



# Apples to Apples? Experiences from Implementing High Intensity Gait Training in the US and Norway

Jenni Moore, George Hornby, Roberta Virva, Lauren Lenca, Chris Henderson, Elisabeth Bø, Jan Nordvik



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## Session Objectives:

- Describe the evidence that supports high intensity gait training in stroke rehabilitation
- Identify barriers and facilitators to providing high intensity gait training in inpatient rehabilitation
- Discuss strategies that could be used to successfully implement high intensity gait training into clinical practice

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# Main Points

## Overview (Moore)

Overview of High-Intensity Gait Training (Hornby)

Mary Free Bed (Virva and Lenca; Grand Rapids, Michigan)

Rehabilitation Hospital of Indiana (Henderson; Indianapolis, Indiana)

Norway (Bø and Nordvik, Oslo, Norway)

Reflection (Moore)

Panel discussion/Q & A

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*17 years or more for evidence to be used in practice (Morris et al, 2011)*

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# Gait Assessments and High Intensity Gait Training across 3 Sites



Restoring Hope and Freedom  
**Mary Free Bed**  
 Rehabilitation Hospital

Grand Rapids, MI



**RHI** |

Indianapolis, Indiana



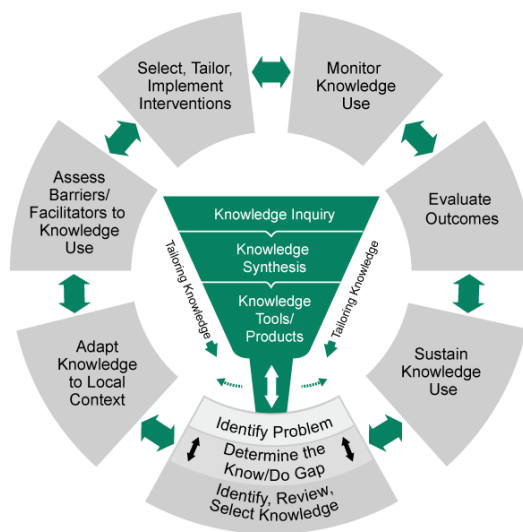
Oslo universitetssykehus  
**SUNNAAS SYKEHUS**  
 Regional kompetansetjeneste for rehabilitering

Oslo, Norway

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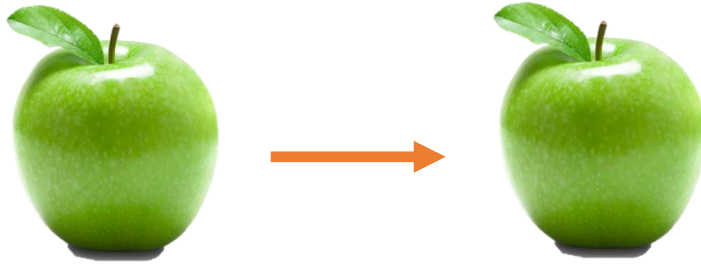


131 bpm (78% HRmax)



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# Focused Intensive Repetitive Step Training (FIRST)



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Project goals

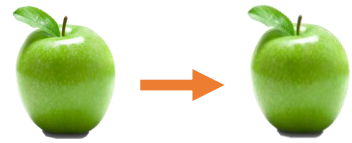
Assessments

Gait Intervention

Implementation Process

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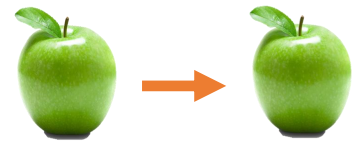
## Project Goals



1. *Examine usual care interventions provided to patients during sub-acute rehabilitation and their relation to patient outcomes*
2. *Implement high intensity stepping program*
  - a) Can a laboratory-tested intervention be implemented into inpatient stroke rehabilitation?
  - b) Does this intervention result in better outcomes than usual care?

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## Project Overview



### Phase 1: collect baseline data during usual care

- Implement gait assessment battery
- Collect stepping data
- Determine outcome measurement changes during usual care

### Phase 2: implement high intensity, variable gait training

- Monitor fidelity of the intervention
- If delivered with fidelity, evaluate effectiveness of intensive gait training program in comparison to usual care

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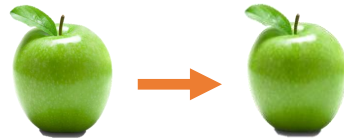
## Assessments



- Primary Outcome Measures
  - 10 Meter Walk Test (with and without assistance)
  - 6 Minute Walk Test (with and without assistance)
  - Berg Balance Scale
- Demographics and secondary outcome measures

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## Intervention



Frequency: 4 sessions per week

Intensity:  $\sim 70 - 85\%$  of  $HR_{max}$

Time: as much time walking as possible in a one hour session

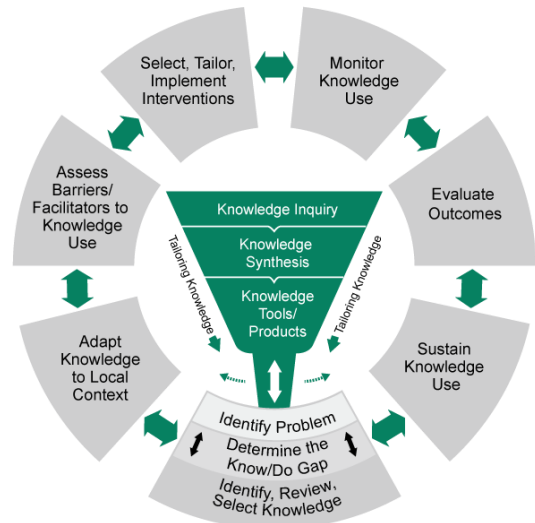
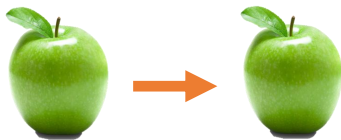
Type: high-intensity variable gait training  
(defined in Holleran et al, 2014)

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# Implementation Process

## The Knowledge-to-Action Cycle

Source: Graham ID et al. *JCHEP* 2006;26:13-24.



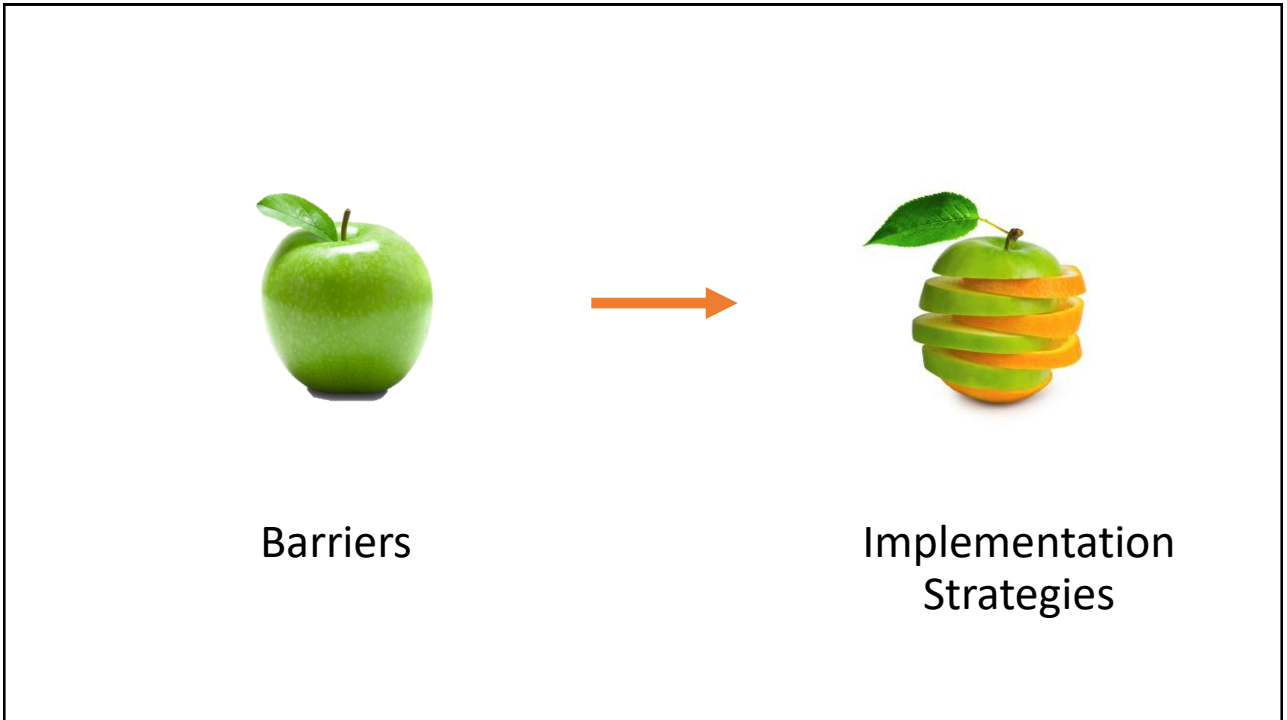
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## Questions Driving our Analysis

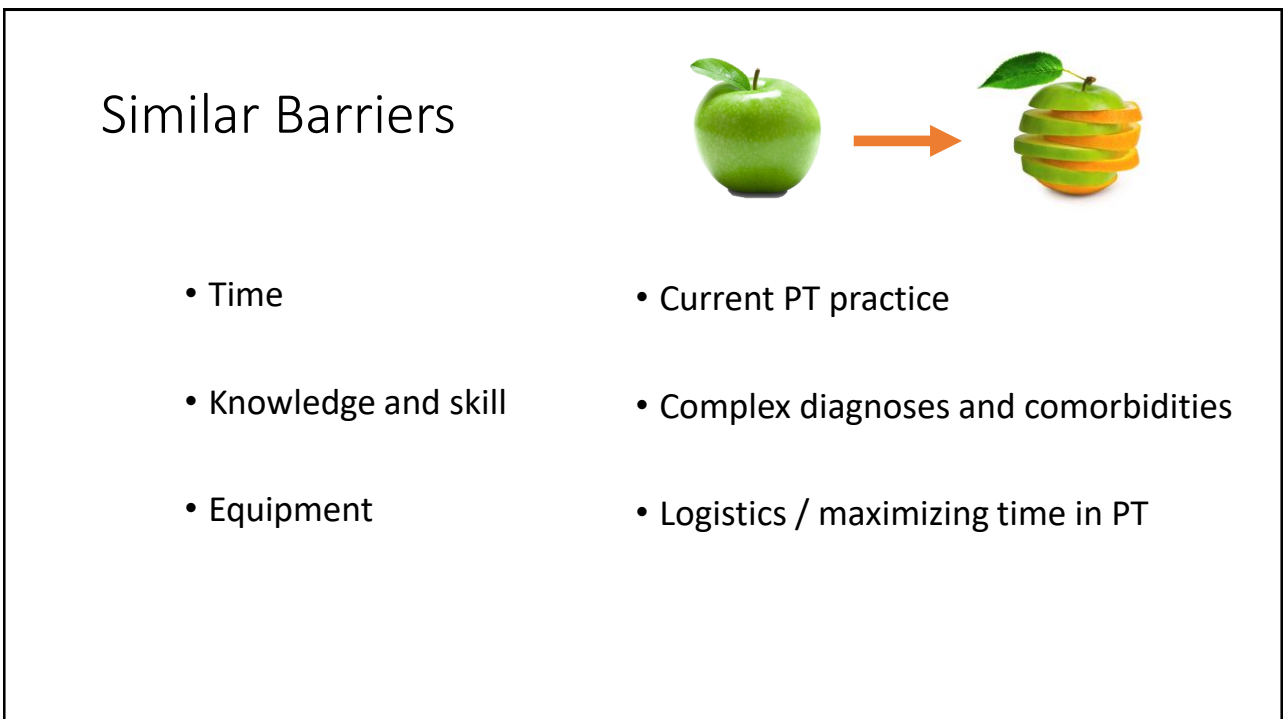


1. Were the two groups similar enough to compare?
2. Did we successfully implement high-intensity gait training?
3. If yes, did the intervention result in better outcomes than usual care?

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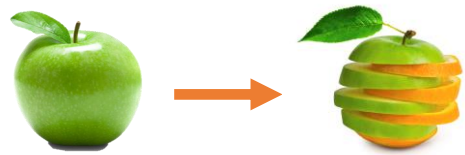
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## Barriers & Implementation Strategies

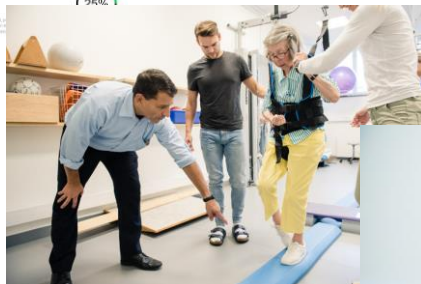
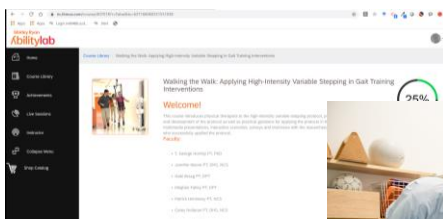


*SELECTED TO OVERCOME SPECIFIC BARRIERS*



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## Strategies Targeting Knowledge and Skill Barriers



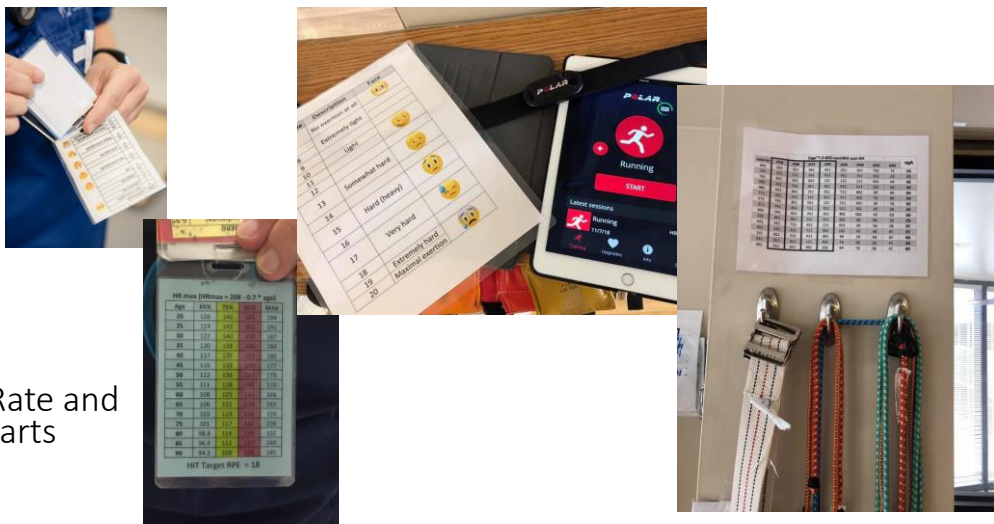
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# Strategies Targeting Environmental Barriers



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# Strategies Targeting Environmental Barriers

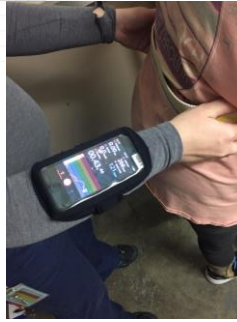


Heart Rate and RPE Charts

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# Strategies Targeting Environmental Barriers

Age	50%	55%	60%	65%	70%	75%	80%	85%	HR MAX
59	83	92	100	108	117	125	133	142	

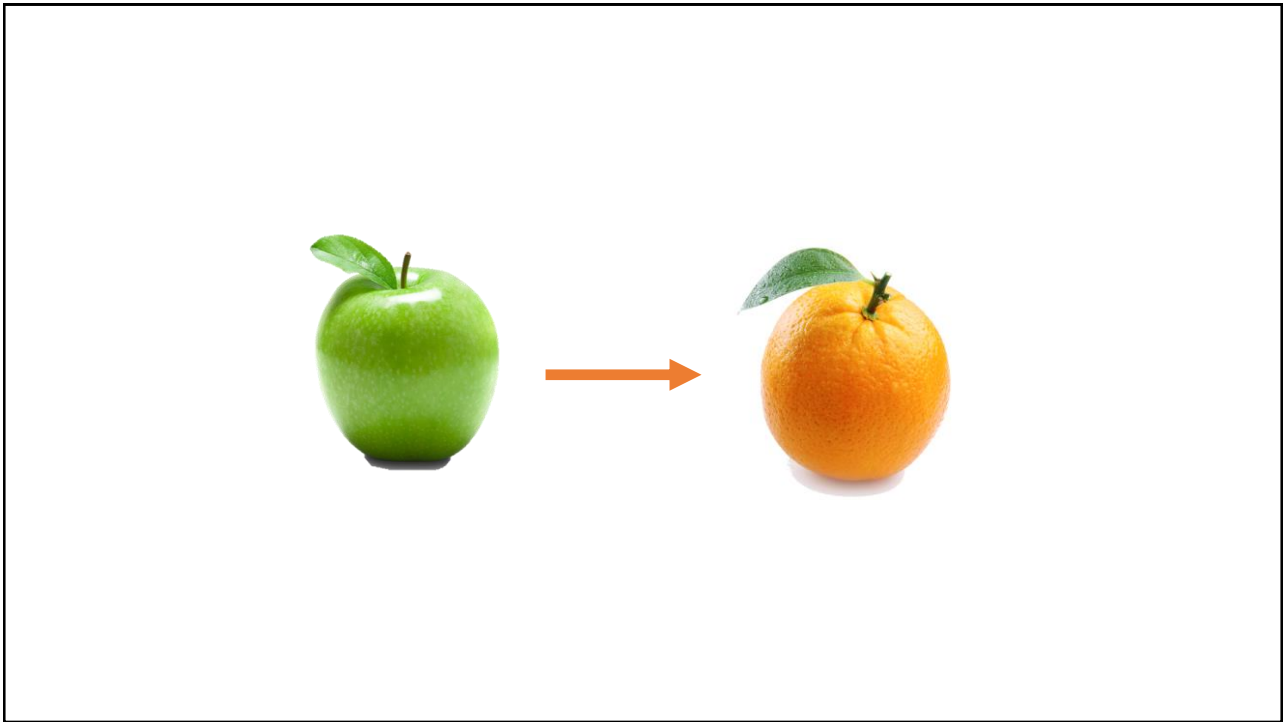


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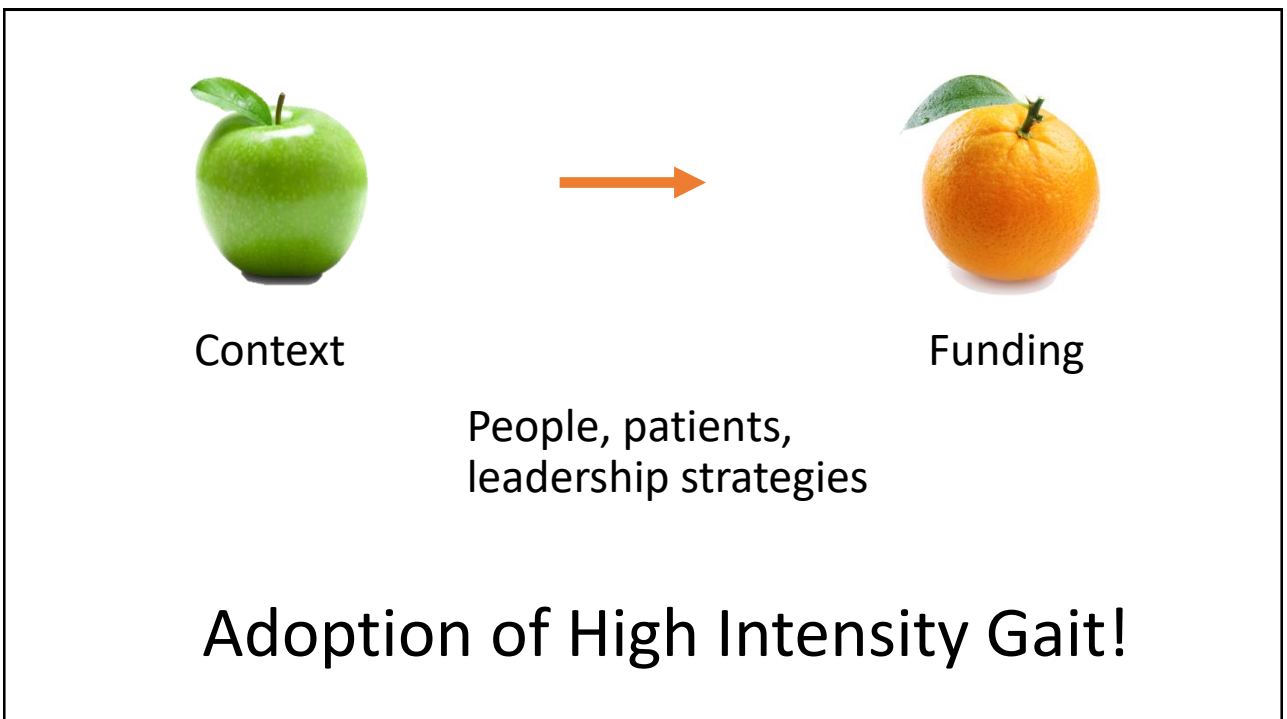
# Strategies Targeting Environmental Barriers



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Restoring Hope and *Freedom*  
**Mary Free Bed**  
 Rehabilitation Hospital

**RHI** | 

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 for rehabilitering



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You will hear...

Why high-intensity gait training?

Implementation stories

Biggest barriers

Most successful implementation strategies

Outcomes (*was high intensity gait implemented? Did it impact the patient?*)

Insights from implementation experiences



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# Main Points

Overview (Moore)

## **Overview of High-Intensity Gait Training (Hornby)**

Mary Free Bed (Virva and Lenca; Grand Rapids, Michigan)

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Norway (Bø and Nordvik, Oslo, Norway)

Reflection (Moore)

Panel discussion/Q & A

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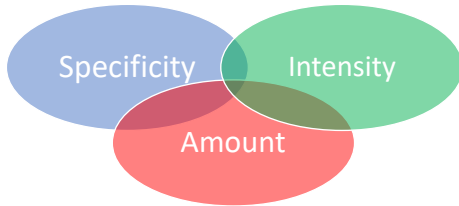
Panel discussion/Q & A

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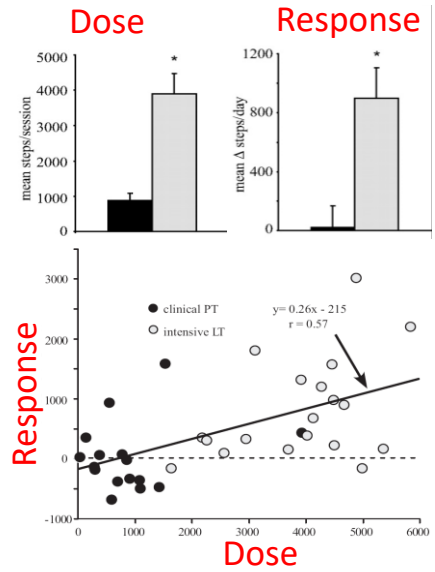
*High intensity training (Moore Stroke 2010)*

Greater amounts of stepping practice with focused high-intensity training (900 to ~4000 steps/session)

Changes in mobility (steps/day) related to steps/session



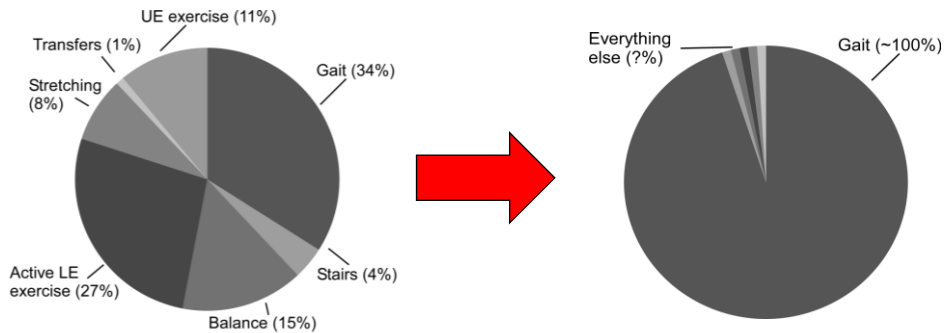
■ Clinical\_PT    □ Locomotor Training



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*Prioritizing goals and activities*

Focus only on task-specific walking training  
(Moore Stroke 2010, Hornby NNR 2016, Hornby Stroke 2019)



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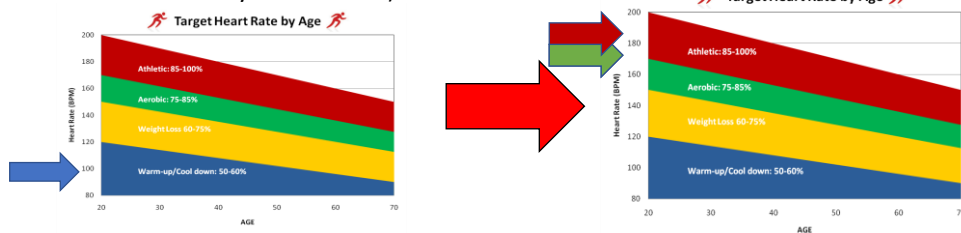
## Prioritizing goals and activities

Focus only on task-specific walking training  
(Moore Stroke 2010, Hornby NNR 2016, Hornby Stroke 2019)

Training HR zone (THR) = 70-80% Heart Rate Reserve (HRR)

Achieving relatively high cardiovascular intensities (Pang J Stroke Cerebrovasc Dis 2013, Mackay-Lyons PTJ 2019)

15-18 BORG Ratings of Perceived Exertion (RPE)



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## High intensity training (Moore Stroke 2010)

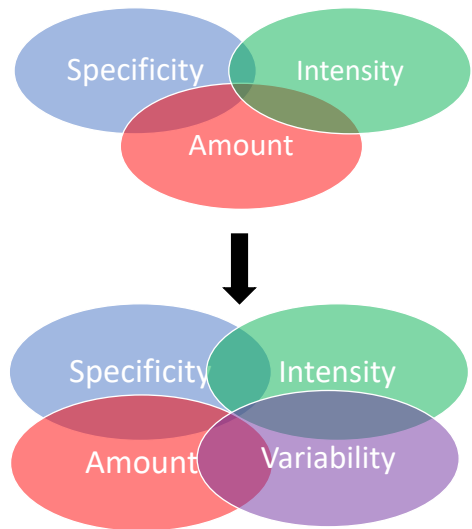
Limited outcomes using only treadmill

(Macko 2005, Moore 2010, Globas 2012)

- Consistent gains in 6 min, peak  $VO_2$
- Limited gains in speed, balance, transfers, steps/day



Studies detailing the potential importance of errors/variability?



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## Prioritizing goals and activities

Focus only on task-specific walking training  
(Moore Stroke 2010, Hornby NNR 2016, Hornby Stroke 2019)

Achieving relatively high cardiovascular intensities (Pang J Stroke Cerebrovasc Dis 2013, Mackay-Lyons PTJ 2019)

Variable (difficult) stepping training (patient and task-specific) (Holleran NNR 2014, Hornby NNR 2019)

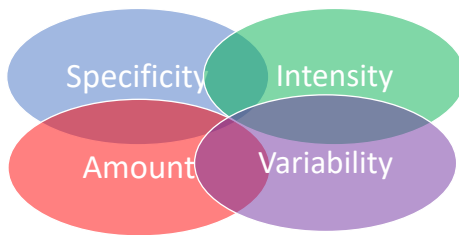
- kinematic variability
- environmental variability
- task variability

Multidirectional stepping  
Multiple environments  
Random order practice

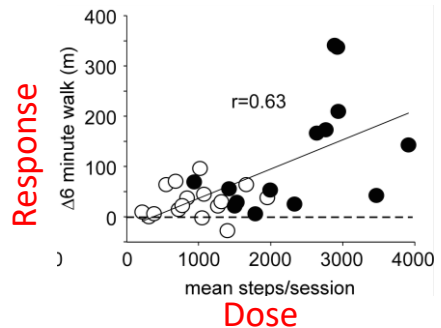
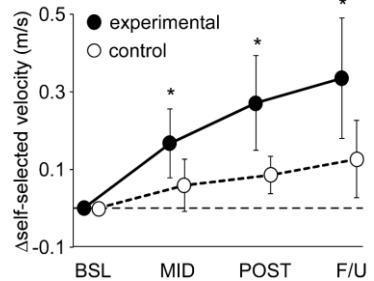


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## High intensity *variable* stepping training (Holleran NNR 2014, Hornby NNR 2016)

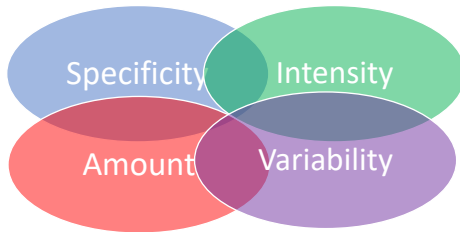


Pilot studies, small RCT  
(Holleran NNR 2014, Straube PTJ 2014, Hornby NNR 2016, Leddy JNPT 2016)

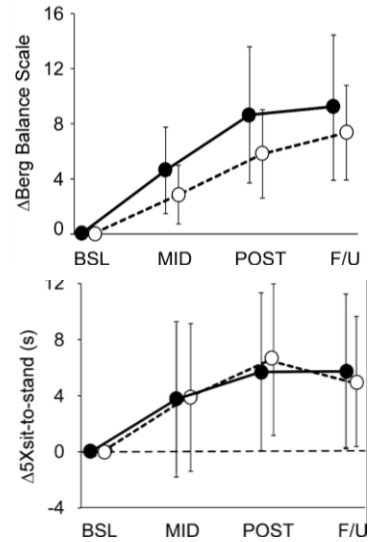


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*High intensity **variable** stepping training*  
 (Holleran NNR 2014, Hornby NNR 2016)



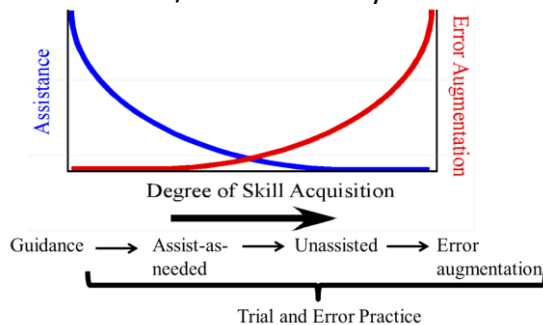
Pilot studies, small RCT  
 (Holleran NNR 2014, Straube PTJ 2014 **Hornby NNR 2016**, Leddy JNPT 2016)



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## Protocol

- Biomechanical demands of walking (Kuo/Donelan PTJ 2010)
  - Propulsion
  - Limb swing advancement
  - Stance control
  - Lateral/frontal stability
- Define successful walking (Holleran NNR 2014)
  - Advancing in a direction
  - Positive step length
  - Limited limb/trunk collapse
  - Maintain upright



*Success = Continuous stepping*  
*Failure = 3-5 consecutive errors*  
*Gait kinematics were not a primary concern*

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## Progressing Biomechanical Subcomponents of Walking



Limb Advancement

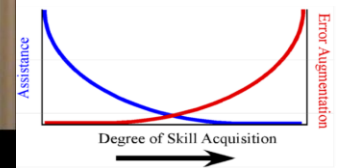
Stance Control

Propulsion

Stability & Balance

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## Progressing Biomechanical Subcomponents of Walking



Limb Advancement

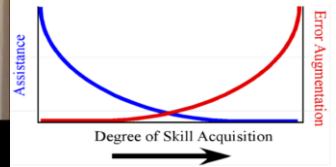
Stance Control

Propulsion

Stability & Balance

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# Progressing Biomechanical Subcomponents of Walking



Limb Advancement

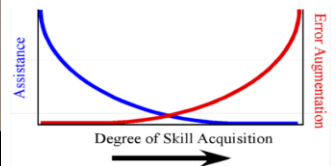
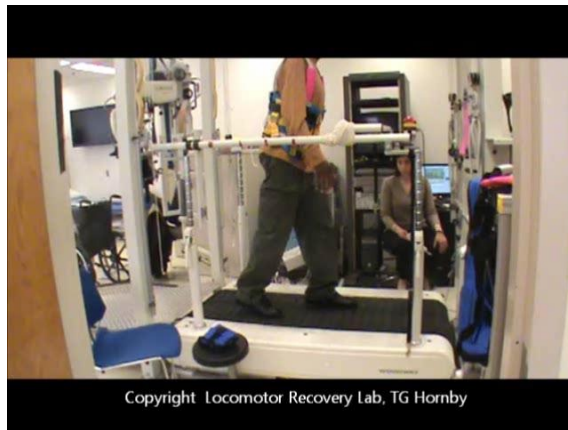
Stance Control

Propulsion

Stability & Balance

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# Progressing Biomechanical Subcomponents of Walking



Limb Advancement

Stance Control

Propulsion

Stability & Balance

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## Training results (Holleran 2014, Hornby 2016, 2019)

Focus only on task-specific walking training (100%)

- Able to achieve 2500-3000 steps/session
- depends on level of gait dysfunction/impairments

Achieve high cardiovascular intensities

- ~~> 70% HR<sub>max</sub> > 13 RPE~~
- > 75% HR<sub>max</sub> > 14 RPE
- ~50% at HR zone, ~90% RPE zone

Variable (difficult) stepping training

- Patient-specific tasks
- Kinematic variability
- Task/environmental
- Hard to quantify . . . Greater in less impaired patients

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This is our “intervention” apple . . . . .



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## This is our “intervention” apple . . . . .

Focus only on task-specific walking training (100%)?

Achieve high intensities (50% of time > 70-75% HR)?

Variable (difficult) stepping training?

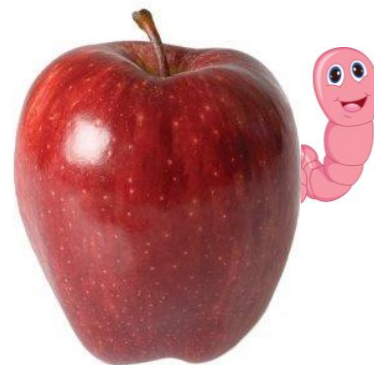


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## Preliminary Implementation Efforts (Hornby NNR 2015)

- Prioritization of activities to maximize amount and intensity of stepping practice
- 2012-2013
  - 201 patients < 6 months post-stroke
  - During inpatient rehabilitation
  - Part of clinical care
- Feasibility of number and intensity of stepping related activities
- Evaluate potential associations of stepping activity with locomotor and non-locomotor outcomes



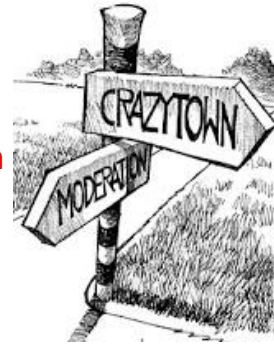
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## Study Sample and Design

- Retrospective data analysis (May 2012 through Oct 2013)
  - Implementation of clinical initiative to maximize amount and intensity of stepping practice
  - No control group
- Inclusion
  - Initial diagnosis of stroke (<6 months)
  - 18-89 years of age
- Exclusion
  - Pregnant
  - HIV or AIDS
  - Incarceration
  - Lower extremity fracture or amputation

Research  
Criteria



Clinical  
Criteria

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## Adaptation of research to clinical practice??

### What did the research do?

- 100% high intensity training (HIT)
  - Able to achieve 2500-3000 steps/session
  - depends on level of impairments
- Achieve high cardiovascular intensities
  - > 70-75%  $HR_{max}$ , > 13-14 RPE
  - ~50% at HR zone, ~90% RPE zone
- Variable difficult stepping training
  - Difficult to quantify
  - More in less impaired patients

### What do we think we can do clinically?

- HIT 4 days/wk (80%)
  - Weekly outcomes, family training (???)
  - Depends on impairments, but how much?
- Achieve higher intensities
  - Medications? Tolerance? HR vs RPE
  - Mackay-Lyons 2002 - 3 min in zone . . . . so more than that . . .
- Variable difficult stepping training
  - Difficult to quantify
  - Way less, more impaired patients

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## Strategies to utilize facilitators/mitigate barriers (Hornby NNR 2015)

- Physical Therapy Staff
  - Prioritizing walking
  - Perform outcome measurements
- Occupational Therapy
  - Repetitive task specific UE training
  - Continuing to address transfers
- Therapy Aides
  - Assist with increased stepping under PT guidance
  - Utilization in PT groups
- Nursing/PCT Staff
  - Consistently ready for therapy
  - Carry over of transfers
- Administrative/Physician Support
  - Group/altering scheduling
  - Medical clearance/complexities
- Research Support
  - Assisted with initiation of program and performed data analysis

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## Data Extraction

- Demographics
- Outcome assessments (Admit and D/C)
  - 6 MWT
  - 10 MWT
  - FIM (Bed, Toilet, Walk, Combined Motor, Combined Cognitive)
  - BERG balance scale
- Training parameters
  - Peak HR & duration
  - Peak RPE & duration
- Stepping Activity

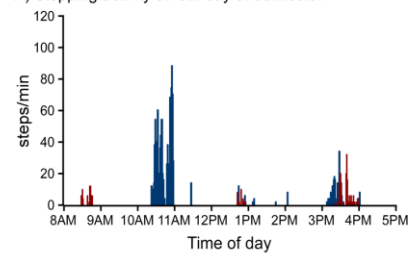


~85% of steps/day  
during scheduled  
PT sessions

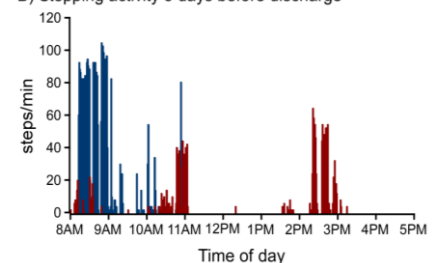
■ Patient within 25th percentile

■ Patient within 75th percentile

A) Stepping activity on 8th day of admission



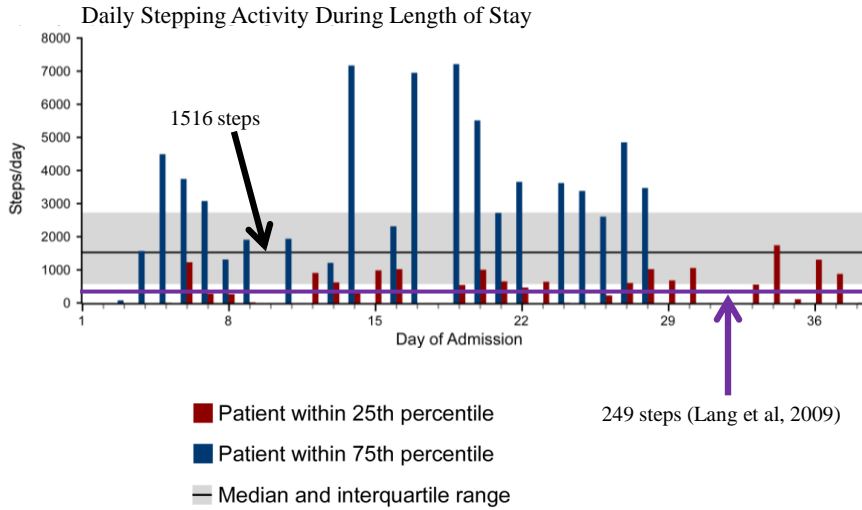
B) Stepping activity 5 days before discharge



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## Results - Stepping Activity

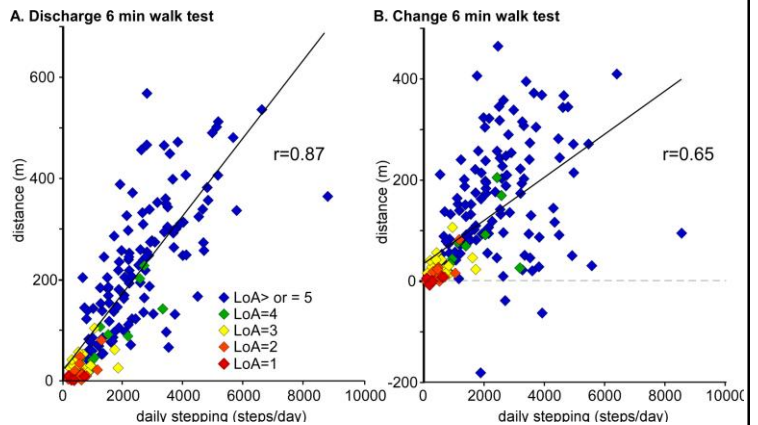


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## Preliminary Implementation Efforts (Hornby NNR 2015)

- Averaged ~1500 steps/day
  - Varied with level of impairments
  - Calculated steps/day per FIM locomotor scores
  - PTs indicate prioritize walking
- Intensities achieved
  - Variable HRs
  - RPE >13 during 38% of sessions recorded
- Stepping practice related to outcomes, walking independence, discharge to home vs other

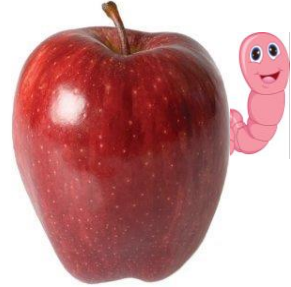


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## Summary

- Translation from laboratory to inpatient setting appears to be possible (as compared to observational data)
- Requires substantial effort
  - Dedication from therapists, nursing, physicians, rehab aides
  - Documentation/monitoring
- The process is slow, long, difficult, tedious . . . .
- Established some normative values for how much is possible (stepping, intensity) . . . . . maybe



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## Main Points

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Overview of High-Intensity Gait Training (Hornby)

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Reflection (Moore)

Panel discussion/Q & A

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## Mary Free Bed Outline:

Implementation story

Phases

- Usual care
- High-intensity gait training
- Barriers/Facilitators

Results: High-Intensity gait training

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## Mary Free Bed Outline:

Implementation story

Phases

- Usual care
- High-intensity gait training
- Barriers/Facilitators

Results: High-Intensity gait training



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## MFB Main Campus Overview



Inpatient rehab facility

- 4.5 PTs 1.0 PTA
- 500 admits last year

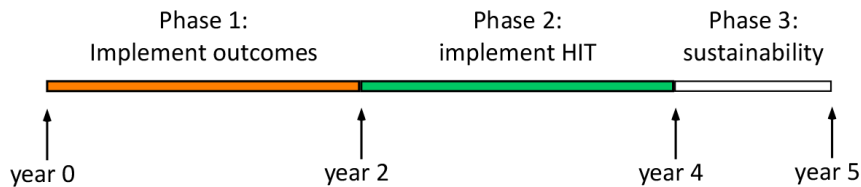
Vision: Learning Health System

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## Implementation Story

High intensity gait training (HIT) – 5 yr implementation study

original implementation strategy



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## Phase 1: Usual Care

## Gait Assessment Implementation

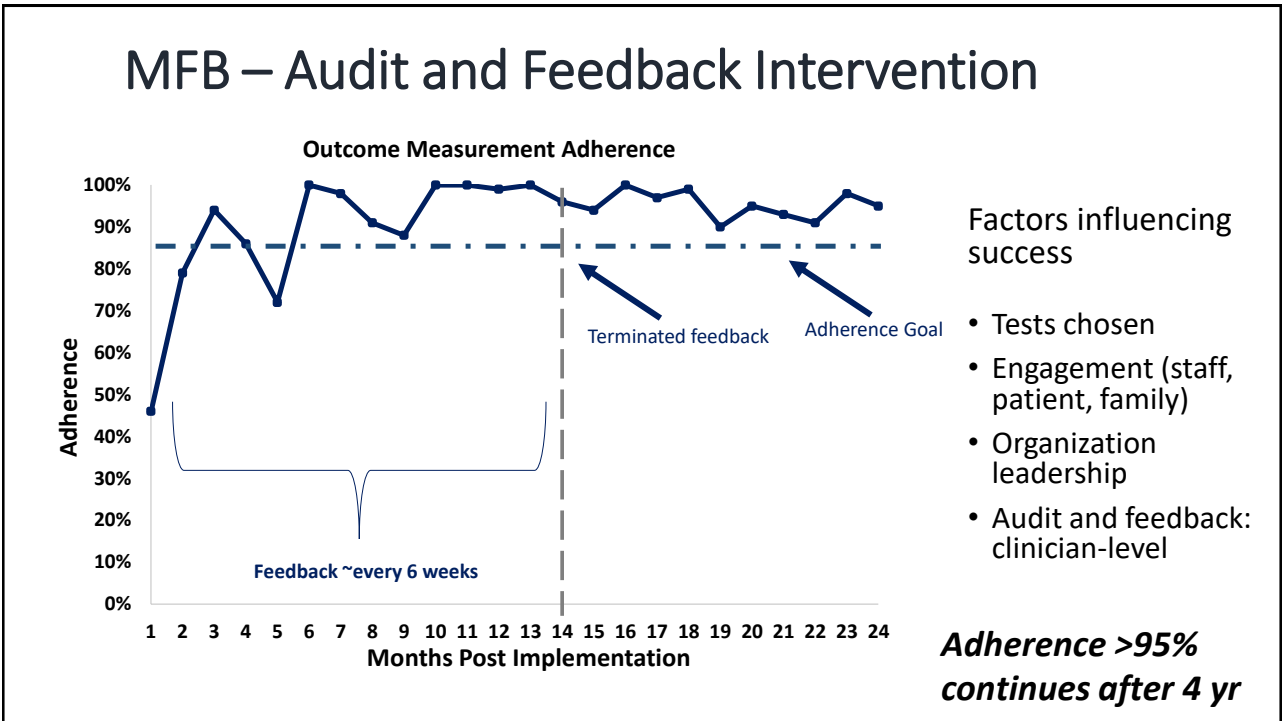
**Assessments (goal > 85% adherence):**

- Berg Balance Scale
- 10 meter walk
- 6 minute walk

**KTA and multi-component KT interventions**

- Education - standardized administration
- “Testing Tuesday”
- Team conference reporting
- Rehab tech assistance
- Audit and feedback (monthly/clinician level)

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## Phase 2: Implementation of HIT

Goal: High Intensity Gait Training (HIT)  
implemented as a standard of care

- Top-down implementation
- Clinician buy-in encouraged with multiple strategies

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## Overview of HIT: Facilitators

Leadership  
Support

Funding

Environment

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## Overview of HIT: Barriers



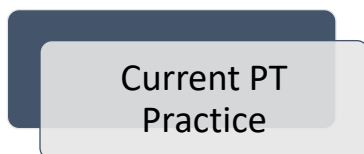
Current PT Practice

Organizational processes

Staffing issues

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## Overview of HIT: Implementation Strategies

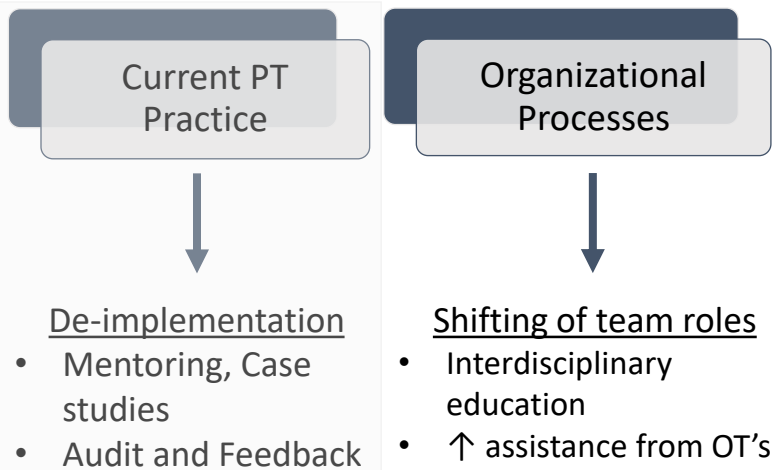


### De-implementation

- Mentoring, Case studies
- Audit and Feedback

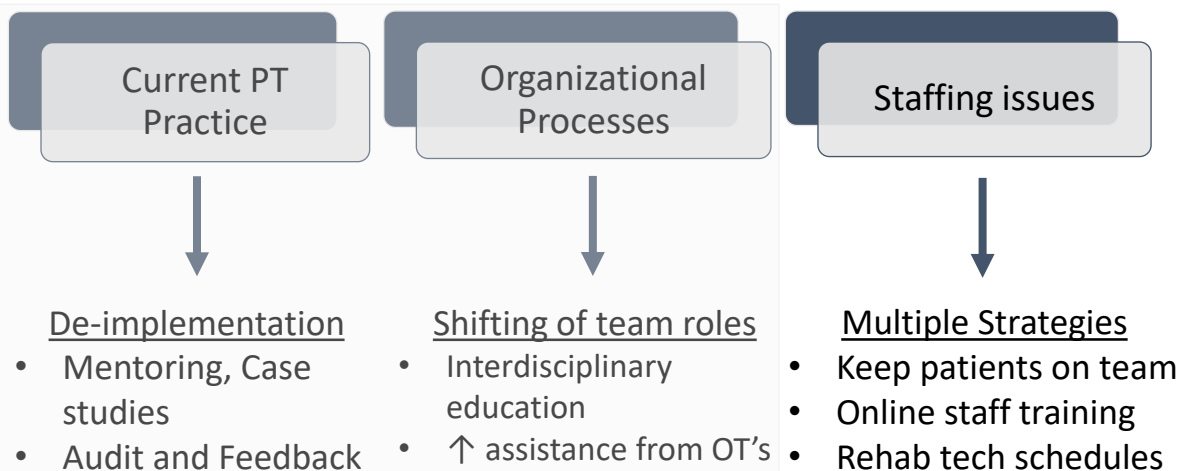
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## Overview of HIT: Implementation Strategies



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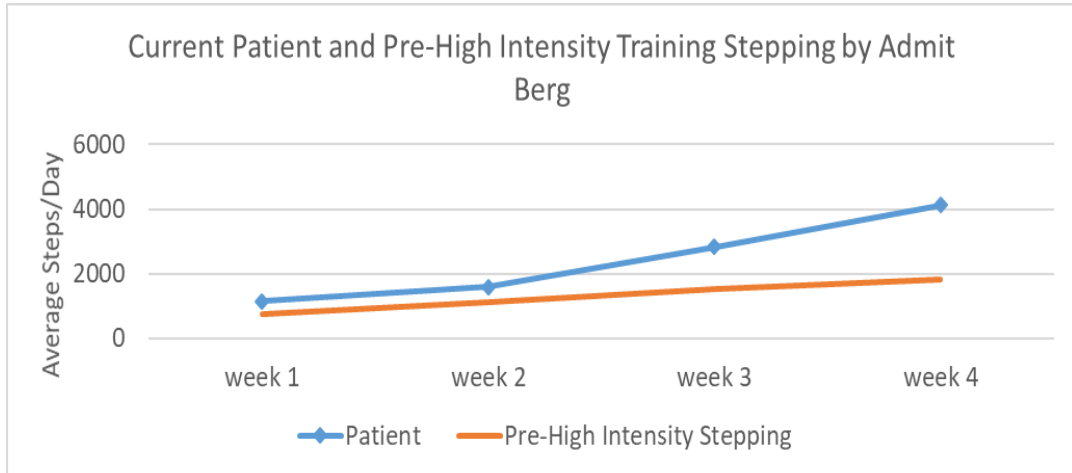
## Overview of HIT: Implementation Strategies



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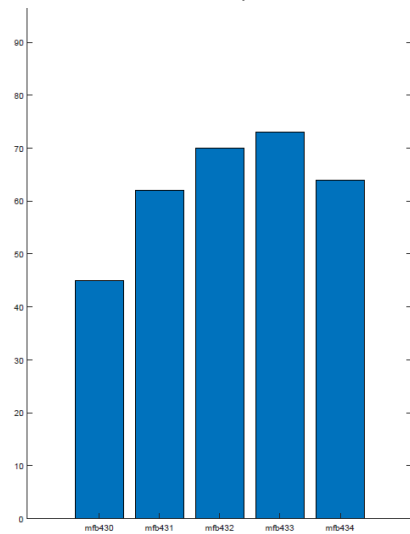
## Stepping Audit and Feedback Example



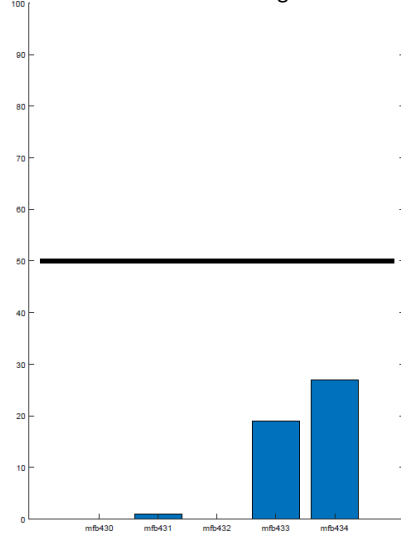
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## Heart Rate Audit and Feedback Example

Percent with Intensity Documentation



Percent of Session in Target HR Zone



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## Questions Guiding Analysis

- 1) Were the patients similar in usual care and high intensity gait?
- 2) Did we successfully implement high intensity gait?
- 3) If yes, did high-intensity gait impact patient outcomes?

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## Results: Patient Demographics

Demographics	Usual Care (Phase 1: n=153)	Implementation (Phase 2: n=257)
Age (years)	66.1±12.2	63.6±13.4
Gender (% male)	61.4%	62.3%
Days post stroke at admit	7.5±7.8	6.9±7.7
Length of Stay (days)	20.9±10.4	23.3±12.4*
Berg Balance Scale (admit)	21.0±16.3	18.9±14.8
FIM Walk (admit)	2.3±1.4	2.4±1.4
FIM Transfer (admit)	3.1±1.2	3.0±1.2
Number PT units/day	4.1±0.7	3.8±0.8*
Number PT sessions	32.7±18.6	31.0±19.7

*Mean ± SD* \**p*<0.05

70

## Results: Patient Demographics

Demographics	Usual Care (Phase 1: n=153)	Implementation (Phase 2: n=257)
Age (years)	66.1±12.2	63.6±13.4
Gender (% male)	61.4%	62.3%
Days post stroke at admit	7.5±7.8	6.9±7.7
Length of Stay (days)	20.9±10.4	23.3±12.4*
Berg Balance Scale (admit)	21.0±16.3	18.9±14.8
FIM Walk (admit)	2.3±1.4	2.4±1.4
FIM Transfer (admit)	3.1±1.2	3.0±1.2
Number PT units/day	4.1±0.7	3.8±0.8*
Number PT sessions	32.7±18.6	31.0±19.7

*Mean ± SD* \**p*<0.05

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## Questions Guiding Analysis

- 1) Were the patients similar in usual care and high intensity gait?
- 2) Did we successfully implement high intensity gait?
- 3) If yes, did high-intensity gait impact patient outcomes?

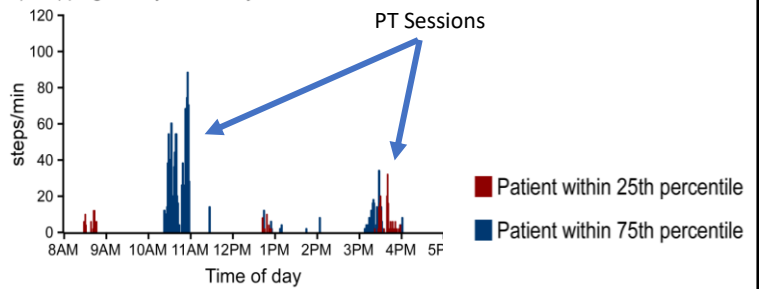
72



## How was Intervention Fidelity Defined?

1. Changes in steps/day between usual care and high-intensity training
2. > 50% of treatment time in the zone (requires consistent documentation)

A) Stepping activity on 8th day of admission



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## Steps/Day During Implementation

Phase	Months	Steps/Day
Usual Care (Phase 1; n=153)	14 mo.	2494 +/- 1865



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## Steps/Day During Implementation

Phase	Months	Steps/Day
Usual Care (Phase 1; n=153)	14 mo.	2494 +/- 1865

75

## Implementation KT Context: Phase 2a

Phase	Months	Steps/Day
Usual Care (Phase 1; n=153)	14 mo.	2494 +/- 1865
Implementation Phase 2a (n=147)	1-15 mo.	

- Initial planned KT Interventions
- 2 PI visits to MFB
- Audit and feedback on patient-level stepping data - weekly
- Audit and feedback on heart rate documentation – one time

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## Implementation KT Context: Phase 2b

Phase	Months	Steps/Day
Usual Care (Phase 1; n=153)	14 mo.	2494 +/- 1865
Implementation Phase 2a (n=147)	1-15 mo.	2409 +/- 1625
Implementation Phase 2b (n=48)	16-21 mo.	

- Preliminary results reported to clinical team – no change in practice
- Re-assessed barriers, new KT interv.
- Audit and feedback on stepping and heart rate - WEEKLY
- MFB clinician training at RHI

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## Implementation KT Context: Phase 2c

Phase	Months	Steps/Day
Usual Care (Phase 1; n=153)	14 mo.	2494 +/- 1865
Implementation Phase 2a (n=147)	1-15 mo.	2409 +/- 1625
Implementation Phase 2b (n=48)	16-21 mo.	2703 +/- 1747
Implementation Phase 2c (n=63)	22-28 mo.	

- Preliminary results reported to clinical team – no change in practice
- Provided specific stepping target goal (↑ by 600 steps/day)
- Re-assessed barriers, new KT interv.
- Audit & feedback: stepping and HR

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## Steps/day During Implementation

Phase	Months	Steps/Day
Usual Care (Phase 1; n=153)	Total 14 months	2494 +/- 1865
Implementation (Phase 2, n= 258)	Total 28 months	2571 +/- 1645



**Changes in Steps/Day: No difference between usual care and implementation ( $p=0.66$ )**

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## Adherence with Heart Rate / RPE Monitoring

### Percentage of PT sessions with HR/RPE documented

- Implementation 28%  
*all phases*
- Phase 2a 15% *KT: HR/RPE A&F one time, Aid assist with HR placement*
- Phase 2b 45% *KT: HR/RPE A&F weekly*
- Phase 2c 64% *KT: HR/RPE A&F weekly*

- All PT sessions audited
- Target intensity: reached for  $\geq 1$  min in 33% of PT sessions *that included HR documentation*

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## Questions Guiding Analysis

- 1) Were the patients similar in usual care and high intensity gait?  
YES!
- 2) Did we successfully implement high intensity gait?  
NO!
- 1) If yes, did high-intensity gait impact patient outcomes?

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## Steps/hour During Physical Therapy

Phase	Months	Steps/Day
Usual Care (Phase 1; n=153)	14 mo.	2494 +/- 1865
Implementation Phase 2a (n=147)	1-15 mo.	2409 +/- 1625
Implementation Phase 2b (n=48)	16-21 mo.	2703 +/- 1747
Implementation Phase 2c (n=63)	22-28 mo.	2847 +/- 1591



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## Steps/hour During Physical Therapy

Phase	Months	Steps/Day	Steps/PT hour
Usual Care (Phase 1; n=153)	14 mo.	2494 +/- 1865	983 +/- 975
Implementation Phase 2a (n=147)	1-15 mo.	2409 +/- 1625	1083 +/- 966
Implementation Phase 2b (n=48)	16-21 mo.	2703 +/- 1747	
Implementation Phase 2c (n=63)	22-28 mo.	2847 +/- 1591	



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## Steps/hour During Physical Therapy

Phase	Months	Steps/Day	Steps/PT hour
Usual Care (Phase 1; n=153)	14 mo.	2494 +/- 1865	983 +/- 975
Implementation Phase 2a (n=147)	1-15 mo.	2409 +/- 1625	1083 +/- 966
Implementation Phase 2b (n=48)	16-21 mo.	2703 +/- 1747	1276 +/- 1060
Implementation Phase 2c (n=63)	22-28 mo.	2847 +/- 1591	



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## Steps/hour During Physical Therapy

Phase	Months	Steps/Day	Steps/PT hour
Usual Care (Phase 1; n=153)	14 mo.	2494 +/- 1865	983 +/- 975
Implementation Phase 2a (n=147)	1-15 mo.	2409 +/- 1625	1083 +/- 966
Implementation Phase 2b (n=48)	16-21 mo.	2703 +/- 1747	1276 +/- 1060
Implementation Phase 2c (n=63)	22-28 mo.	2847 +/- 1591	1542 +/- 1018



**Usual Care < Implementation (p < 0.001)**  
**Usual Care < Phase 2a < Phase 2b < Phase 2c (p < 0.01)**

86

## Summary

- Implemented outcome measures successfully with high levels of fidelity ( $\geq$  95% adherence)
- High intensity gait training implementation results
  - No change in steps/day
  - Inconsistent heart rate documentation
- *Not implemented with fidelity, BUT saw significant increase in steps/PT hour*
  - *KT interventions resulted in significantly improved steps/session (although not steps/day)*

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LESSONS LEARNED

recognize mistakes

observe what works

document them

share them

Implementation of this intervention is more challenging than gait assessments

Feedback type and clinician motivation

- Consider clinician level feedback instead of patient level feedback
- Best results noticed after given specific target numbers (OM administration, steps, and HR)

Heart rate adherence was poor - *Poor adherence with documentation AND the intervention?*

Use context to inform fidelity metrics, not just previous experience

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# Main Points

Overview (Moore)

Overview of High-Intensity Gait Training (Hornby)

Mary Free Bed (Virva and Lenca; Grand Rapids, Michigan)

## **Rehabilitation Hospital of Indiana (Henderson; Indianapolis, Indiana)**

Norway (Bø and Nordvik, Oslo, Norway)

Reflection (Moore)

Panel discussion/Q & A

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- 64 beds
- ~30% of total admits
- 300+ stroke admits/year



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# Implementation Story

- RHI leadership motivated to improve patient outcomes
  - ↑ emphasis on evidence-based practice
  - ↑ participation in research



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# Implementation Story

## Original implementation strategy

**Phase 1:**  
Implement outcomes  
and HIT equipment

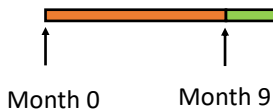
**Phase 2:**  
Implement HIT



## Actual implementation strategy

**Phase 1:**  
Implement outcomes  
and HIT equipment

**Phase 2:**  
Implement H



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## Phase 1: Usual Care

### Implementation of outcome measures

- Standardizing outcomes assessments
  - Worked with existing OM committee
  - Clinicians as research blinded raters
- Equipment
- Team conference reporting and educating staff
- Rehab tech assistance
- Senior PT transitions to 0.5 FTE research
- Informal feedback

**Berg Balance Scale (BBS):** 14 static and dynamic balance activities without use of assistive devices; scores range 0 - 56 (best)

Minimal Detectable Change	
Group	Score
Stroke (subacute)	6.9
Stroke (chronic)	3.8
Elderly (based on initial score)	0 - 24 = 4.6
	25 - 34 = 6.3
	35 - 44 = 4.9
45 - 56 = 3.3	

Cut off scores	
Group	Score
Elderly - risk of future fall	< 45
Elderly w/ previous fall - risk of future fall	< 52
Elderly w/o previous fall - risk of future fall	< 43

Score Range	Likely Functional Capacity
0 - 5	Some sitting balance, requires > min assist to stand
6 - 26	Likely performing sit to stand with supervision; possibly standing with feet next to each other or eyes closed
27 - 44	Possibly able to pick up objects from floor, turn in a circle
45 - 56	Likely able to stand with one foot in front of other or stand on one leg

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## Phase 1: Usual Care

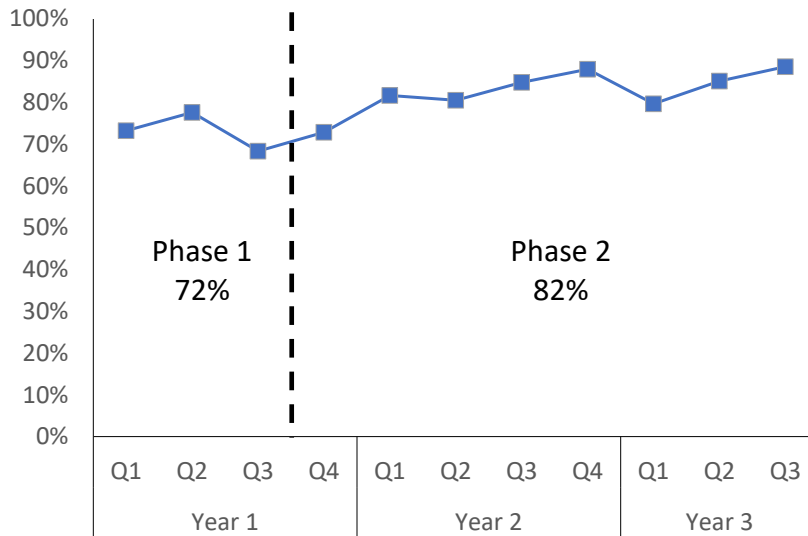
### HIT equipment implementation

- Inservice on equipment
- Individual clinician skills checks
- Clinician initiated co-treats w/ researchers



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## Outcome measure compliance



### Factors influencing success

- Collaborate with OM committee
- Interdisciplinary engagement

### Factors limiting success

- Only informal feedback provided
- Buy-in on low level patients

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## Phase 2: Implementation of HIT

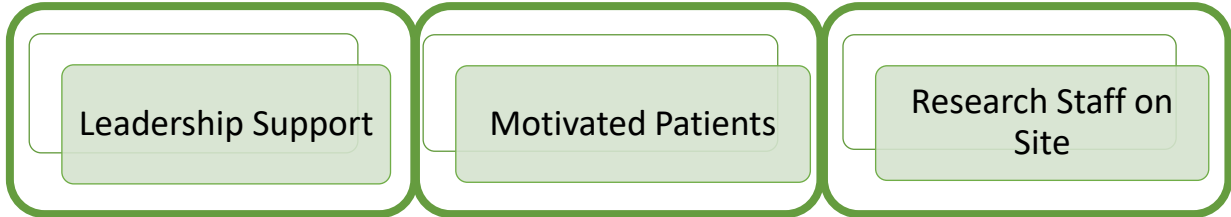
### Goals:

- High Intensity Gait Training (HIT) as primary PT intervention
  - Top-down and bottom-up implementation

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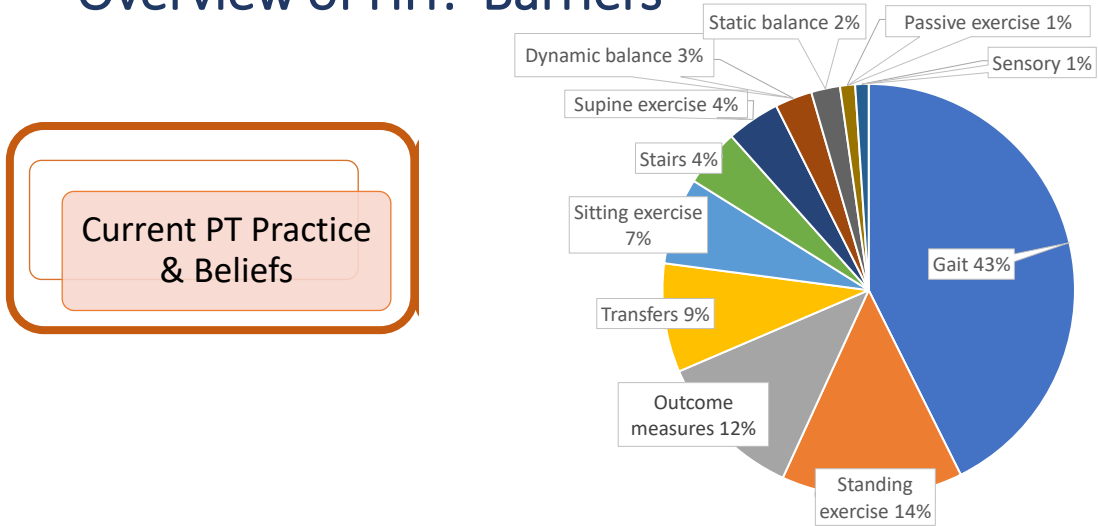


## Overview of HIT: Facilitators



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## Overview of HIT: Barriers



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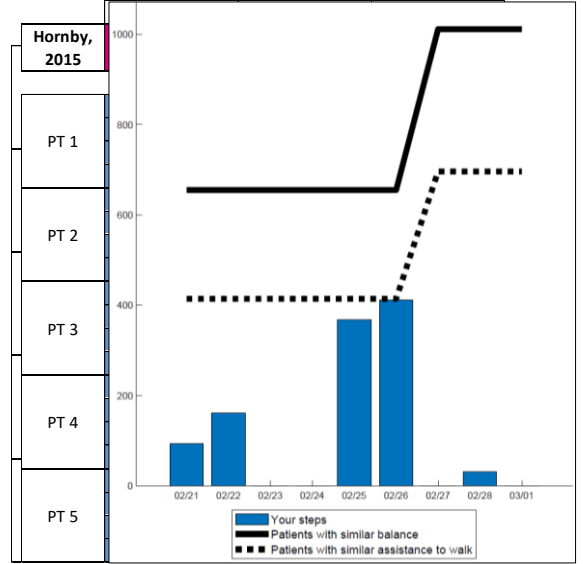
# Overview of HIT: Implementation Strategies

Current PT Practice & Beliefs

## De-implementation

- Education training for PTs and aides
- Mentoring
- MD orders for HIT
- Audit and feedback

Percent with walking practice prioritized



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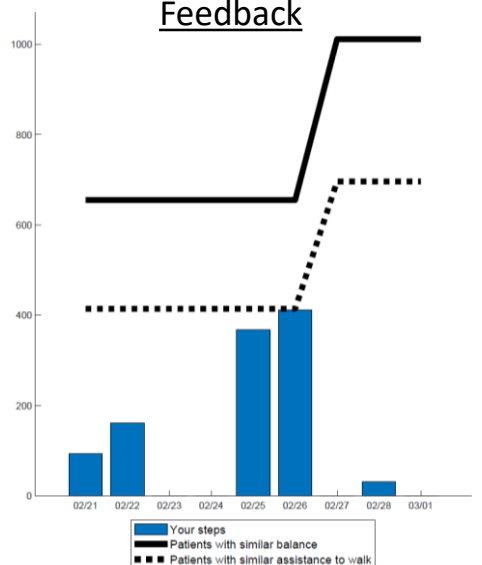
# Overview of HIT: Implementation Strategies

Patient & Caregiver Preferences

## Education

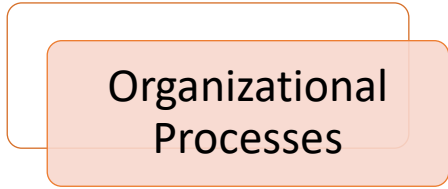
- Dose/response relationship
- Performance vs retention
- Gait is primary predictor of d/c location

Feedback



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# Overview of HIT: Implementation Strategies



Interdisciplinary buy-in

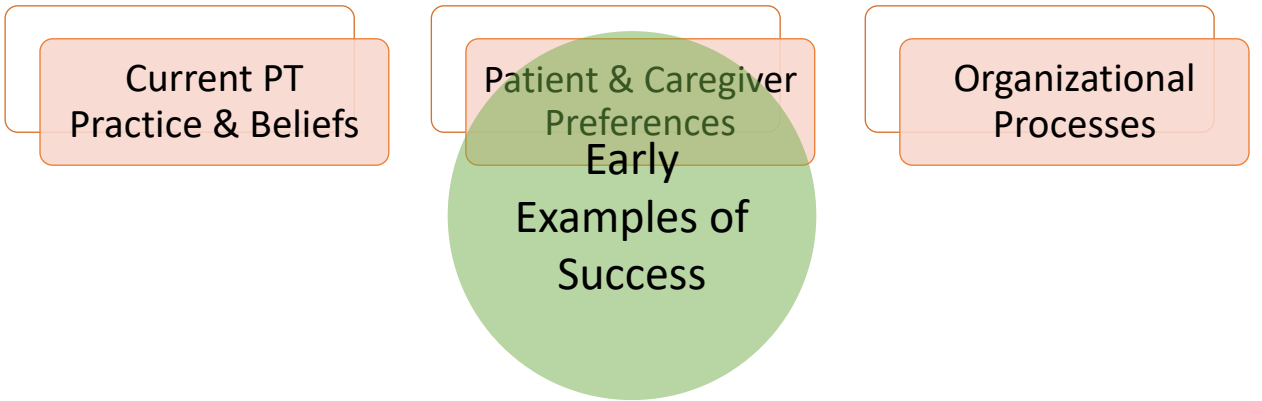
- Staff education
- OTs doing ↑ transfers

Effect on other therapies

- Adjust to avoid PT
- Adjust to follow PT

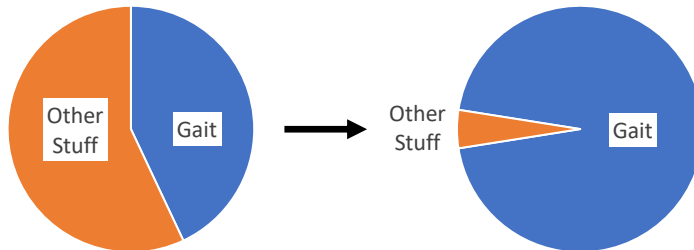
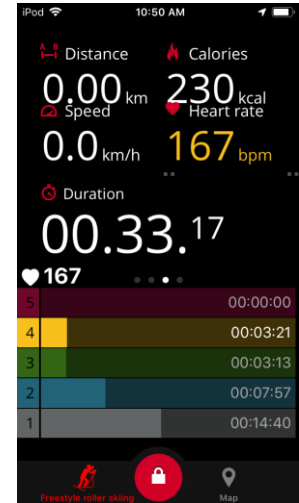


# Overview of HIT: Barriers



## How was Intervention Fidelity Defined?

1. Significant  $\uparrow$  in steps/day
2. ???
  - a) Prioritize walking practice
  - b) Target high aerobic intensities



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## Questions Guiding Analysis

- 1) Were the patients similar in usual care and high intensity gait?
- 2) Did we successfully implement high intensity gait?
- 3) If yes, did high-intensity gait impact patient outcomes?

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## Results: Patient Demographics

	Usual Care (n=133)	Implementation (n=501)
Age (years)	64.2±13.2	66.2±13.0*
Gender (% male)	51%	55%
Days post stroke at admit	10.6±8.7	13.7±11.7*

Mean ± SD      \* $p < 0.05$

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## Questions Guiding Analysis

- 1) Were the patients similar in usual care and high intensity gait?
- 2) Did we successfully implement high intensity gait?
- 3) If yes, did high-intensity gait impact patient outcomes?

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## Results: Steps Per Day

Changes in steps/day between usual care and high-intensity training

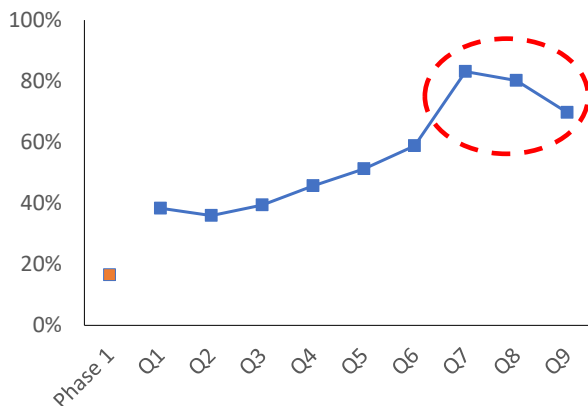
	Usual Care (n=133)	Implementation (n=501)
Steps/day	962±857	1201±1063*
	<i>Mean ± SD</i>	<i>*p&lt;0.05</i>

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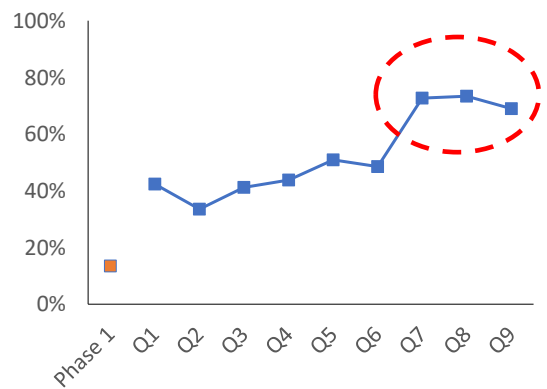
## Results: Walking Practice during PT

Changes in steps/day between usual care and high-intensity training  
 Was walking practice prioritized?

In most impaired pts, was gait practiced?



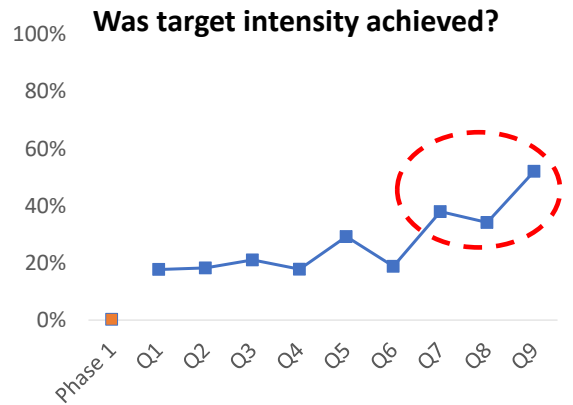
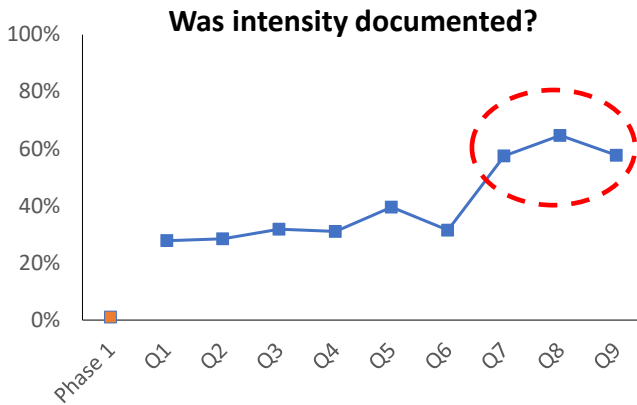
Across all patients, was gait prioritized?



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## Results: Aerobic intensity during PT

- Changes in steps/day between usual care and high-intensity training
- Was walking practice prioritized?
- Was high intensity targeted?



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## Results

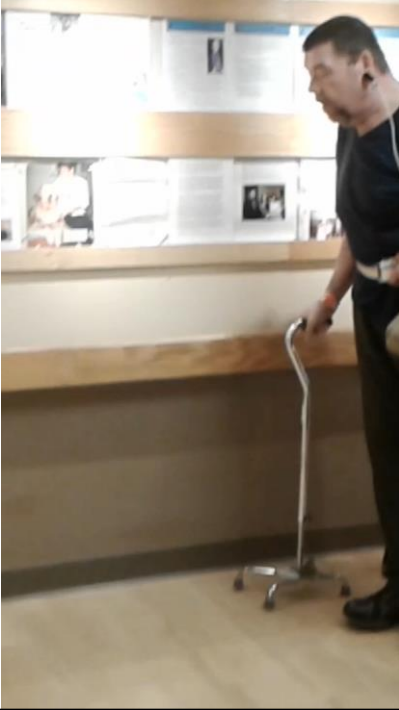
### What was different in quarters 7-9?

- Change in therapy leadership
- Initiated therapist specific feedback

	MaxA / TotalA	MinA / ModA	≥ Contact Guard
PT 1	46%	69%	83%
	67%	93%	78%
	100%	89%	100%
	73%	100%	100%
PT 2	28%	53%	51%
	37%	67%	59%
	64%	79%	88%
	55%	76%	95%
PT 3	17%	100%	0%
	44%	75%	63%
	91%	100%	100%
	72%	100%	100%
PT 4	30%	69%	83%
	60%	82%	89%
	100%	82%	100%
	70%	100%	100%
PT 5	21%	80%	0%
	28%	78%	64%
	70%	73%	77%
	67%	88%	82%

Patients with similar balance  
 Patients with similar assistance to walk

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## Questions Guiding Analysis

- 1) Were the patients similar in usual care and high intensity gait? → Maybe
- 2) Did we successfully implement high intensity gait?
- 3) If yes, did high-intensity gait impact patient outcomes?

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## OM Changes Across LOS

	Usual Care (n=133)	Implementation (n=501)
Berg Balance Scale	14.1±11.0	14.7±12.2
10MWT (m/s)	0.16±0.20	0.22±0.27
6MWT (m)	48±84	73±91*
FIM Walk	2.2±3.0	2.0±1.7
FIM Transfer	1.5±1.0	1.6±1.2

Mean ± SD

\*p<0.05

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## OM Changes Across LOS

	Usual Care (n=133)	Implementation (n=501)	Quarters 7-9 (n=167)
Berg Balance Scale	14.1±11.0	14.7±12.2	16.7±13.0
10MWT (m/s)	0.16±0.20	0.22±0.27	0.26±0.32*
6MWT (m)	48±84	73±91*	86±94*
FIM Walk	2.2±3.0	2.0±1.7	2.0±1.8
FIM Transfer	1.5±1.0	1.6±1.2	1.8±1.3*

Mean ± SD

\*p<0.05

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## Next Steps



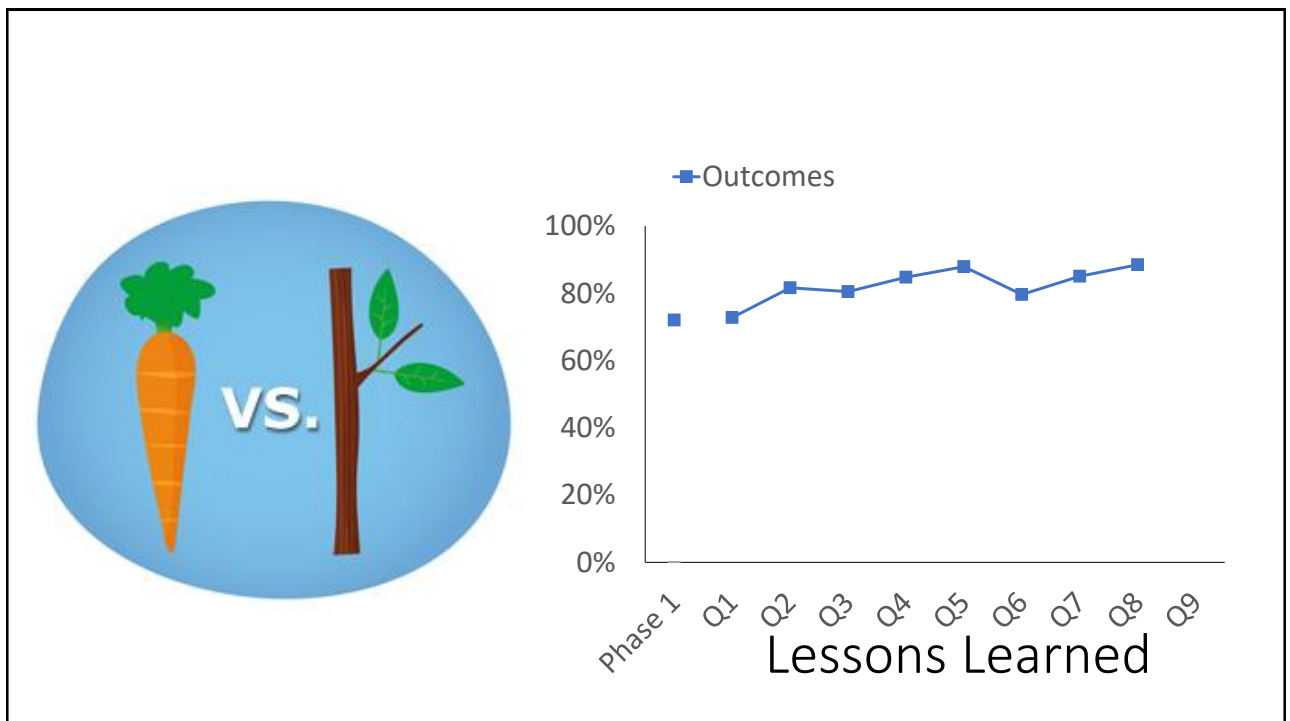
114



## Summary

- Outcome measures implemented with acceptable levels of fidelity
- Implementation of HIT continues...
  - ✓ Significant change in steps/day
  - ✓ Prioritizing walking practice
  - ✓ Prioritizing high intensities
- HIT starting to positively affect outcomes!

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# Main Points

Overview (Moore)

Overview of High-Intensity Gait Training (Hornby)

Mary Free Bed (Virva and Lenca; Grand Rapids, Michigan)

Rehabilitation Hospital of Indiana (Henderson; Indianapolis, Indiana)

## **Norway (Bø and Nordvik, Oslo, Norway)**

Reflection (Moore)

Panel discussion/Q & A

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# Outline



The Norwegian health care system



Our implementation story – facilitators, barriers and implementation strategies



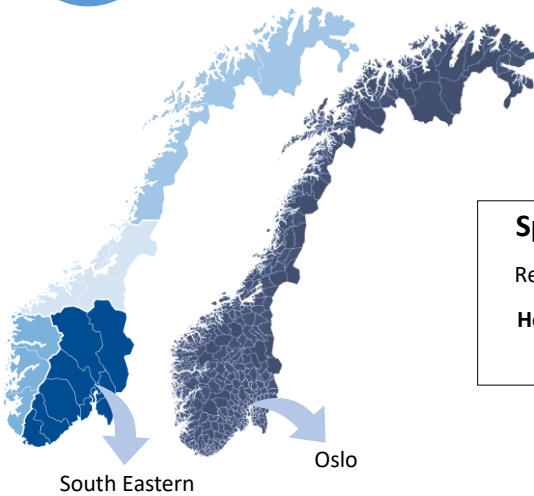
Results



Lessons learned



# The Norwegian health care system



- Vision: Equal and free access for all to high quality healthcare services
- Mainly publicly/governmental funded
- Two main authority levels within healthcare

### Specialist level service

Regional Health authorities (4)

**Hospitals (incl. rehabilitation)**

### Primary level service

Municipalities (356)

Primary health care, social services, Care services and **rehabilitation**

### National and regional competence service



## Aker campus in Oslo

### Oslo University Hospital – unit for rehabilitation

- 160 stroke patients yearly, average LOS 20 days
- Subacute phase

### Oslo municipality – unit for rehabilitation

- 70 stroke patients yearly, average LOS 21 days
- Subacute and chronic phase

### Regional competence service in rehabilitation - center for knowledge translation (RKR)

- Responsible for proposing, initiating and coordinating methods and models of quality improvement and knowledge translation in rehab



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## A long implementation story short...



### Once upon a time... in 2014

Networking - Norwegians and Americans discussed research and a possible collaboration

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## A long implementation story short...



The idea  
presented to  
senior PT  
(opinion leader)



KT-plan

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## Facilitators



### **Professional anchoring**


Academically well-grounded  
project

Use of the Knowledge to  
Action model




KT-plan

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# Barriers



**Current care delivery model**

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# Implementation Strategy





KT-plan


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**BARRIERS TARGETED**

 **Current care delivery model**

 **Current intervention strategies**


 **Online-course, study visit to US**  
**Development of specific protocol**





**Re-organizing delivery and content**


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**BARRIERS TARGETED**

 **Current care delivery model**

 **Current intervention strategies**

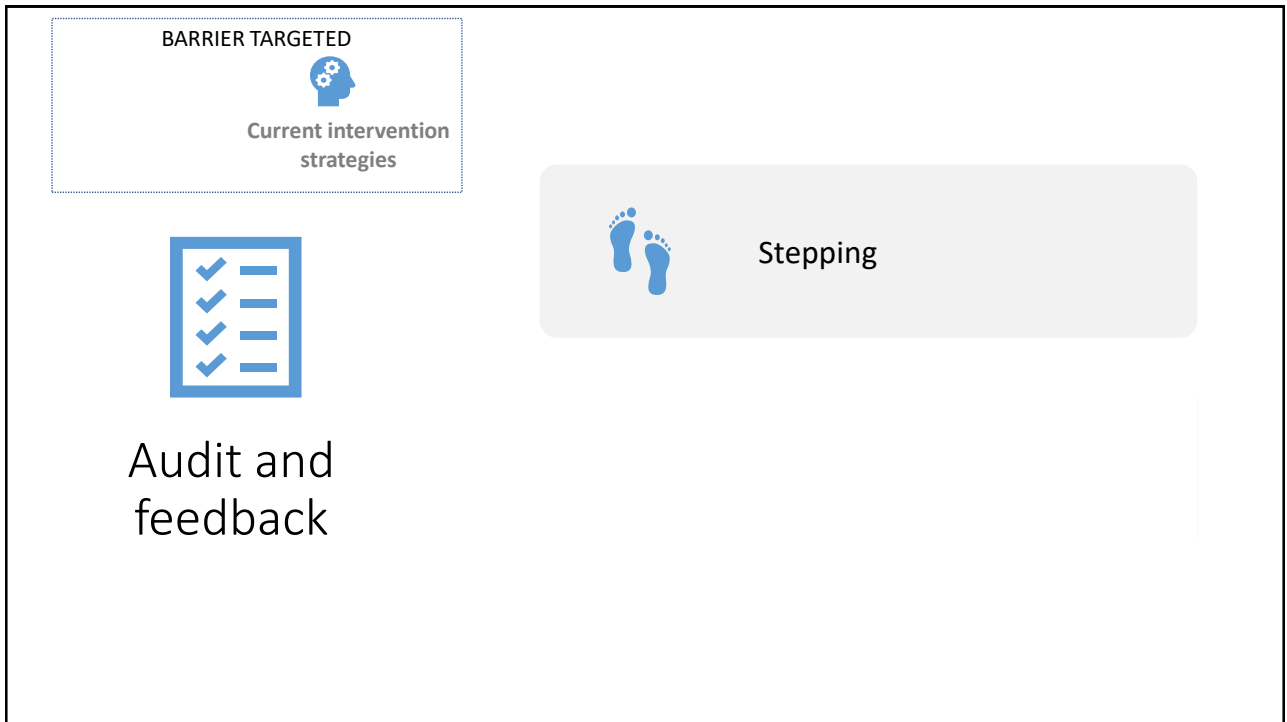
 **Formal case discussions**

 **Informal case discussions**

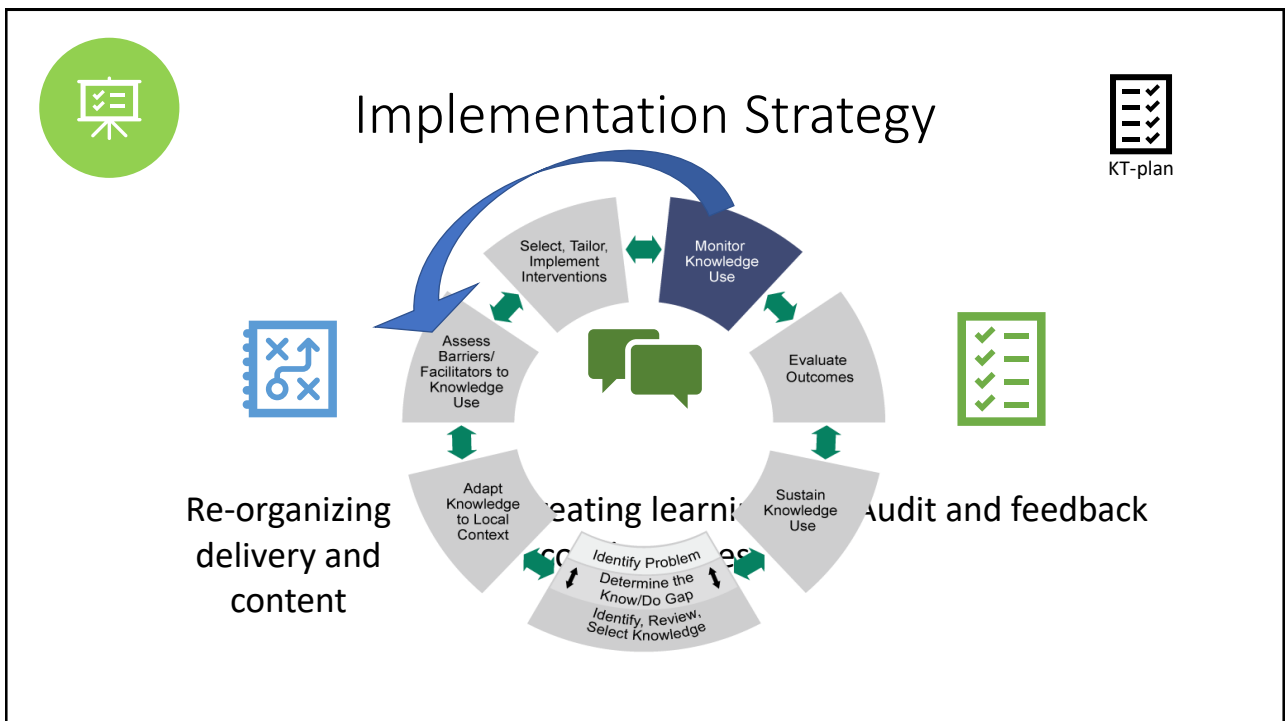


**Creating learning collaboratives**

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## Were the two groups similar enough to compare?

Demographics  
and  
Baseline  
Characteristics

	Phase 1 (2017) (n=56)	Phase 2 (2018) (n=56)	p-values
Age (years)	74±14	74±10	p=0.69
Gender (male/female, n)	29/27	29/20	p=0.25
Paretic side (right/left, n)	36/18	32/24	p=0.47
Ischemic/hemorrhagic (n)	41/13	41/15	p=1.00
Duration post-stroke (days)	11±11	13±10	p=0.30
CCI (a.u.)	4.5±1.0	4.6±2.0	p=0.58
Modified Rankin Scale (a.u.)	3.4±0.7	3.3±0.87	p=0.69
Paretic leg strength (a.u.)	3.0±0.81	3.0±0.84	p=0.72

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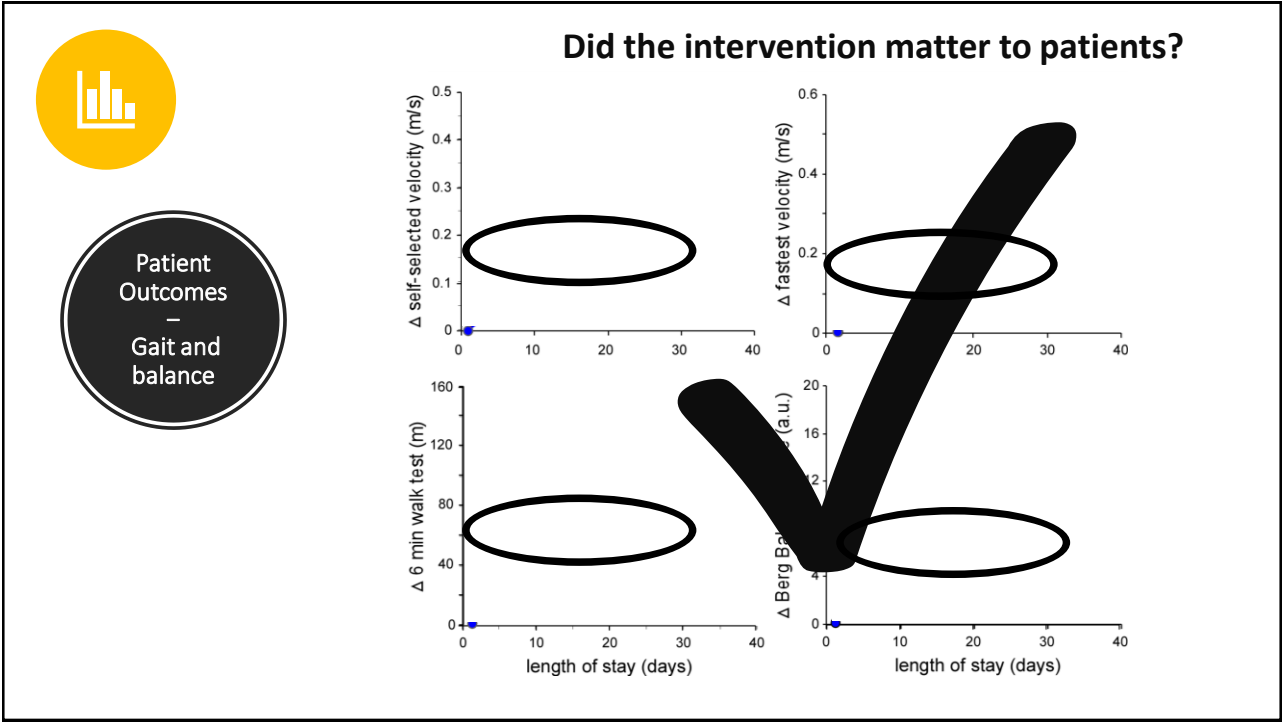


## Did we successfully implement high-intensity gait training?





Training  
Characteristics

	Phase 1 (2017) (n=56)	Phase 2 (2018) (n=56)	p-values
Stepping activity (steps/day)	3917±2656	5700±84	p<0.001
Highest frequency hour (steps/hour)	1167±612	1666±653	p<0.001
Steps/min during highest frequency hour	44±10	55±10	p<0.001
Peak HR (% predicted max)	-	79±8.3	-
Mean HR (% predicted max)	-	66±7.4	-
Time in HR range (% session)	-	34±27	-

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## Lessons learned

- Importance of having a KT plan
- Importance of asking questions continuously: WHY NOT? HOW DO YOU DO THIS?
- Value of measurement
- Networking and openness to change



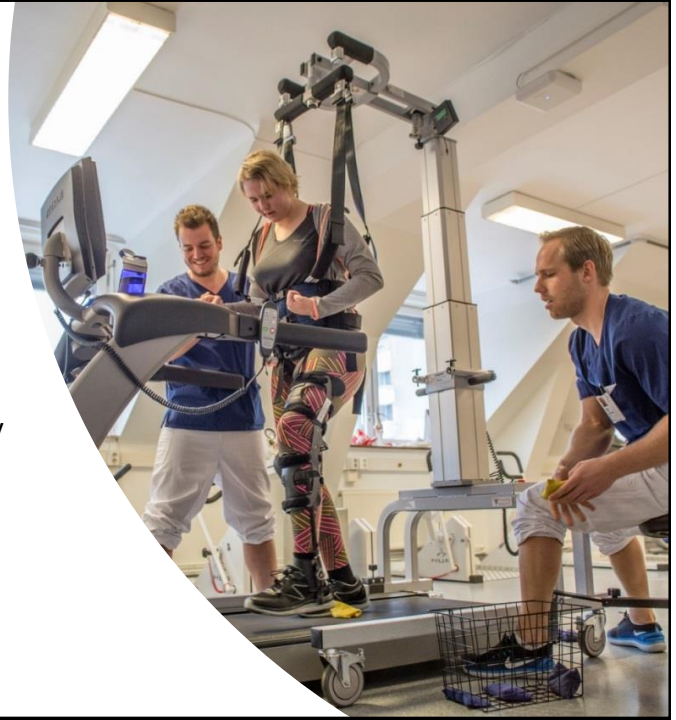
KT-plan

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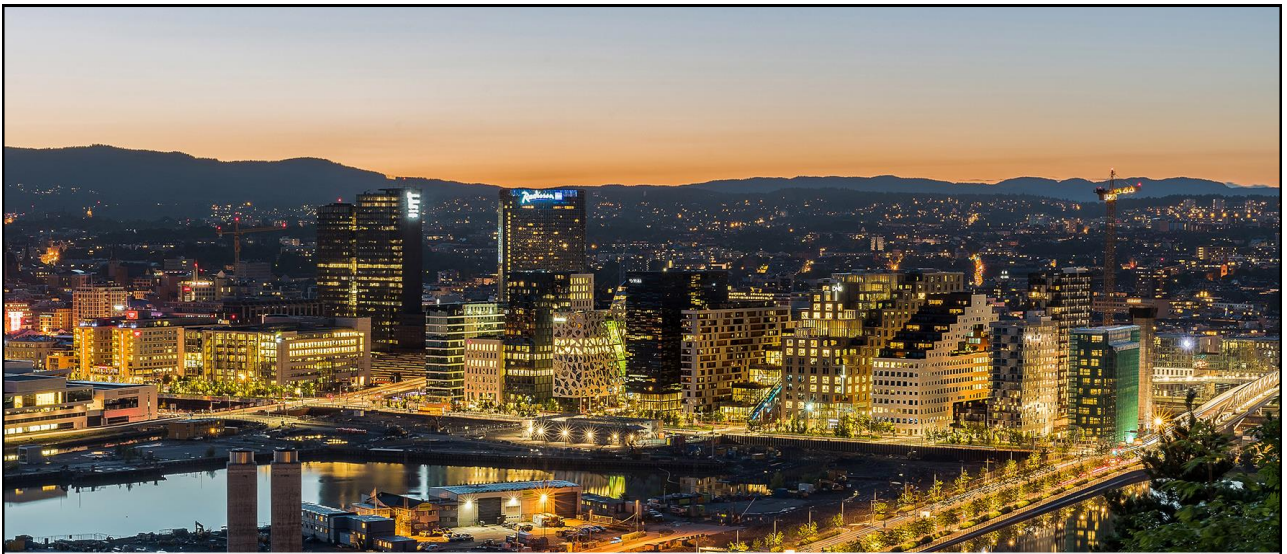
## Summary

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- Started by networking
- Thorough KT plan and good support
- Successfully implemented
  - Increased steps per session and day
  - Impacted patient outcomes
- Still current treatment in year 3 after implementation
- New projects are in the planning stage



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Thanks for your attention!



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## Main Points

Overview (Moore)

Overview of High-Intensity Gait Training (Hornby)

Mary Free Bed (Virva and Lenca; Grand Rapids, Michigan)

Rehabilitation Hospital of Indiana (Henderson; Indianapolis, Indiana)

Norway (Bø and Nordvik, Oslo, Norway)

### Reflection (Moore)

Panel discussion/Q & A

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## Implementation of High-Intensity Gait



Gait Assessment adherence > 85% after 6 months  
High-Intensity Gait: No change in steps/day  
Significant changes in steps/PT session



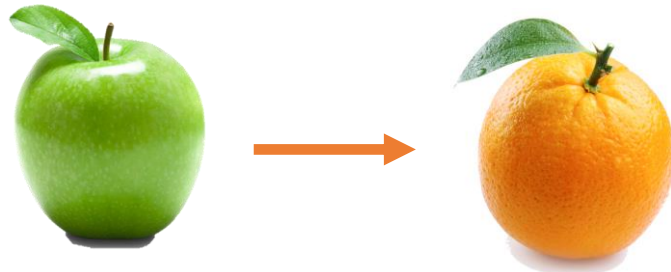
Gait Assessment adherence > 80%  
High-Intensity Gait: Improved adherence after several months  
Project ongoing



Successful Implementation in < 1 year  
Impact on patients  
As much change in 1 week of HIT as with the entire usual care stay

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# Implementation of High-Intensity Gait



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Lessons Learned  
recognize mistakes  
observe what works  
document them  
share them

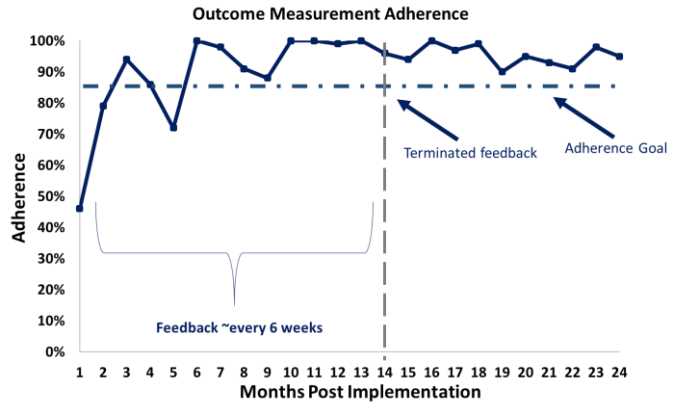
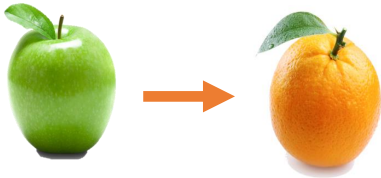
Implementation  
Lessons

Intervention Efficacy

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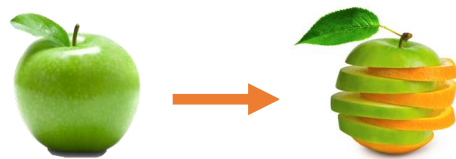
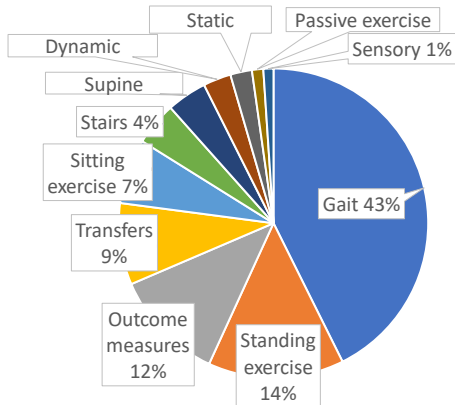


## Implementation of Assessments vs. Implementation of THIS Interventions



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## Lessons Learned: De-Implementation of Traditional Practices



*De-implementation = removal of interventions that do not appear to provide optimal care*

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## Lessons Learned: De-Implementation of Traditional Practices



1 year discussing High-Intensity Gait Training; Consensus = YES!



Set date to start High-Intensity Gait Training



Created learning collaborative to hold each other accountable

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## Leadership Strategies Used



### Top-Down

MFB Assessment Implementation  
2<sup>nd</sup> Half of RHI Implementation



### Bottom-Up

MFB Gait Implementation  
1<sup>st</sup> Half of RHI Implementation  
Norwegian Project

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## Leadership Strategies: Lessons Learned

In research, associations between adoption and a leader's:

- Involvement in the project (Damenpour, 1992; Greenhalgh et al, 2004)
- Attitude and commitment to change (Damenpour, 1992; Greenhalgh et al, 2004)
- Style of leadership (Elenkov & Manev, 2005)
- Vision (Greenhalgh et al, 2004)

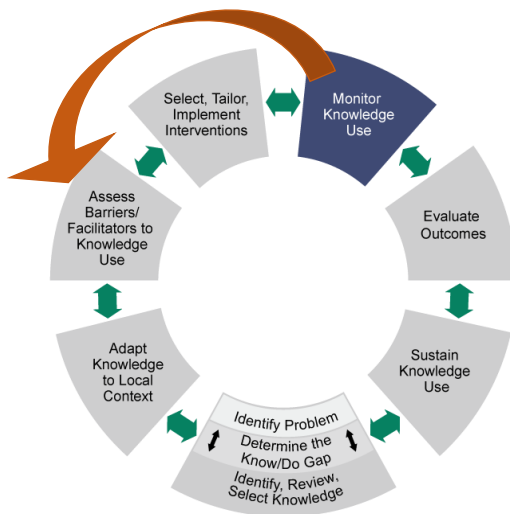
In the FIRST projects....



*Important to remember that leadership CAN be an implementation strategy*

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## Lessons Learned: KT is an ITERATIVE PROCESS



Several iterations of:

- Assessing barriers
- Selecting KT interventions
- Monitoring knowledge use
- Assessing barriers
- Repeat....

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# Implementation Takes Time!!!



*3 year journey that is still underway*

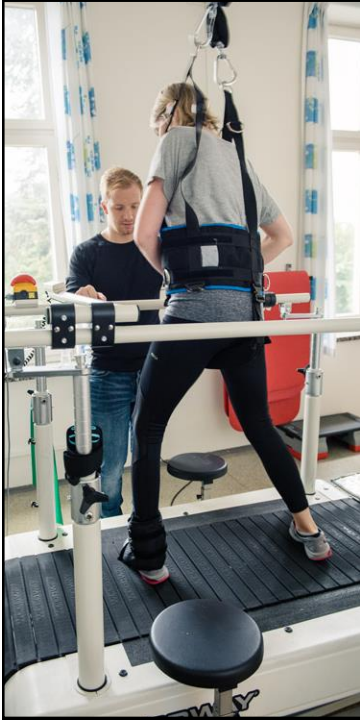
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Lessons Learned  
recognize mistakes  
observe what works  
document them  
share them

Implementation  
Lessons

Intervention Efficacy

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## What IS High Intensity Gait?

*What should the fidelity metrics be?*

*When should we stop iterating between barriers, interventions, and monitoring?*

*Possible metrics:*

1. 75% of sessions with walking prioritized
2. 50% of “walking prioritized” sessions in the target zone

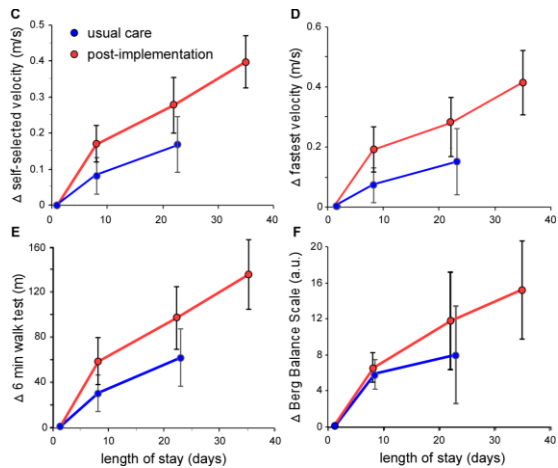
*Monitor steps/day AND steps/PT session*



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## Intervention Efficacy



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# Intervention Efficacy

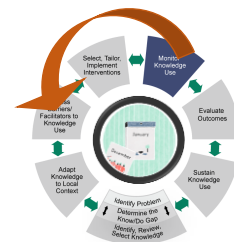
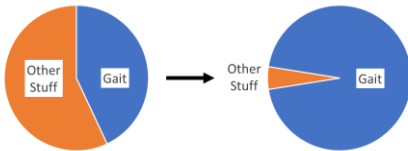


*Is some change (adding a tool to the tool box) better than no change at all?*

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# Lessons Learned

## SUMMARY



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## Thank You!



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# Main Points

Overview (Moore)

Overview of High-Intensity Gait Training (Hornby)

Mary Free Bed (Virva and Lenca; Grand Rapids, Michigan)

Rehabilitation Hospital of Indiana (Henderson; Indianapolis, Indiana)

Norway (Bø and Nordvik, Oslo, Norway)

Reflection (Moore)

**Panel discussion/Q & A**