Database of Knowledge Translation Tools
Intervention Summary

1. High-Intensity Gait Training - Adults with Subacute and Chronic Stroke

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2. Intervention Description and Dose Recommendations

Purpose of the intervention: In stroke rehabilitation, high-intensity gait training improves:

- Walking speed, endurance, and balance
- Transfers & stair climbing may improve when training includes variability of tasks and environment

Recommended dose: *The optimal dose of High Intensity Gait Training is not currently known. However, the KEs reviewed the doses provided that obtained good results and made recommendations based on feasibility in practice. The dose is described as a FITT guideline, indicating **F**requency, **I**ntensity, **T**ime, **T**ype of exercise.*

- **F**requency: Minimum of 3 sessions/week, ideally ≥ 4 sessions/week
- **I**ntensity:
  - 70-85% of HR Max (heart rate calculator https://www.ntnu.edu/cerg/hrmax)
  - Rating of perceived exertion of 14 – 17 ("Hard" to "very hard"
- **T**ime during the session: 30-60 minute sessions (spend as much time as possible walking)
- **T**otal time (duration) of the intervention in the research:
  - continue standardized outcome measures, continue treatment as long as clinically meaningful gains are made
  - Minimum duration in outpatient setting: 4 weeks
  - Minimum duration in inpatient setting: 21 days
- **T**ype of intervention: High-intensity variable gait training on treadmills and overground (including stairs)

Recommended progression of intervention:

Trial for non-ambulatory sub-acute patients:

- It is difficult to identify non-ambulatory acute/subacute patients who will benefit from the training
- Responders to treatment can be identified with greater specificity and sensitivity *after being exposed to a high dose of treatment for 1 week.*
- Deliver the program as recommended to non-ambulatory acute/subacute patients for *at least 1 week* before determining whether the patient may benefit. Specifically, look for the following assessment results to determine if the patient will *likely achieve walking with contact guard assist or better before discharge from inpatient rehabilitation.*[1]
  - Admission:
    - Berg Balance Score: 5.5 points (66% sensitivity, 86% specificity)
    - Steps/day (can occur with/without assistance): 1099 (56% sensitivity, 85% specificity)
  - Week 1:
    - Berg Balance Score: 10.5 points (79% sensitivity, 86% specificity)
    - Steps/day (can occur with/without assistance): 1099 (85% sensitivity, 85% specificity)

For example, if a patient scores ≥ 11 points on the BBS after 1 wk of treatment, he is likely to walk with contact guard assist or better at discharge from inpatient rehabilitation (median length of stay in the study was 28 days; average number of sessions per day was 1.1 session/day)

Trial for non-ambulatory chronic patients:

- Research studies have not examined the effect of this program on non-ambulatory chronic patients, therefore it is difficult to be confident of the effect of the training in this population.
- Recommend trialing a high dose of the program for 2 – 4 weeks while assessing weekly outcomes with the recommended standardized measures. If a clinically meaningful change is not demonstrated after 4 weeks, consider discontinuing the intervention.

Knowledge Expert group recommendation for application to regional health authority:

- Utilize high intensity gait training for patients undergoing subacute and chronic stroke rehabilitation
- Patients should be cleared by physician for the recommended intensity (i.e. heart rate zones)
- Heart rate should be continuously monitored throughout the sessions
- Blood pressure should be assessed before, during, and after training is over (at least 3 x or more)

Considerations:

- Clear inclusion criteria for high intensity gait training have not been defined
- May be beneficial to trial for at least 1 – 2 weeks with all non-ambulatory and ambulatory patients to determine response. Patients should be measured routinely with standardized outcome measures to determine if he/she is responding to treatment.
- The frequency of 3 x wk is based on frequencies studied in the literature. If patients cannot attend at least 3 sessions a wk, it is unclear whether benefits similar to the research will be obtained from the high intensity gait training program.
- The minimum duration of 4 weeks is based on frequencies studied in the literature. If patients cannot attend in an outpatient setting for at least 4 weeks or an inpatient setting for 3 weeks, it is unclear whether benefits similar to the research will be obtained from the high intensity gait training program.
- RPE rating recommendation should be considered a guideline, but not a range that is hard rule. Some patients may be able to work at higher ranges with lower heart rates, and others may rate very low on the scale with a very high heart rate. Clinicians should consider other signs of exertion when determining how to interpret the rating, such as perspiration and heavy breathing. For example, if the patient rates a 17, but is able to hold a conversation while walking, the effort is not likely “very hard.”

Diagnosis: Stroke, most studies focused on unilateral supratentorial stroke, but we recommend trialing program on patient regardless of location of stroke
Acuity level: Subacute and chronic stroke
Current level of function: (inclusion criteria below)

- Subacute stroke: non-ambulatory and ambulatory patients included. *Note, it may be necessary to deliver a high dose of the intervention for 1 week before determining whether a patient has capacity to respond to the intervention.*
- Chronic stroke: Population studied included individuals who able to walk > 10 meters over ground with or without physical assistance, Mini-Mental Status Exam score >23/30. Patients who ambulate at speeds <0.9 m/s as their Self-selected velocity speed were primarily studied. However, we recommend a trial in non-ambulatory patient groups (see considerations in section 3 above).

Gait speed: 10 Meter Walk Test (10MWT) at self-selected and fast velocity
Static and Dynamic Sitting/Standing Balance: Berg Balance Scale
Walking distance/endurance: 6MWT

Transfers: Five times sit-to-stand or 30 second sit-to-stand
Daily stepping: Step activity monitor or pedometer
Administration timing:

- Inpatient: Administer within 3 days of admission, weekly, and within 3 days of discharge
- Outpatient: Administer within first 2 sessions, every 2 – 4 weeks, and within 2 sessions of discharge

Brief overview of theoretical basis for intervention:

- Intensity = power output (i.e. workload)
- Relative power output: estimated using cardiopulmonary or metabolic measures; reflects the underlying neuromuscular activity during locomotor tasks
- During walking training, intensity can be manipulated by increasing walking speed or carried load.
- High-intensity gait training is associated with:
  - Greater release of modulatory and trophic factors that contribute to increased synaptic connectivity of active neural circuits
  - Improved muscular strength
  - Greater cardiovascular capacity that underlie improved locomotor performance

Evidence supporting the impact of the intervention:

Improved walking speed

- Subacute stroke
  - Level 1 evidence: Improved self-selected and fastest speeds after high intensity variable gait training (.27 m/s improvement in SSV; .36 m/s improvement in FV)[2]
  - Level 2 evidence: Improved self-selected (increased by .33 m/s) and fastest speeds (increased by .53 m/s) with a high intensity variable gait training program[3]
- Chronic Stroke
  - Level 1 evidence*:* Improved gait speed (.13 m/s self-selected; .13 m/s fastest speed) after a therapist-assisted treadmill program[4]
  - Level 2 evidence
    - Improved self-selected velocity (.05 m/s) and fastest velocity (.03 to .11 m/s) after high intensity treadmill program[5]
    - Improved self-selected (increased by .23 m/s) and fastest speeds (increased by .38 m/s) with a high intensity variable gait training program[3]
    - Improved self-selected velocity (improved .1 m/s) and fastest velocity (improved.1 m/s) after high intensity interval training[6]

Improved endurance/walking distance

- Subacute stroke
  - Level 1 evidence: Improved 6MWT distance with high intensity variable gait training (increase of 116 meters)[2]
  - Level 2 evidence: Improved 6 MWT distance (increased 89 meters) with a high intensity variable gait training program[3]
  - Level 3 evidence: Improved 6 MWT distance (increased by 131 meters) with a high intensity variable gait training program[1]
  - Level 3 evidence: Improved 6 MWT level of assistance (increased, on average, from moderate assist (50 – 75% assistance required - improved to supervision) with a high intensity variable gait training program[1]

- Chronic stroke

- Level 2 evidence
  - Improved 12 minute walking distance (15 to 39 meters) after high intensity treadmill walking[5]
  - Improved 6 minute walking distance (~34 meters, maintained at follow-up) after a high intensity, therapist-assisted treadmill[4]
  - Improved 6 MWT distance (increased 144 m) with high intensity variable gait training[3]
  - Improved 6 MWT distance (increased 40 m in high, compared to 6 m in low intensity)[7]

Increased efficiency

- Chronic stroke
  - Level 2 evidence
    - Decreased oxygen cost to walk after high intensity treadmill walking (Decreased 119 to 78 ml/kg/km)[5]
    - Decreased oxygen cost to walk after high intensity interval training (decreased 2.2 ml/kg/min)[6]

Improved single-limb stance time (i.e. patients walk more symmetrically because they are spending more time on the impaired limb in stance)

- Subacute stroke: Level 1[2] and level 2[3] evidence
- Chronic stroke: Level 2[3,4] evidence

Improved balance:

- Subacute stroke
  - Level 1 evidence*:* Improved Berg Balance Score with high intensity variable gait training (increase of 8 points)[2]
  - Level 2 evidence: Improved Berg Balance Scale (increased an average of 8.6 points) after high intensity variable gait training[8]
  - Level 3 evidence: Improved Berg Balance Scale (increased an average of 29 points) after high intensity variable gait training in inpatient rehabilitation[1]
- Chronic stroke:
  - Level 2 evidence: Improved Berg Balance Scale (increased an average of 6.2 points) after high intensity variable gait training[8]

Improved transfers:

- Subacute stroke
  - Level 1 evidence
    - Improved Five Times Sit to Stand time after high intensity variable gait training (decrease of 6 seconds; not significantly different that control group)[2]
  - Level 2 evidence: Improved Five Times Sit to Stand time (decreased 12 seconds) after high intensity variable gait training[8]
  - Level 3 evidence: FIM toilet transfer improved from max assist to min assist (on average) after high intensity variable gait training program delivered in inpatient rehabilitation[1]
- Chronic stroke:
  - Level 2 evidence: Improved Five Times Sit to Stand time (decreased 6 seconds) after high intensity variable gait training[8]

Improved steps per day:

- Subacute stroke
  - Level 1 evidence: Improved steps per day after high intensity variable gait training (increase of 975 steps/day, not significantly different that control group)[2]
- Chronic stroke:

- Level 2 evidence: Improved steps per day (~25% increase) after high intensity treadmill walking stepping dose during PT was moderately associated with change in daily stepping (r = .57)[5]

Improved quality of life

- Chronic stroke: Level 2 evidence: Improved SF-36 physical function score (increase 4 points)[4]

FITT (dose) reported in the literature

- Frequency:
  - 5 x week[3]
  - 4-5 x week[2,8]
  - 3 x week[6,7]
  - Other: varied from 2-5 days/wk, matched previous outpatient therapy[5]
- Intensity
  - HR < 85% of age-predicted HR max; BP below 220/110[4]
  - 70-80% of Heart Rate Reserve[2,3,7,8]
  - 53 – 72% of Heart Rate Reserve[6]
  - RPE 15 to 17 ("hard" to "very hard)[7,8]
  - RPE ≥ 14[1]
- Time per session:
  - 25 min[6]
  - 30 min of walking, maximum of 1 hour session (with rest breaks)[4]
  - 1 hour[3]
  - Up to 40 minutes of walking in a 1 hour session[2,7,8]
- Time/Duration:
  - 12 sessions in outpatient-type setting[4,7]
  - 10 weeks in outpatient-type setting[2,3,8]
  - Median 28 (range 21 – 35) days in inpatient-rehabilitation[1]
- Type
  - Treadmill, forward walking, harness with body weight support of 30% - 40% provided during session 1, decreased 10% per session as tolerated without substantial knee buckling or toe drag.[4]
  - Treadmill and overground – high intensity variable training (appendix with protocol provided)[2,3,7]
  - Treadmilll with 30-second bursts of treadmill walking at maximum safe speed, alternated with 30- to 60-second recovery periods[6] compared to continuous treadmill walking with speed adjusted to maintain 45% (+/-) 5% HRR. Target heart rate (HR) was progressed to 50%(+/-) 5% HRR after 2 weeks of training

8. Documentation Tips:

Components to include in documentation:

- Target HR and/or Borg RPE range
- Minutes spent in target range while training
- Peak HR and/or Peak RPE
- Amount of time spent doing treadmill, stair, and overground walking

9. Links to other relevant resources:

Online presentations: Free online courses on high intensity gait training are available, please contact Jenni Moore at jmoore@knowledgetranslation.org for more information.

Other KT resources: Several KT tools are available to assist with implementation of high intensity gait training. Please contact Jenni Moore at jmoore@knowledgetranslation.org for more information.

Full literature review and tables

10. References:

1. Hornby TG, Holleran CL, Leddy AL, et al. Feasibility of Focused Stepping Practice During Inpatient Rehabilitation Poststroke and Potential Contributions to Mobility Outcomes. *Neurorehabilitation and neural repair.* 2015.
2. Hornby TG, Holleran CL, Hennessy PW, et al. Variable Intensive Early Walking Poststroke (VIEWS): A Randomized Controlled Trial. *Neurorehabilitation and neural repair.* 2015.
3. Holleran CL, Straube DD, Kinnaird CR, Leddy AL, Hornby TG. Feasibility and potential efficacy of high-intensity stepping training in variable contexts in subacute and chronic stroke. *Neurorehabilitation and neural repair.* 2014;28(7):643-651.
4. Hornby TG, Campbell DD, Kahn JH, Demott T, Moore JL, Roth HR. Enhanced gait-related improvements after therapist- versus robotic-assisted locomotor training in subjects with chronic stroke: a randomized controlled study. *Stroke; a journal of cerebral circulation.* 2008;39(6):1786-1792.
5. Moore JL, Roth EJ, Killian C, Hornby TG. Locomotor training improves daily stepping activity and gait efficiency in individuals poststroke who have reached a "plateau" in recovery. *Stroke; a journal of cerebral circulation.* 2010;41(1):129-135.
6. Boyne P, Dunning K, Carl D, et al. High-Intensity Interval Training and Moderate-Intensity Continuous Training in Ambulatory Chronic Stroke: A Feasibility Study. *Physical therapy.* 2016.
7. Holleran CL, Rodriguez KS, Echauz A, Leech KA, Hornby TG. Potential contributions of training intensity on locomotor performance in individuals with chronic stroke. *Journal of neurologic physical therapy : JNPT.* 2015;39(2):95-102.
8. Straube DD, Holleran CL, Kinnaird CR, Leddy AL, Hennessy PW, Hornby TG. Effects of dynamic stepping training on nonlocomotor tasks in individuals poststroke. *Physical therapy.* 2014;94(7):921-933.