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Better lung health for all

Balance Training during Pulmonary Rehabilitation

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Teesside University

COPD and Balance

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- People with COPD have a **4-times greater likelihood of falls** than healthy age-matched adults *(Roig et al, 2011).*
- COPD and hypertension are the only chronic conditions associated with an increased risk of falls *(Sibley et al, 2014).*
- Performance is **worse than healthy controls** on balance outcome measures *(Loughran et al, 2020).*

"I don't want to go out sometimes I'm so afraid I might fall" (Breathe Easy support group member, 2017)

"I had fallen and was lying on the floor at the bottom of the steps. I couldn't get up and people were just walking past. I think they thought I was drunk" (patient attending pulmonary rehabilitation, 2018)

Balance and Acute Exacerbations of COPD

- Balance was assessed pre and post-pulmonary rehabilitation (PR) and at 3, 6, and 12m follow up.
- Balance was assessed 7 days following an acute exacerbation of COPD (AECOPD) and 1m later.
- Balance ↓ from prior to an AECOPD (baseline) to 7 days following.
- Balance was still reduced at 1m although there had been recovery.

	Absolute change in the BBS (%) (mean (95% CI))	**Absolute change in the total BEST score** (%) (mean (95% CI))	**Absolute change in ABC scale** (%) (mean (95% CI))
"Baseline" to 7 days post-AECOPD (n=8)	-2.5 (-0.8 to -4.2)*	-6.4 (-9.5 to -3.3)*	-6.2 (-17.5 to 5.0)
"Baseline" to 1m post-AECOPD (BBS n=11, BEST n=11, ABC n=10)	-1.2 (-0.1 to -2.4)*	-1.2 (-3.3 to 0.9)	-2.9 (-16.0 to 10.2)

(** p≤0.001 *p<0.05)

Harrison et al, Cardiopulm Rehabil and Prev, 2019

Mechanisms Underpinning Balance Impairment

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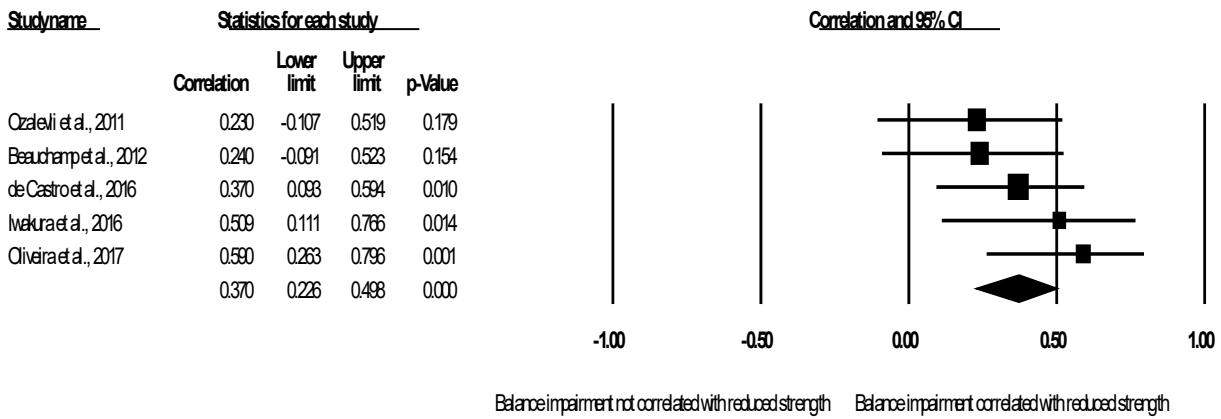
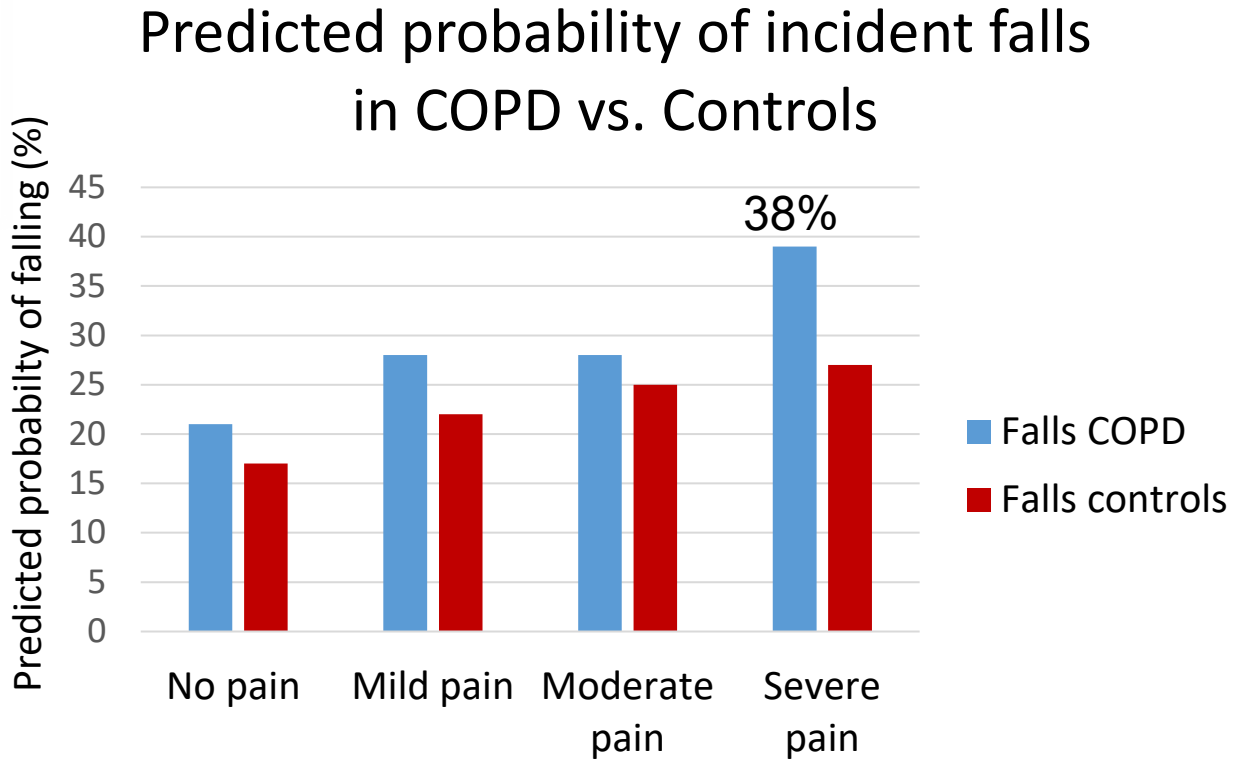


- Meta-analysis of correlations between balance and quadriceps strength was weak-moderate (r=0.37) *(Loughran et al., Thorax, 2020).*

- Secondary data analysis (COPD n=806, controls n=3,898) found the greater the severity of pain the greater the probability of falling.
- 38% of people with COPD and severe pain will fall in the following 2 years *(Loughran et al., manuscript in preparation).*



Mechanisms Underpinning Balance Impairment

People with COPD and persistent pain had:

- Greater balance impairment and slower gait speed (especially under dual task conditions)
- Pain severity (r=.58), reduced ankle (r=.44) and hip (r=.37) muscle strength and poor muscle endurance (r=.65) were all associated with BESTest scores.

	Persistent pain n=25 (58%)		No persistent pain n=18 (42%)		Group mean difference	P-value	95% Confidence Interval of the Difference	
	Mean	Std. Dev.	Mean	Std. Dev.			Lower	Upper
BBS	51.04	4.91	54.06	2.65	-3.02	0.02*	-5.59	-0.44
BESTest	76.22	12.66	89.61	7.32	-13.39	0.00*	-20.11	-6.66
30sec STS	9.43	3.25	12.29	3.26	-2.87	0.01*	-5.01	-0.71

Loughran et al., manuscript in preparation.

Pulmonary Rehabilitation and Balance Training

- The focus of PR is on breathlessness and balance training is not included.
- PR without balance training has little effect on balance.

Balance Variables	Pre-rehab n=29	Post-rehab n=29	Mean change	95% CI	MCID
BBS*	46.9 ± 7.0	49.6 ± 5.7	2.8	1.7 to 3.8	5 ✗
TUG (s)*	15.7 ± 5.3	14.2 ± 4.5	-1.5	-2.4 to -0.5	0.9- 1.4 (s) ✔
ABC	74.3 ± 17.0	79.1 ± 16.0	4.8	-1.0 to 10.7	19 ✗

*Significant at $p<0.05$

BBS = Berg Balance Scale; TUG = Timed Up and Go; ABC = Activities Balance Confidence Scale; MCID = Minimal Clinically Important Difference

Beauchamp et al, Chest, 2010

Balance Assessment and Intervention

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- The ATS/ERS statement recommends that balance be included as an outcome assessment in PR.

- How to identify if a patient is at risk of falling?
- What specific tests to use in a multifactorial balance assessment?
- What to include in a targeted falls prevention programme?

Balance Assessment

Step 1

- A fall is defined as *"a sudden involuntary transfer to the ground"*
- Words associated with a loss of balance: *trip, stumble, staggered, collapsed*

** Pain maybe an indicator*

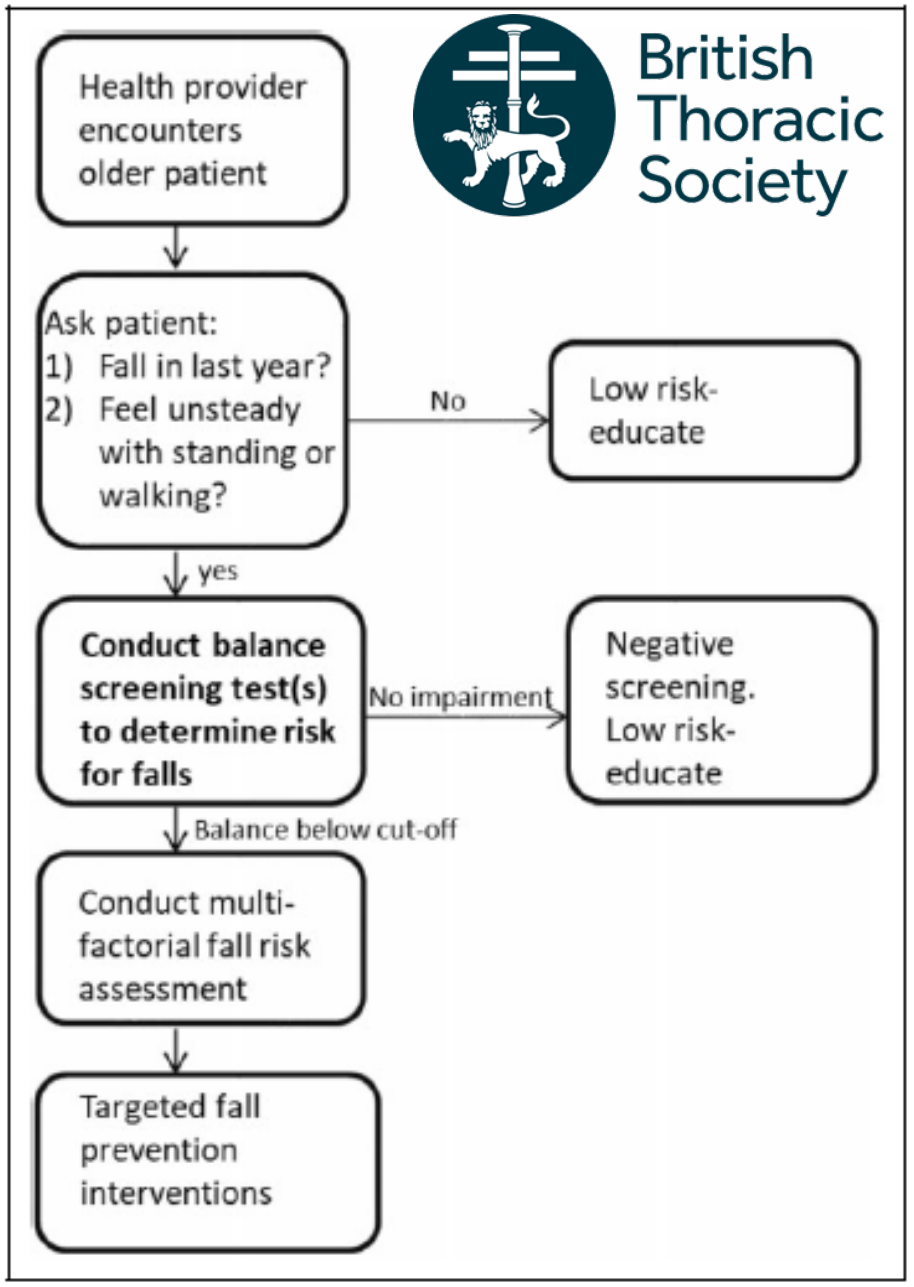


Figure 1. Simplified summary of best practice guidelines for fall prevention in community-dwelling older adults.

Beauchamp et al, CRD, 2018

Balance Assessment

Step 1

Step 2

- Timed Up and Go (TUG)

Timed ability to stand from a chair
walk 3 meters at pace and return
to sit in the chair

≥12 seconds = ↑ risk of falls

- *Single leg stance (SLS)*

<5 seconds = ↑ risk of falls

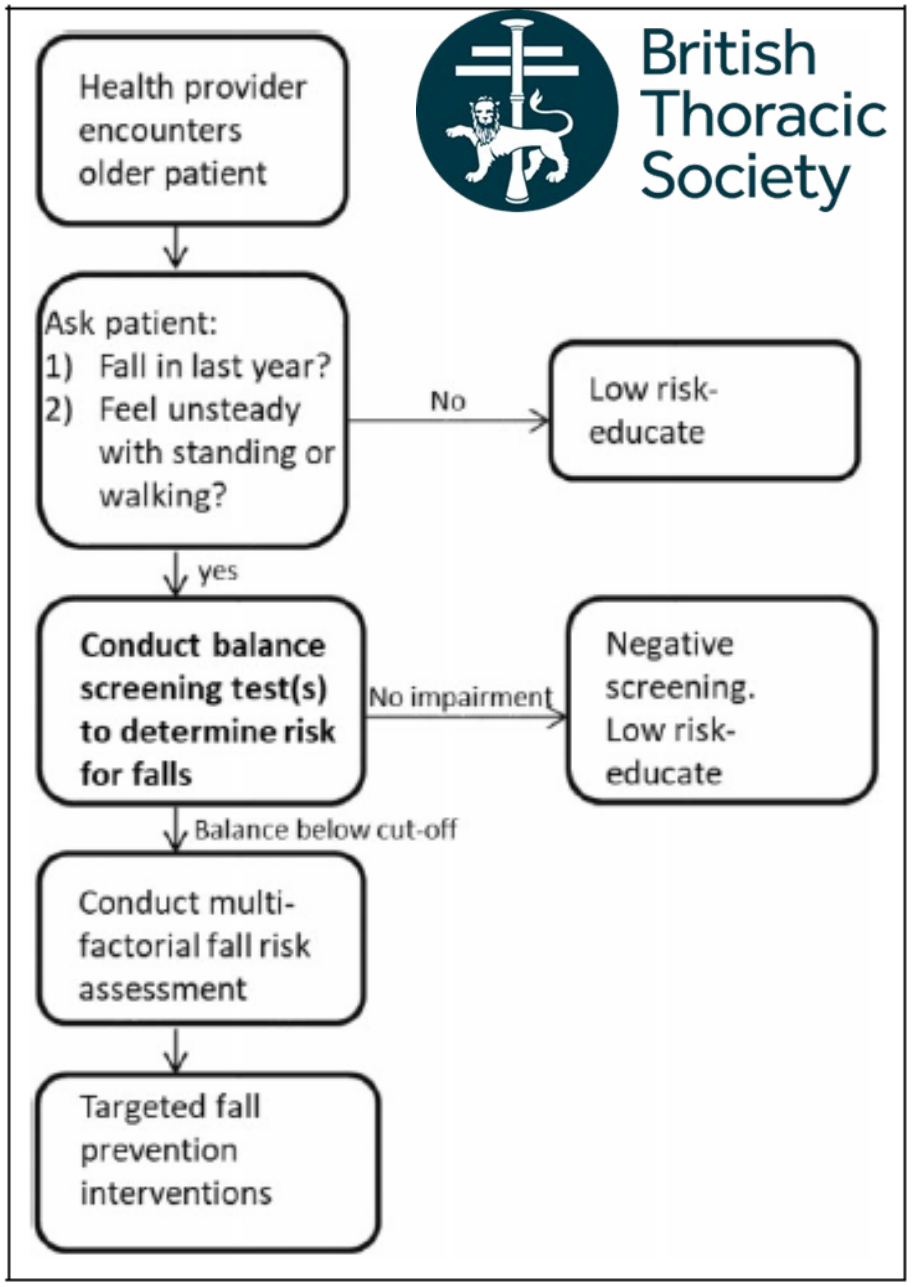


Figure 1. Simplified summary of best practice guidelines for fall prevention in community-dwelling older adults.

Beauchamp et al, CRD, 2018

Balance Assessment

Step 1

Step 2

Step 3

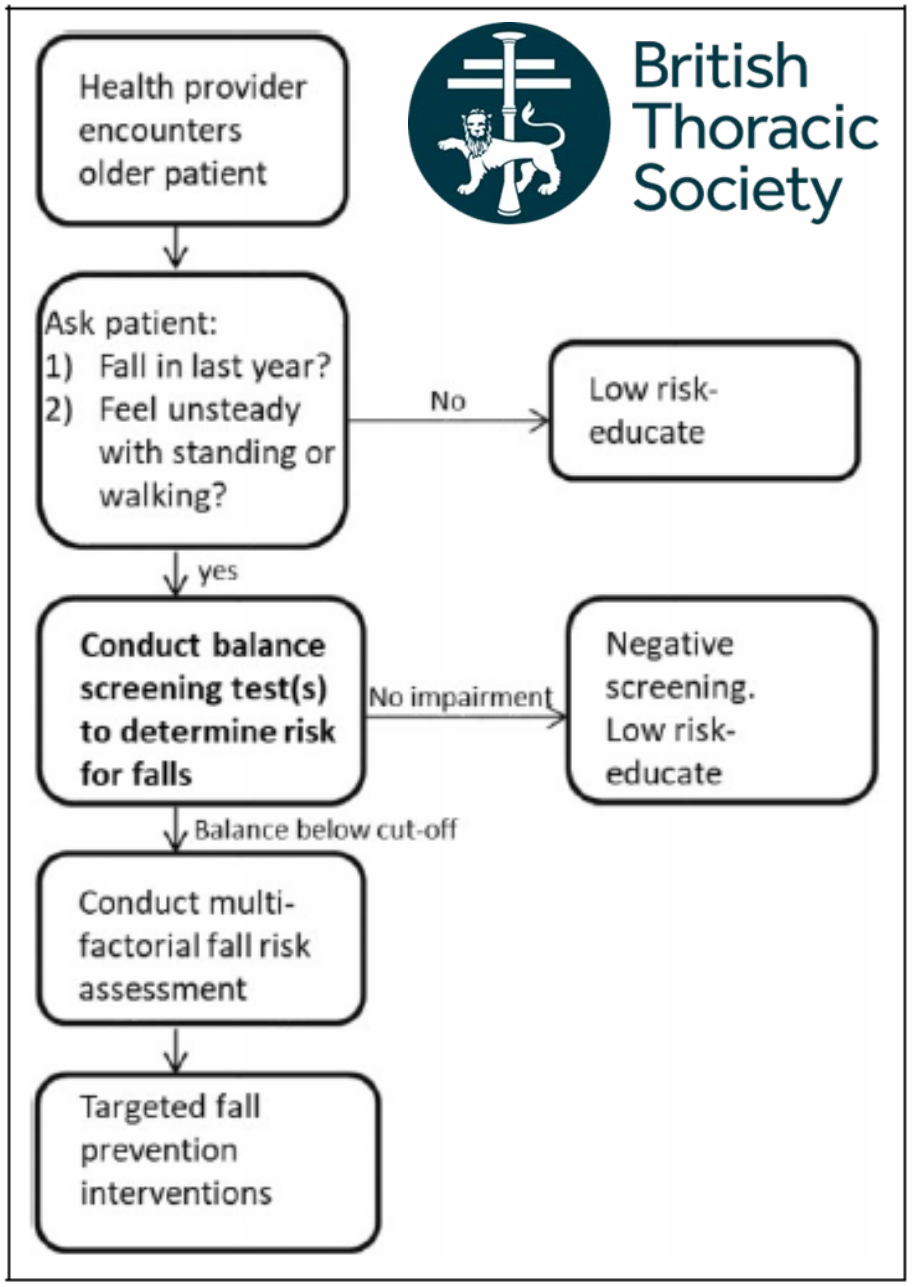


Figure 1. Simplified summary of best practice guidelines for fall prevention in community-dwelling older adults.

Beauchamp et al, CRD, 2018

Comprehensive Balance Assessment

- An international expert consensus group recommends the **Berg Balance Scale (BBS)** and the **mini Balance Evaluation Systems Test (BEST)** as part of a core balance outcome set *(Sibley et al., 2015).*
- **BBS**
  - 14 performance-based tasks (e.g. getting up from a chair to SLS).
  - Scored on a 5 point ordinal scale (0-4) ↑scores = ↑balance.
  - Max score = 56

✗ Ceiling effect for higher functioning patients.

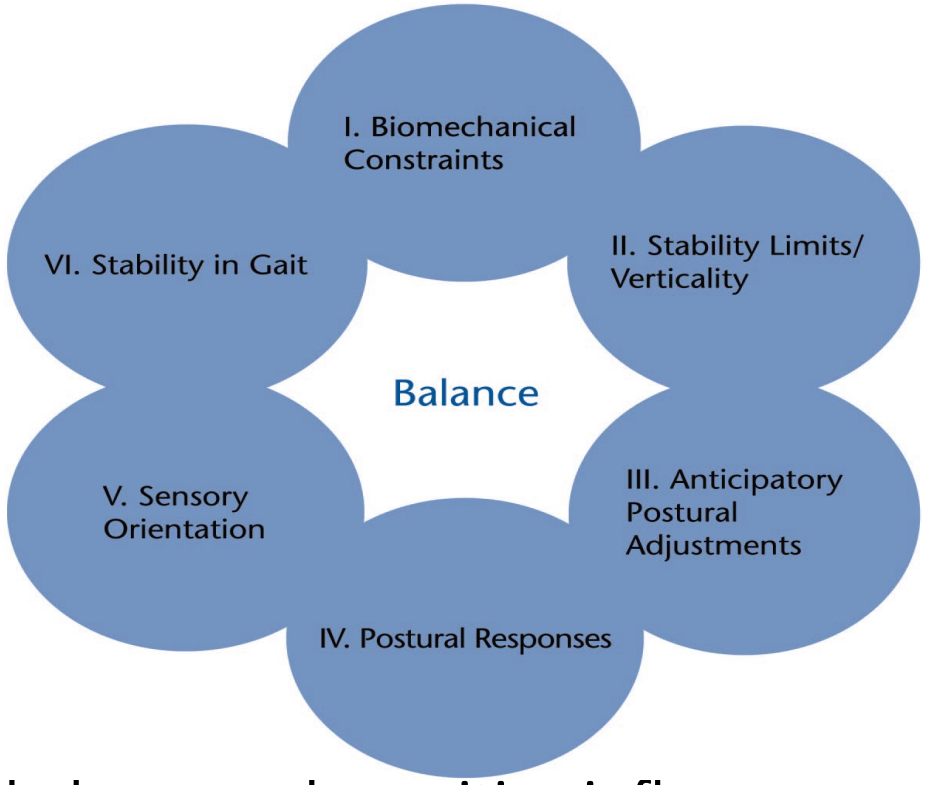
✗ No assessment of reactive balance or cognitive influences on balance.

✔ Good for patients with lower balance abilities.

✔ Easy to administer (15 mins aprox) and interpret.

Comprehensive Balance Assessment

- **Mini BEST**
  - Shorted version of the Balance Evaluation Systems Test (BEST) which assesses 6 balance subsystems.
  - 14 performance-based tasks
  - Scored on a 3 point ordinal scale
    ↑scores = ↑balance.
  - Max score = 28



✔ Less of a ceiling effect.

✔ Assesses more aspects of balance including reactive balance and cognitive influences.

✔ Target an intervention to areas of impairment.

✗ Less information on psychometric properties and clinicians are less familiar with its administration.

Balance Confidence and Fear of Falling

- **The Activities Specific Balance Confidence (ABC) Scale**
  - Evaluates balance confidence or balance self-efficacy.
  - 16 Items (e.g. mobility inside the home to walking up and down a ramp).
  - Confidence doing each activity rated on an 11-point scale (0%=no confidence to 100%=completely confident).
- **Falls Efficacy Scale (FES-I)**
  - Measure fear of falling
  - 16 items
  - Scores range from 16 (no concern about falling) to 64 (severe concern about falling).
  - Short FES-I. 7 items. Scores range from 7 to 28.

Social and Environmental Factors Influencing Balance

- **Social and environmental factors**
  - Lung disease contribute disproportionately to the health inequality gap
  - Socioeconomic deprivation has been linked to an increased falls risk.
  - e.g. those caring for grandchildren, because childcare is not affordable, and living in small spaces are more likely to trip over toys left on the floor.

Balance Intervention

Step 1

Step 2

Step 3

Step 4

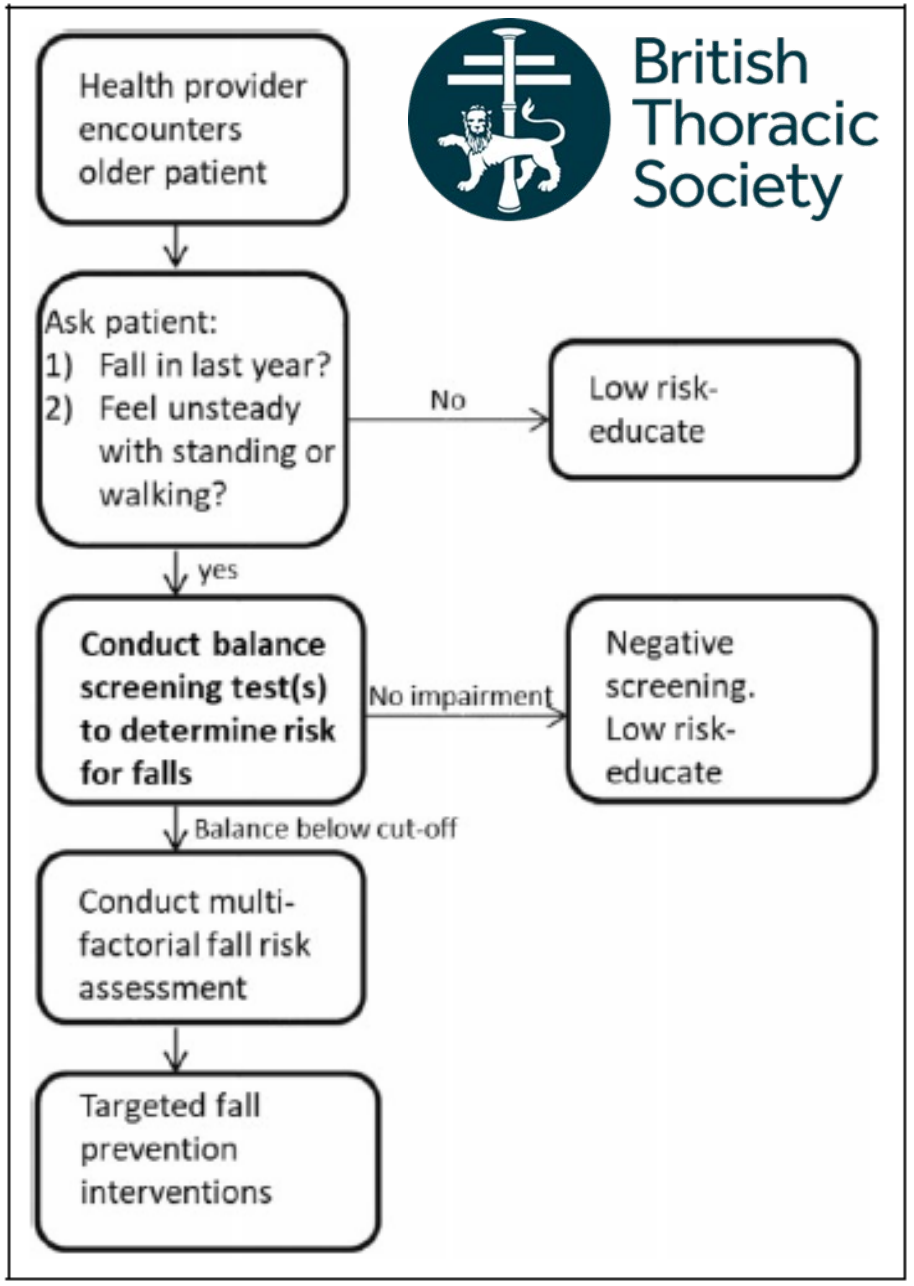


Figure 1. Simplified summary of best practice guidelines for fall prevention in community-dwelling older adults.

Beauchamp et al, CRD, 2018

Balance Intervention

- *Objective:* Determine effects of balance-specific training in individuals with COPD.
- *Methods:*
  - 39 patients with COPD at risk for falls
  - Randomised to PR with balance training or usual PR
- *Intervention:*
  - 30-min supervised balance training 3x/week for 6 weeks.
  - Delivered concurrently with PR in groups of 2-3.
  - Focus on **biomechanics, transitions and gait.**
  - Progression individualised based on time and stability criteria.

CHEST Original Research

COPD

A Randomized Controlled Trial of Balance Training During Pulmonary Rehabilitation for Individuals With COPD

Marla K. Beauchamp, PhD, PT; Tania Janaudis-Ferreira, PhD; Verônica Parreira, PhD; Julia M. Romano, MSc; Lynda Woon, BSc, PT; Roger S. Goldstein, MD, FCCP; and Dina Brooks, PhD, PT

Balance Intervention

1. Static and dynamic stance exercises

e.g. Narrow stance, tandem stance, SLS, standing on uneven surfaces.

2. Transitions

e.g. Sit to stand from a chair/floor, stairs.

3. Gait stability

e.g. Obstacle courses in p-bars, walking with dual tasks.

4. Functional strengthening

e.g. Exercises for the lower limbs (squats, step ups and side leg lifts), core exercises on a balance ball.

Balance Outcomes

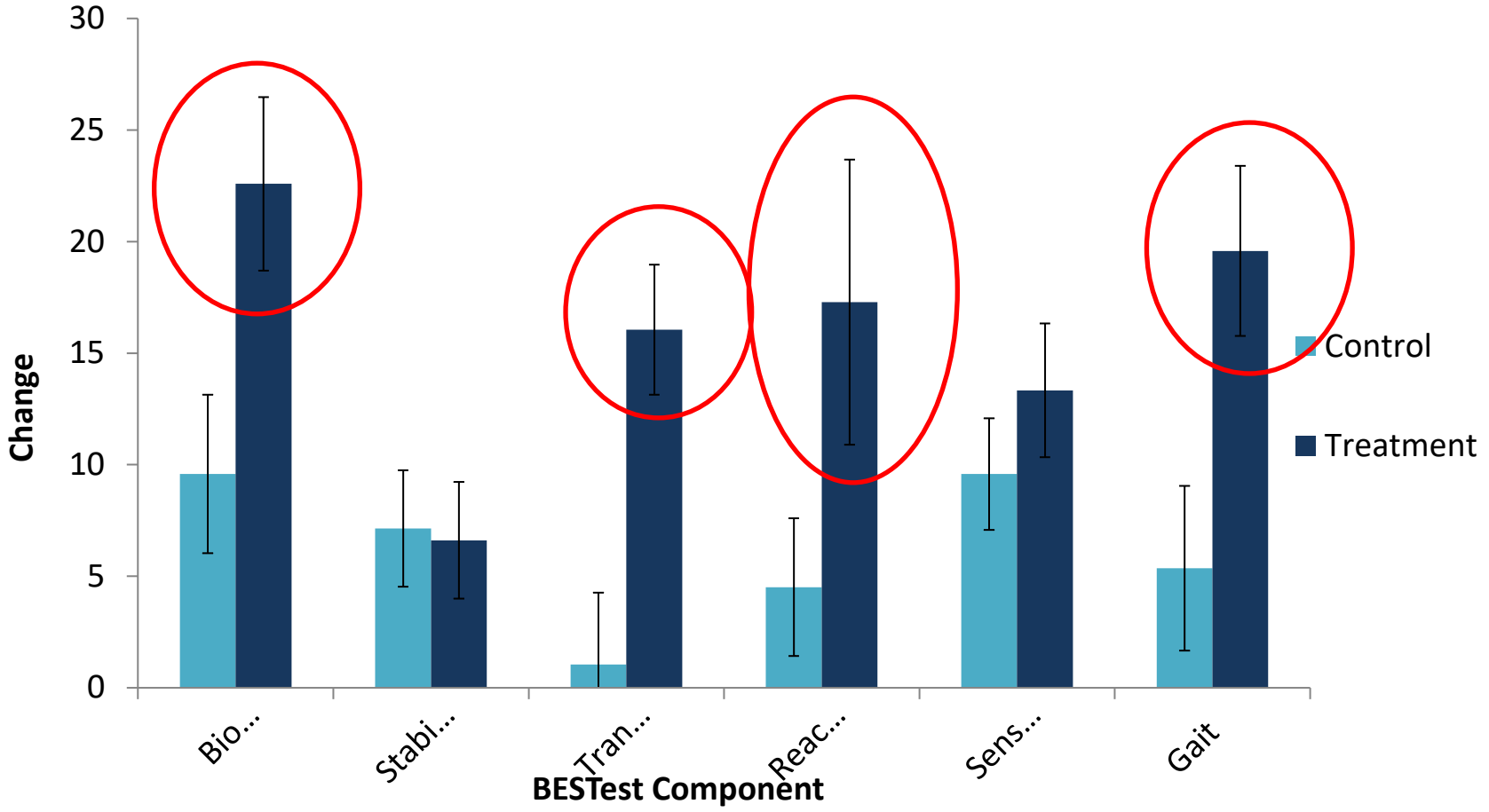
- Improvement in the intervention group was greater for balance, physical function and functional lower-extremity strength.
- No between-group differences for changes in balance confidence.
- The MCIDs were observed in the intervention group.

Outcome	Change in controls	Change in intervention	Mean difference (95%CI)	MCID in COPD
BBS	1.6 ± 3.9	7.0 ± 5.5 ✔	5.4 (2.1-8.6)** ✔	5
BESTest	6.0 ± 5.5	15.6 ± 2.4 ✔	9.6 (3.9-15.3)**	13
ABC scale	13.0 ± 19.5	22.0 ± 22.3 ✔	9.0 (-5.2-23.3)	19
PF-10	5.6 ± 16.7	18.7 ± 13.2 ✔	13.1 (3.0-23.2)* ✔	10
Chair-stand	2.9 ± 3.6	6.2 ± 4.0 ✔	3.3 (0.6-6.0)* ✔	3

- $p < 0.05$**
- $p < 0.01$

Balance Outcomes

- Greatest improvements in balance were seen in the BESTest subcomponents:
  - **Biomechanics**
  - **Transitions**
  - **Reactive control**
  - **Gait**



Balance Training and Falls

- Balance training improves balance but does balance training reduce falls?

JMIR RESEARCH PROTOCOLS Beauchamp et al

Protocol

Pulmonary Rehabilitation With Balance Training for Fall Reduction in Chronic Obstructive Pulmonary Disease: Protocol for a Randomized Controlled Trial

Marla K Beauchamp[1,2], MScPT, PhD; Dina Brooks[2,3], PT, PhD; Cindy Ellerton[2,3], PT, MSc; Annemarie Lee[4,5,6], PT, PhD; Jennifer Alison[7,8], PT, PhD; Pat G Camp[9,10], PT, PhD; Gail Dechman[11], PT, PhD; Kimberley Haines[12], PT; Samantha L Harrison[13], MScPT, PhD; Anne E Holland[4,5,14], PT, PhD; Alda Marques[15,16], PT, PhD; Rahim Moineddin[17], PhD; Elizabeth H Skinner[12,18], PT, PhD; Lissa Spencer[8], PT, PhD; Michael K Stickland[19,20], PhD; Feng Xie[21,22,23], PhD; Roger S Goldstein[2,3,24], MD

- 9 sites across 4 countries: Canada, Australia, Portugal and UK (Teesside).
- 244/400 (n=41 at UK site) recruited to date with findings expected early 2023.

Balance Training in a Sustainable Clinical Service

- A prospective, single group, longitudinal study.
- All health care professionals (HCPs) responsible for delivering PR took part (n=8)

	Knowledge Translation action	Knowledge Translation effect
Step 1	One hour training session regarding the benefits and practical applications of balance training and familiarization with the balance equipment	Increased knowledge and awareness of the benefits of balance training
Step 2	Assistance with the balance training sessions delivering guidance on; prescription, progression and providing practical demonstrations as requested	Increased trust and rapport with the health care professionals
Step 3	Program development, led by the health care professionals responsible for delivering pulmonary rehabilitation	Increased feelings of ownership and likelihood of sustainability
Step 4	Development of program logs, led by the health care professionals responsible for delivering pulmonary rehabilitation	Increased feelings of ownership and likelihood of sustainability
Step 5	Brief BEST tests results pre and post pulmonary rehabilitation are provided on a one-to-one basis.	Refection on performance and enhanced motivation

Harrison et al, BMC Pulm Med, 2015

Balance Training in a Sustainable Clinical Service

- Staff-to-patient ratio = 1:3. Recently a ratio of 2:11 has been shown to be feasible *(O'Hoski et al, 2020)*
- Improvements in balance outcomes were equivalent to those observed in the RCT (COPD n=19).
- Focus group (HCP n=6). Perceptions of the barriers and strategies to delivering balance training in PR.
  - ✗ Distracts from the usual PR programme.
  - ✗ Time constraints, space and staffing.
  - ✔ Deliver twice weekly and introduce a home-programme early *(O'Hoski et al, 2020).*
  - ✔ Provide visuals aids to promote independence in higher functioning patients.
  - ✔ Consider the environment (i.e. p-bars) if staffing not available.

Multiple Choice Questions

- **Clinical Scenario 1**

A 76 year old man with COPD attends his PR assessment. He has had several exacerbations over the winter months and reports feeling unsteady when walking his two small dogs. He has osteoarthritis (OA) and pain in both knees. He reports no previous falls.

Multiple Choice Questions

- **Clinical Scenario 1**

A 72 year old man with COPD attends his PR assessment. He has had several exacerbations over the winter months and reports feeling unsteady when walking his two small dogs. He has osteoarthritis (OA) and pain in both knees. He reports no previous falls.

Q. What are the potential risk factors indicating this gentleman requires a falls screening test?

a. Inactivity, lower limb weakness, pain

b. Exacerbations, potential for trip hazards, OA, pain

c. Reduced balance confidence, exacerbations, lower limb weakness

Multiple Choice Questions

- **Clinical Scenario 1**

A 72 year old man with COPD attends his PR assessment. He has had several exacerbations over the winter months and reports feeling unsteady when walking his two small dogs. He has osteoarthritis (OA) and pain in both knees. He reports no previous falls.

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a. Inactivity, lower limb weakness, pain

b. Exacerbations, potential for trip hazards, OA, pain ✔

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Multiple Choice Questions

- **Clinical Scenario 1**

A 72 year old man with COPD attends his PR assessment. He has had several exacerbations over the winter months and reports feeling unsteady when walking his two small dogs. He has osteoarthritis (OA) and pain in both knees. He reports no previous falls.

Q. Which balance screening test would you use?

a. SLS

b. TUG

Multiple Choice Questions

- **Clinical Scenario 1**

A 72 year old man with COPD attends his PR assessment. He has had several exacerbations over the winter months and reports feeling unsteady when walking his two small dogs. He has osteoarthritis (OA) and pain in both knees. He reports no previous falls.

Q. Which balance screening test would you use?

a.SLS

b.TUG✔

Multiple Choice Questions

- **Clinical Scenario 2**

A 62 year old woman with COPD attends her PR assessment. During the Incremental Shuttle Walk Test (ISWT) she appears to be unsteady. She reports that she fell getting out of bed 2 weeks ago.

Multiple Choice Questions

- **Clinical Scenario 2**

A 62 year old woman with COPD attends her PR assessment. During the ISWT she appears to be unsteady. She reports that she fell getting out of bed 2 weeks ago.

Q. You want to do a comprehensive balance assessment, which test do you select?

a. TUG

b. BBS

c. Mini BEST

Multiple Choice Questions

- **Clinical Scenario 2**

A 62 year old woman with COPD attends her PR assessment. During the ISWT she appears to be unsteady. She reports that she fell getting out of bed 2 weeks ago.

Q. You want to do a comprehensive balance assessment, which test do you select?

a.TUG ✗

b.BBS

c.Mini BEST✔

NB. Check circumstances of fall and any injuries

Multiple Choice Questions

- **Clinical Scenario 2**

Mini BEST - Poor performance (score 0) on compensatory stepping correction (reactive postural responses) and stance with eyes open on an uneven surface (sensory orientation).

Q. What exercises would be included in a personalised balance training programme?

a. Perturbations and standing in narrow stance on foam throwing and catching a ball

b. Sit to stand and the TUG with dual task

c. Squats and low level obstacle course

Multiple Choice Questions

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Q&A

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Thank you for listening

South Tees Hospitals NHS
NHS Foundation Trust

Pulmonary Rehabilitation team at
South Tees Hospitals NHS Foundation Trust

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