

Standardised Fall-Risk Assessment: Clinical & Sensor-Based Approaches

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EU Falls Festival
24th & 25th March 2015
Stuttgart, Germany



Acknowledgments

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- Health Service Executive
PCCC Physiotherapy staff
- Dr Alan Bourke (EPFL/NTNU)
- Dr Jean Saunders (UL)



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Overview

- Fall-Risk Screening & Assessment
- Sensor-Based Ax Methods
- Ax in the Community: Key Findings
- Lessons Learned & Future Directions

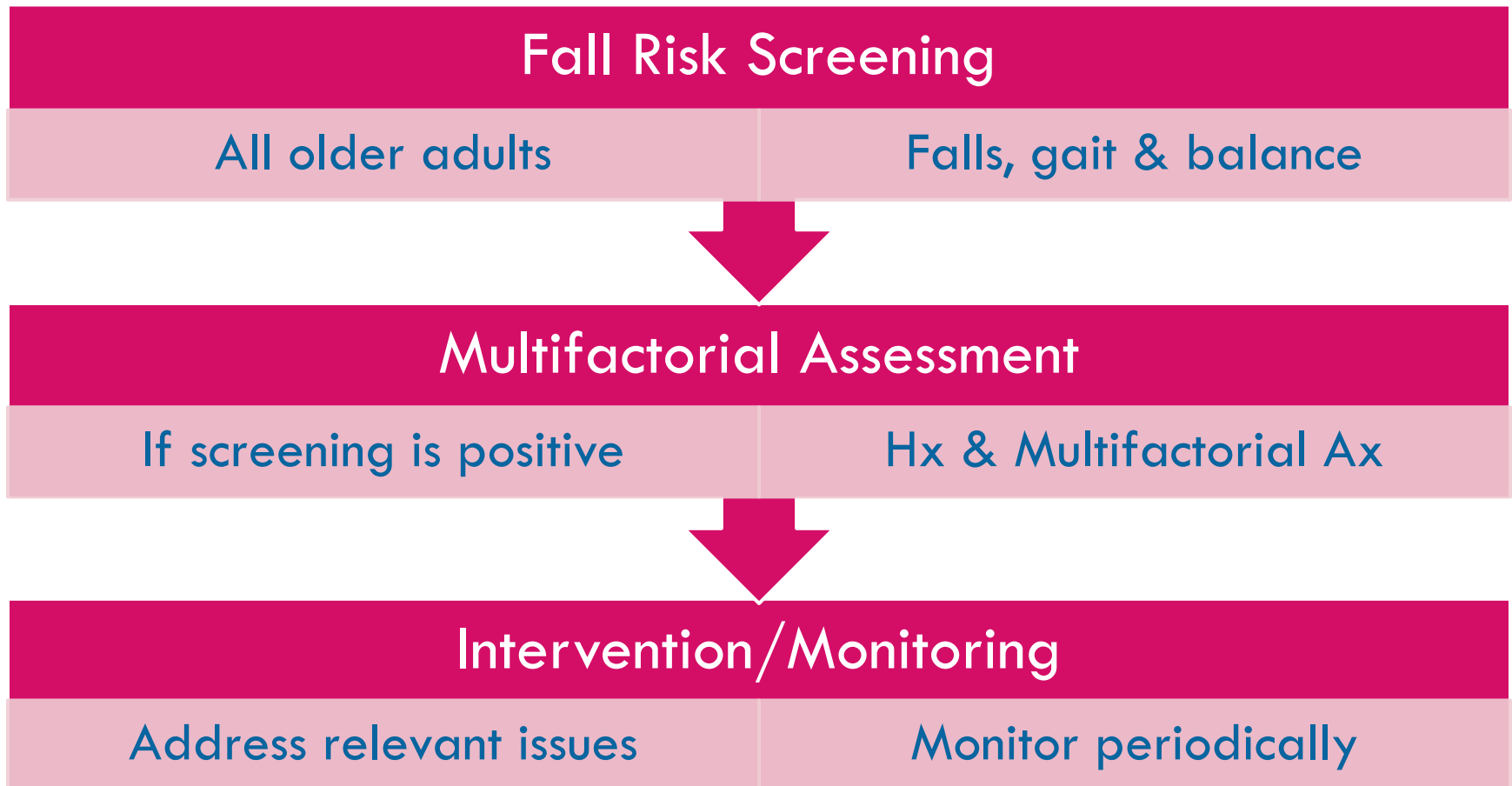


Falls in Ireland

- 22% of individuals aged 52-64 yrs fall annually
- 30% of community-dwellers aged ≥ 75 yrs
(TILDA 2014)
- 20% of over 65s who fall sustain serious injuries
- Annual cost of falls & fractures to HSE = €404 million
(Gannon et al 2013)
- Projected to increase to €2 billion by 2031
(DoHC 2008)

(adapted from AGS/BGS Guidelines 2011; DoHC 2008)

Falls: Screening & Assessment



Sensor-Based Fall-Risk Assessment

- Body-worn sensors analyse movement & assess balance

(Mancini and Horak 2010; Ní Scanaill et al. 2011)

- Objective, inexpensive, portable, accurate, feasible
- Translational research – applications in clinical settings
- Relationships to current clinical assessments
- Sensor set-up? Optimal variables to classify fall-risk in specific populations? Standardised tasks?

(Howcroft et al. 2013; Shany et al. 2012a&b)

Exploring Standardised Fall-Risk Assessment in the Community

Findings from Recent Research

Study Design & Participants

High-Risk Group

- Aged ≥ 65 years
- Primary care falls prevention programme participants
- No neurological conditions

Low-Risk Group (Non-Fallers)

- Aged ≥ 65 years
- No falls in previous 1 yr
- Never referred to falls prevention services
- No neurological conditions

Pre-Intervention
Assessment



Once-Off Assessment

High-Risk v Low-Risk: Clinical Ax

High-Risk Group	Determined by
Older	-
Greater number of medications	-
Poorer balance	BBS, walking aids
Poorer mobility & function	TUG, FTSS, gait speed
Lower falls efficacy	MFES
Lower PA levels	PASE
Poorer self-rated functioning & health	EQ-5D-3L
More conservative fall-related behaviours	FaB

⇒ **As expected, appropriate referral for intervention**

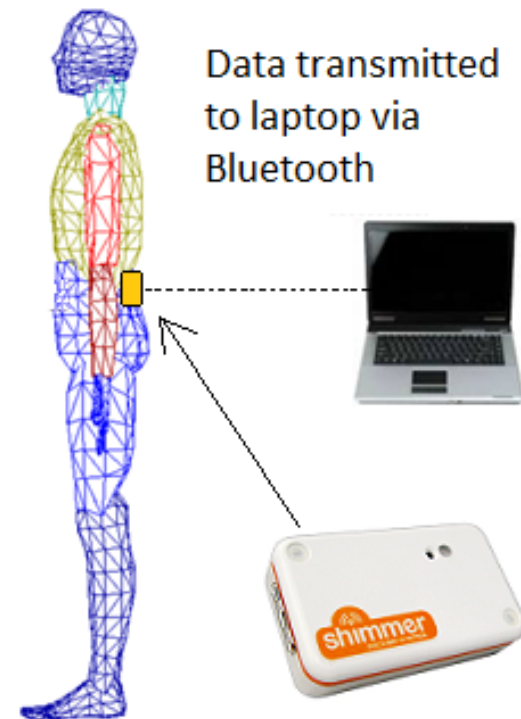
Sensor-Based Fall-Risk Assessments

Static

1. Standing Balance
 - 10s Normal Stance
 - 10s Eyes Closed
 - 10s Feet Together

Dynamic

2. 5m Walk
3. Timed Up and Go (TUG)



SFRA in Standing

- Peak detection algorithm
- Fall detection & gait analysis
(Bourke et al. 2007; Zijlstra and Hof 2003)

Standing ML Mean Inter-optimum

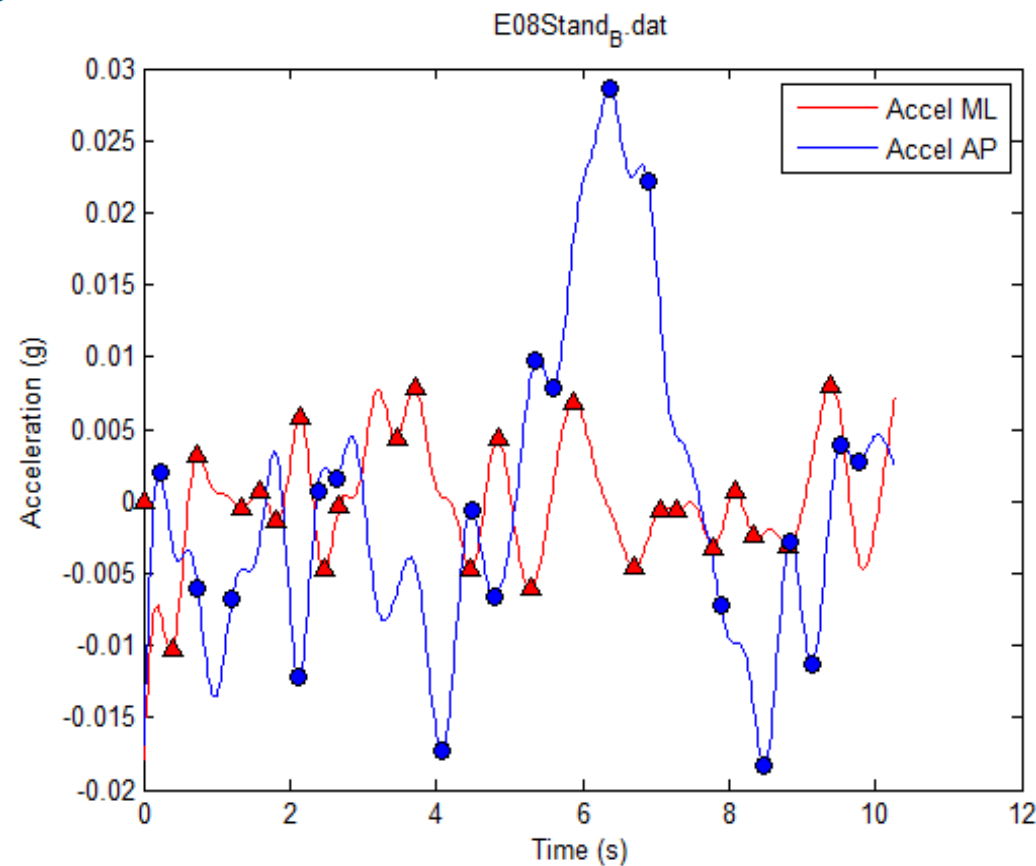
- Acceleration
- Jerk



Lower in High-Risk Group

“Smooth” postural control adjustments

⇒ Impaired balance responses?

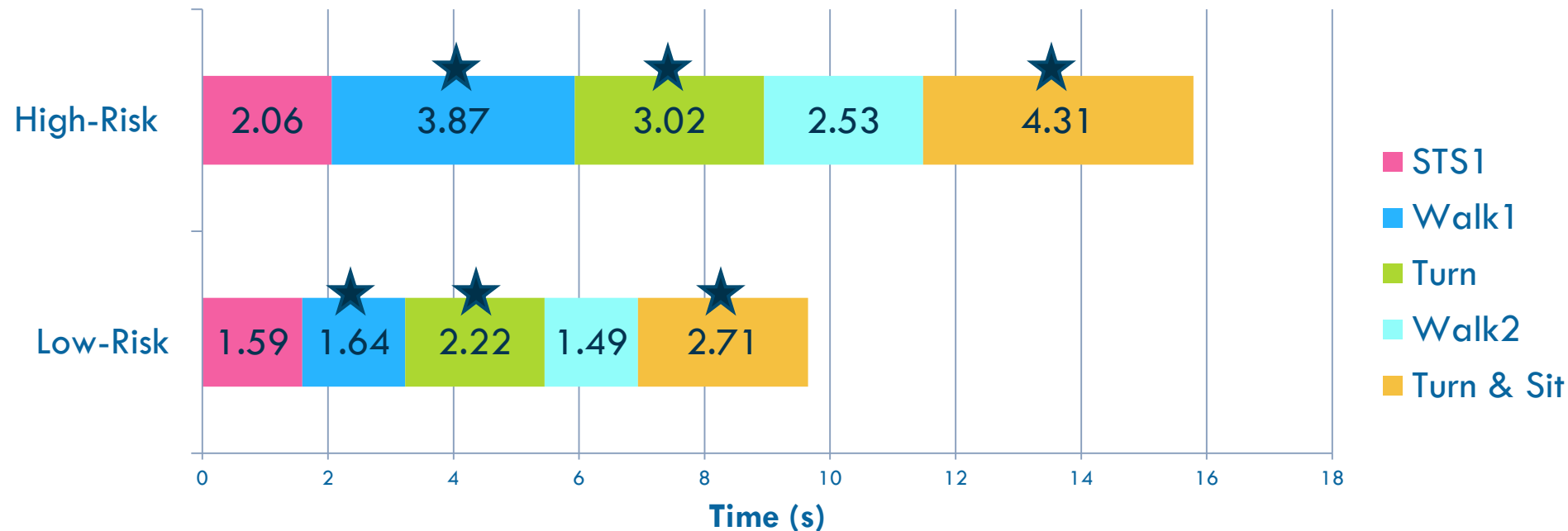


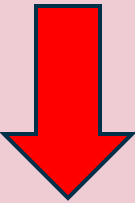
Sensor-Based Gait Analysis

	High-Risk	Low-Risk	<i>p</i>
Speed (m/s)	0.77 (0.18, 1.54)	1.28 (0.61, 1.67)	<0.001
Cadence (steps/min)	96.0 (74.8, 120.1)	118.8 (101.8, 160.3)	<0.001
Mean Step Time (s)	0.60 (0.50, 0.75)	0.49 (0.39, 0.58)	<0.001
SD Step Time (s)	0.04 (0.02, 0.14)	0.02 (0.01, 0.06)	<0.001
ML RMS Accel (g)	0.06 (0.00, 0.10)	0.08 (0.05, 0.16)	<0.001
AP RMS Accel (g)	0.08 (0.04, 0.14)	0.11 (0.06, 0.20)	<0.001

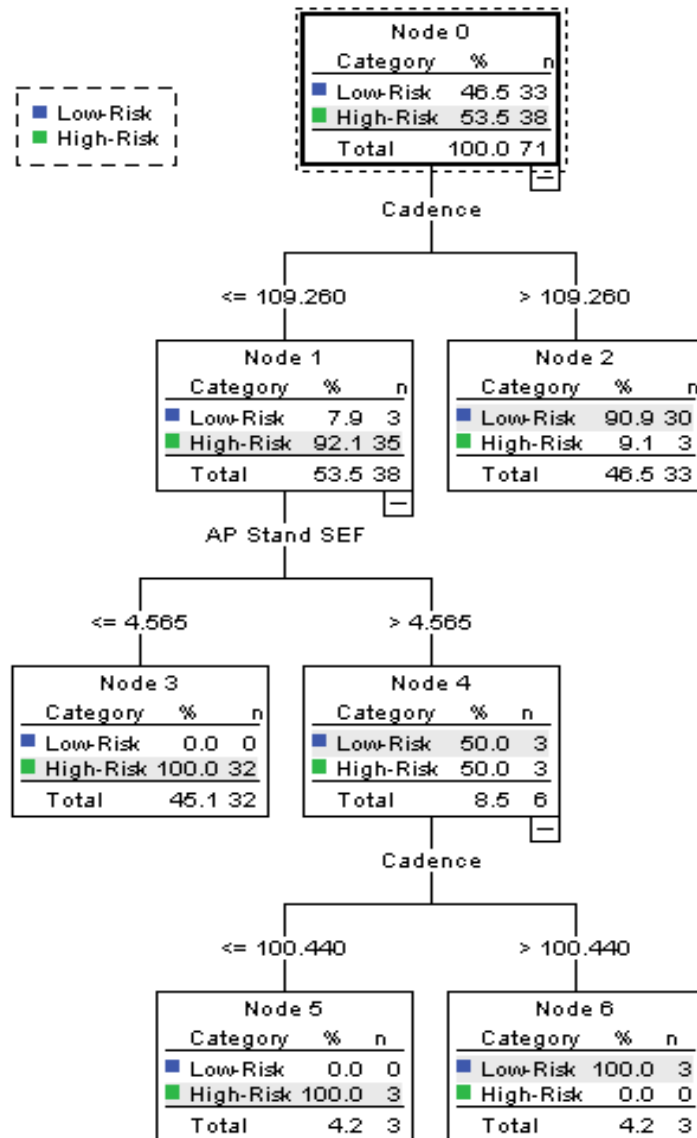
Note. Median (maximum, minimum)

Sensor-Derived TUG Phase Times



Axis	Sensor-Derived TUG Turn Variables	High-Risk
All	Acceleration & angular velocity variance	
All	Max/min acceleration	
AP	Mean acceleration	
Yaw & Pitch	Max/min angular velocity	
Roll	Mean angular velocity	

Classifying Fall-Risk: Sensor \pm Clinical



- Classification & regression tree models
- Sensor \pm Clinical = Unchanged CRT model
- Excellent accuracy from all models: 95.8%
- Cross-sectional data only
- Over-fitting

Lessons Learned & Future Directions

- ✓ SFRA useful as a clinically-meaningful assessment tool
- ✓ Portable objective community gait assessment
- ✓ Simple characterisation of TUG performances
- ✓ Classifies high-risk adults \geq ? clinical assessment tools

BUT

Specific Roles in Clinical Care Pathways?

User-Friendly Implementation Methods?

Consensus on Evidence-Based Protocols?