 10 times for each foot.</td>
<td>1) Try with one hand support 2) Try with no hand support.</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td><strong>Strengthening Exercises</strong></td>
<td>Sit in a chair with your back well supported. Straighten the leg out. Lower the leg.</td>
<td>Repeat 10 times each side.</td>
<td></td>
</tr>
<tr>
<td>Front Knee</td>
<td>Stand up tall facing a solid surface with both hands on the surface. Bend the knee, bringing the foot towards your bottom. Keep the knee under the hip. Lower the foot to the floor.</td>
<td>Repeat 10 times each side.</td>
<td></td>
</tr>
<tr>
<td>Back Knee</td>
<td>Stand up tall facing a solid surface with both hands on the surface. Lift the leg to the side keeping the toes, knees and hips facing forward. Return the foot to the floor.</td>
<td>Repeat 10 times each side.</td>
<td></td>
</tr>
<tr>
<td>Side Hip</td>
<td>Stand up tall facing a solid surface with both hands on the surface. Place your feet shoulder width apart. Come up onto your toes. Lower your heels to the ground.</td>
<td>Repeat 10 times.</td>
<td></td>
</tr>
<tr>
<td>Calf Raises</td>
<td>Stand up tall facing a solid surface with both hands on the surface. Place your feet shoulder width apart. Come back on your heels raising your front ofoot off the floor. Lower your feet back to the ground.</td>
<td>Repeat 10 times.</td>
<td></td>
</tr>
<tr>
<td>Toe Raises</td>
<td>Stand up tall facing a solid surface with both hands on the surface. Place your feet shoulder width apart. Come back on your heels raising your front ofoot off the floor. Lower your feet back to the ground.</td>
<td>Repeat 10 times.</td>
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</tr>
</tbody>
</table>

**Balance Exercises**
<table>
<thead>
<tr>
<th>Exercise</th>
<th>Description</th>
<th>Progression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knee bends</td>
<td>Stand up tall facing a solid surface with both hands on the surface. Place feet shoulder width apart. Squat halfway down, bending your knees. When you feel your heels start to lift, straighten up.</td>
<td>Repeat 10 times.</td>
</tr>
<tr>
<td>Backwards Walking</td>
<td>Stand up tall and hold onto support on both sides. Walk backwards 10 steps.</td>
<td>Progression: 1) Try with one hand support 2) Try with no hand support.</td>
</tr>
<tr>
<td>Walking and Turning Around</td>
<td>Stand up tall and hold onto support on both sides, Walk and turn in a clockwise direction. Walk back to starting position then turn in a counterclockwise direction. This exercise is a figure eight movement.</td>
<td>Progression: 1) Try with one hand support 2) Try with no hand support.</td>
</tr>
<tr>
<td>Heel Toe standing</td>
<td>Stand up tall and hold onto support on both sides, Place one foot in front of the other foot so your feet form a straight line. Hold this position for 10 seconds. Change position and the other foot directly in front. Hold this position for 10 seconds.</td>
<td>Progression: 1) Try with one hand support 2) Try with no hand support.</td>
</tr>
<tr>
<td>Heel Toe walking</td>
<td>Stand up tall and hold onto support on both sides, Place one foot in front of the other foot so your feet form a straight line. And then bring the foot from behind directly in front of the other.</td>
<td>Progression: 1) Try with one hand support. Turn around and try with the other hand. 2) Try with no hand support</td>
</tr>
<tr>
<td>One Leg Stand</td>
<td>Stand up tall and hold onto support on both sides, Stand on one leg. Try to hold this position for 10 seconds. Stand on the other leg try to hold this position for 10 seconds.</td>
<td>Progression: 1) Try with one hand support 2) Try with no hand support.</td>
</tr>
<tr>
<td>Heel Walking</td>
<td>Stand up tall and hold onto support on both sides, come back on your heels and raise the front of your foot off the floor. Walk 10 steps on your heels.</td>
<td>Progression: 1) Try with one hand support 2) Try with no hand support.</td>
</tr>
<tr>
<td>Toe Walking</td>
<td>Stand up tall and hold onto support on both sides, Come up onto your toes. Walk 10 steps on your toes.</td>
<td>Progression: 1) Try with one hand support 2) Try with no hand support.</td>
</tr>
<tr>
<td>Heel to toe walking backwards</td>
<td>Stand up tall and hold onto support on both sides, Place one foot directly behind the other foot. Move the foot that is now in front directly behind. Continue for 10 steps.</td>
<td>Progression: 1) Try with one hand support 2) Try with no hand support.</td>
</tr>
<tr>
<td>Sit to Stand</td>
<td>Sit in a chair that is not too low. Place your feet behind your knees. Lean forward over your knees. Push off with both hands to stand up</td>
<td>Repeat 5 times.</td>
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<td></td>
<td></td>
<td>Progression: 1) Try with one hand support 2) Try with no hand support with arms crossed</td>
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</tbody>
</table>
**Walking exercises**

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Description</th>
<th>Progression</th>
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</thead>
<tbody>
<tr>
<td>Sideways Walking</td>
<td>Stand up tall facing a solid surface with both hands on the surface. Take 10 steps to the right. Take 10 steps to the left</td>
<td>Progression: 1) Try with one hand support 2) Try with no hand support. with hands on hips</td>
</tr>
<tr>
<td>Sidestepping over hurdles</td>
<td>Stand up tall facing a solid surface with both hands on the surface. Step over hurdles going to left. Change direction and step over hurdles going to the right.</td>
<td>Progression: 1) Try with one hand support 2) Try with no hand support.</td>
</tr>
<tr>
<td>Lateral Step up on Stairs</td>
<td>Stand up tall and hold onto railing with both hands. Step up onto the stair.</td>
<td>Progression: 1) Try with one hand support 2) Try with no hand support.</td>
</tr>
<tr>
<td>Stair walking</td>
<td>Stand up tall and hold onto handrails on both sides, Go up and down the stairs</td>
<td>Progression: 1) Try with one hand support</td>
</tr>
</tbody>
</table>