RECOMMENDATIONS FOR AN EVIDENCE-BASED PARA DRESSAGE CLASSIFICATION SYSTEM: AN INTRODUCTION AND UPDATE ON RESEARCH

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INNOVATIVE THINKING
FOR THE REAL WORLD

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HARTPURY

CLASSIFICATION IN PARA SPORT

- Determines who is eligible to compete in para-sport and groups the eligible athletes in sport classes *according to their activity limitation in a certain sport* (IPC, 2015)
- Purpose: "to promote participation in sport by people with disabilities by *minimising the impact of eligible impairment* on the outcome of competition (Tweedy, 2002)"
  - Athletes are successful NOT because their impairment is less severe than competitors.
- Sport-specific Classification
  - An impairment of any given type, severity or location may cause relatively little disadvantage in one sport, but significant disadvantage in another

WHAT IS AN "IMPAIRMENT"?
WHO – INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH" (ICF).

Body Functions are physiological functions of body systems (including psychological functions).

Body Structures are anatomical parts of the body such as organs, limbs and their components.

Impairments are problems in body function or structure such as a significant deviation or loss.

Activity is the execution of a task or action by an individual.

Participation is involvement in a life situation.

Activity Limitations are difficulties an individual may have in executing activities.

Participation Restrictions are problems an individual may experience in involvement in life situations.

Environmental Factors make up the physical, socal and attitudinal environment in which people live and conduct their lives..

Table 1. An overview of ICF

	Part 1: Functioning and Disability	
Components	Body Functions and Structures	Activities and Participation
Domains	Body functions Body structures	Life areas (tasks, actions)
Constructs	Change in body functions (physiological) Change in body structures (anatomical)	Capacity Executing tasks in a standard environment Performance Executing tasks in the current environment
Positive aspect	Functional and structural integrity	Activities Participation
	Functioning	
Negative aspect	Impairment	Activity limitation Participation restriction
	Disability	

IPC'S CLASSIFICATION CODE AND INTERNATIONAL STANDARDS (2007)

- General framework for Paralympic Classification across all sports.
- Committed to the development of:
  - Evidence-based systems of Classification.
  - Transparent and defensible systems of Classification
- "International Paralympic Committee Position Stand – Background and Scientific Principles of Classification in Paralympic Sport" (Tweedy and Vanlandewijck, 2011).
- No sport has fully achieved the requirement for a system of Classification to be evidence-based – *Research Required*

CLASSIFICATION SYSTEMS SHOULD:

- Describe eligibility criteria in terms of:
  - Type of impairment
  - Severity of impairment
- Describe methods for classifying eligible impairments according to *the extent of activity limitation they cause*
- ***RESEARCH –***
  - Develop objective, reliable measures of impairment and activity limitation.
  - Investigate the relative strength of association between impairment and activity limitation.

ELIGIBLE IMPAIRMENTS

Physical Impairments

1. Vision Impairment
2. Intellectual Impairment
3. Hypertonia
4. Ataxia
5. Athetosis
6. Impaired Muscle Power
7. Impaired ROM
8. Limb Deficiency
9. Leg Length Difference
10. Short Stature

"Minimum impairment Criterion – to be eligible the impairment must be severe enough that it impacts his/her sport performance (IPC, 2015)."

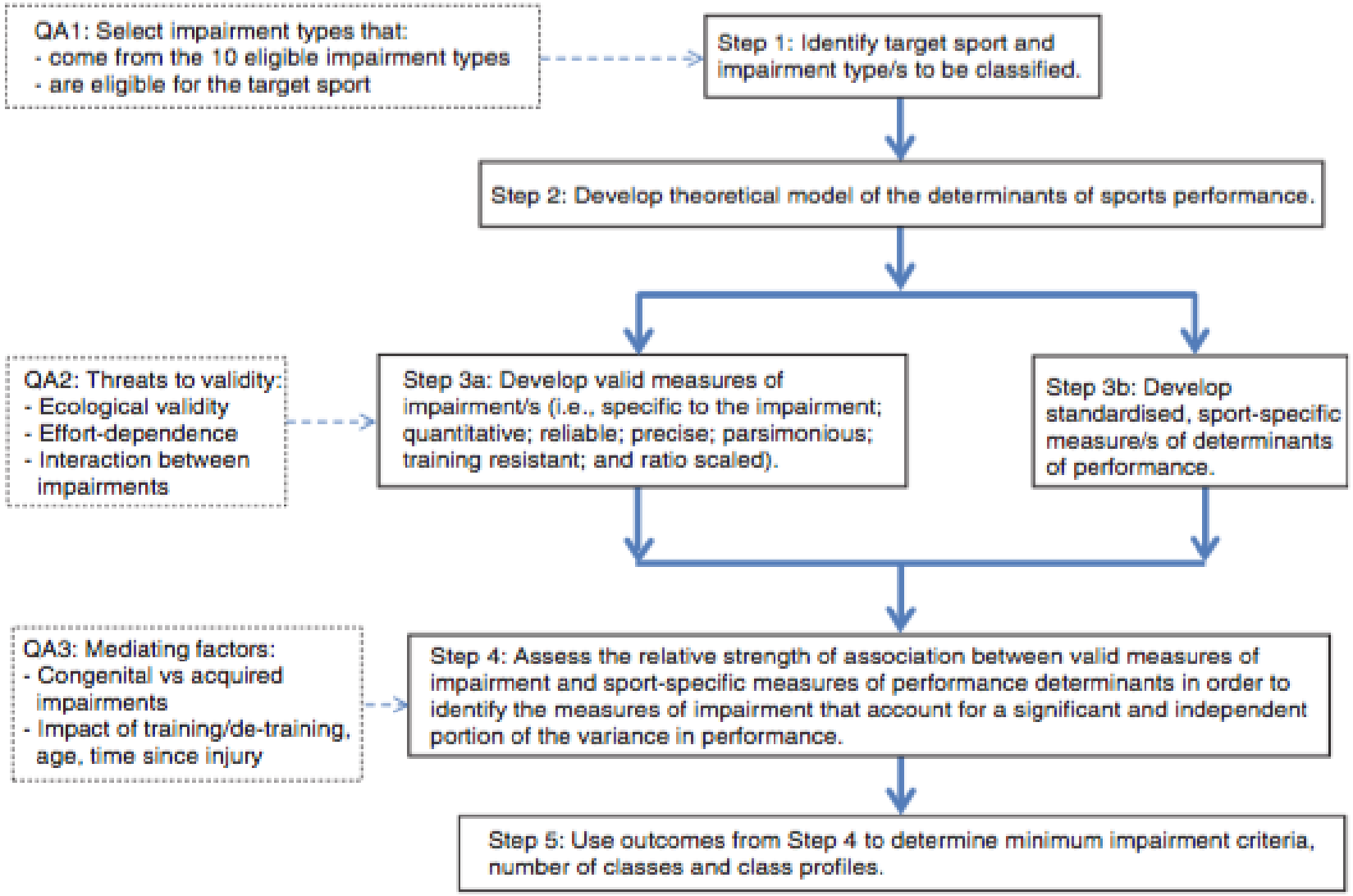


Figure 7.1 Schematic representation of research required for the development of evidence-based systems of classification. The boxes with the solid outlines (Steps 1–5) are essential. The boxes with dashed outlines (QA1–QA3) are not essential to every research program, but are generally important quality assurance (QA) measures.

Tweedy and Vanlandewijck (2007)

EXAMPLE: CONNICK ET AL. (2015) HOW MUCH DO RANGE OF MOVEMENT AND COORDINATION AFFECT PARALYMPIC SPRINT PERFORMANCE?

- Focussed on:
- Eligible impairments : ataxia, hypertonia, athetosis (i.e. CP, traumatic brain injury)
- Sport classes : T35 – 38
- Measures of impairment: Range of movement (ROM), Coordination
- Measure of performance: acceleration, maximal velocity
- Assess relative strength of association between measures of impairment and measures of performance to evaluate the validity of tests for purposes of classification.

31-38: Track and field athletes with cerebral palsy or other neurological conditions that affect muscle co-ordination and control. Athletes in classes 31-34 compete in a seated position (using a racing or throwing chair), while athletes in classes 35-38 compete standing.

ATHLETICS

All impairment groups can compete in athletics but a system of letters and numbers is used to distinguish each class.

A letter F is for field athletes, T represents those who compete on the track, and the number shown refers to their impairment.

11-13: Track and field athletes who are visually impaired. Blind athletes compete in class 11, wear compulsory blindfolds and run with a guide runner. Athletes in class 12 are visually impaired but running with a guide is optional.

20: Track and field athletes who are intellectually impaired. Athletes in this class have difficulty with reaction time and memory recognition during an event. There are three events for men and women in the Rio programme - 1,500m, long jump and shot put- these particular events have been medically proven to have an impact on performance for T/F20 competitors.

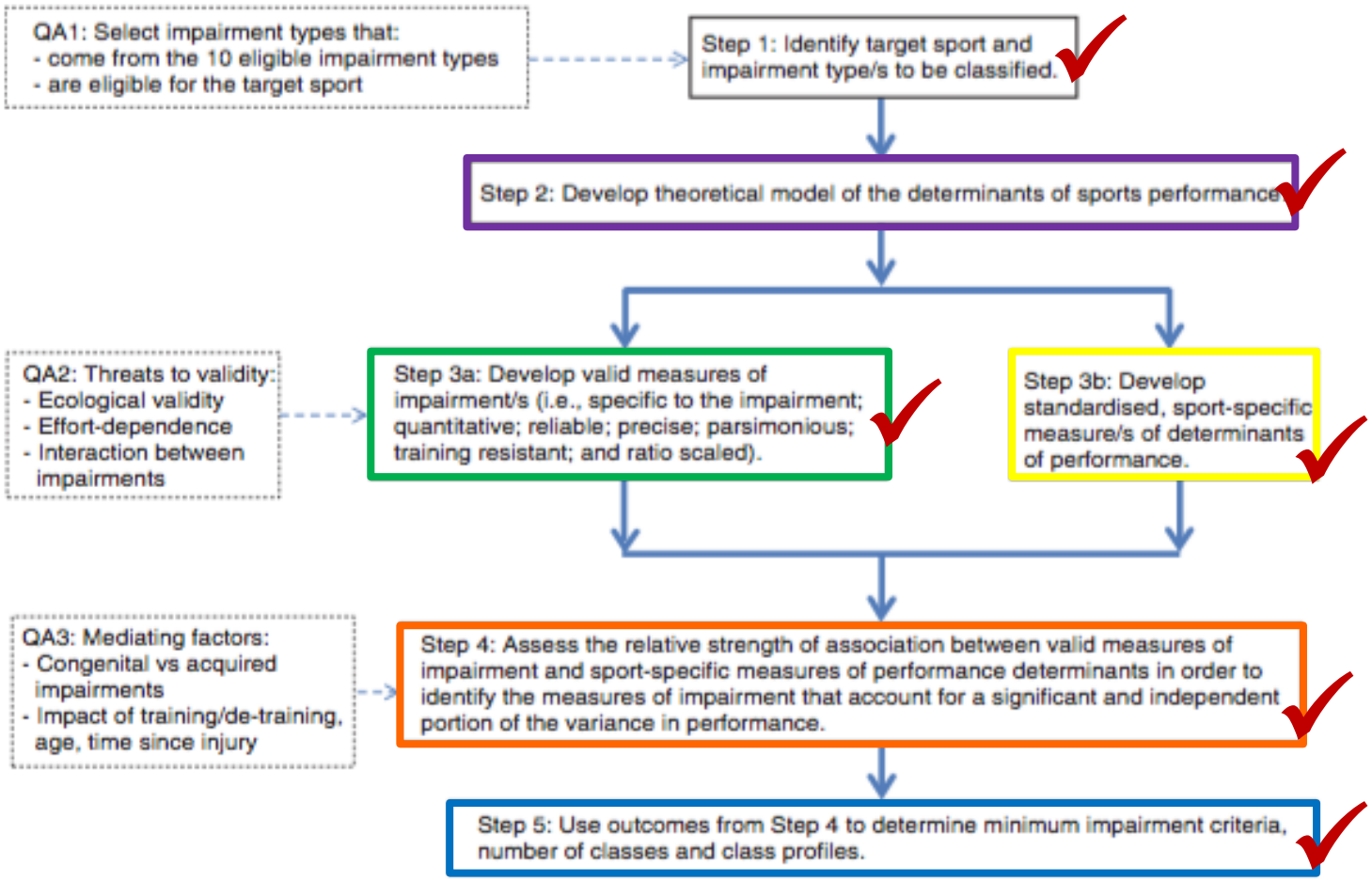
31-38: Track and field athletes with cerebral palsy or other neurological conditions that affect muscle co-ordination and control. Athletes in classes 31-34 compete in a seated position (using a racing or throwing chair), while athletes in classes 35-38 compete standing.

40: Track and field athletes with short stature (also known medically as dwarfism).

42-47: Track and field amputees. In classes 42-44 the legs are affected and in class 45-47 the arms are affected. Athletes in these classes compete standing and do not use a wheelchair.

T51-54: Wheelchair track athletes. Athletes in class 51-52 are affected in both lower and upper limbs. T53 athletes have fully functioning arms but have no trunk function at all, while T54 athletes have partial trunk and leg functions.

F51-58: Wheelchair field athletes. Athletes in F51-54 classes have limited shoulder, arm and hand functions and no trunk or leg function, while F54 athletes have normal function in their arms and hands. In the F55-58 classes the trunk and leg function increases.



Running speed
Time for *n* meters (s)

ROM (measured using digital inclinometer):
- Max thigh flexion and heel pull distance
- Max thigh extension
- Dorsiflexion lunge
- Backward stepping lunge

Coordination (lower limb reciprocal tapping task)
- Reciprocal unilateral tapping (RUT) 0.05 m target
- RUT 0.12 m target
- Reciprocal bilateral tapping (RBT)

60 m Maximal Sprint
- Time to 15 m (acceleration phase)
- Time between 30 – 60 m (maximal velocity phase)

Pearson correlation coefficients to evaluate relationship between outcome measures and sprint performance.

- Heel pull distance
- Maximum thigh extension (best leg)
- Maximum thigh flexion (best leg)
- Dorsiflexion lunge (best leg)

Tweedy and Vanlandewijck (2007)

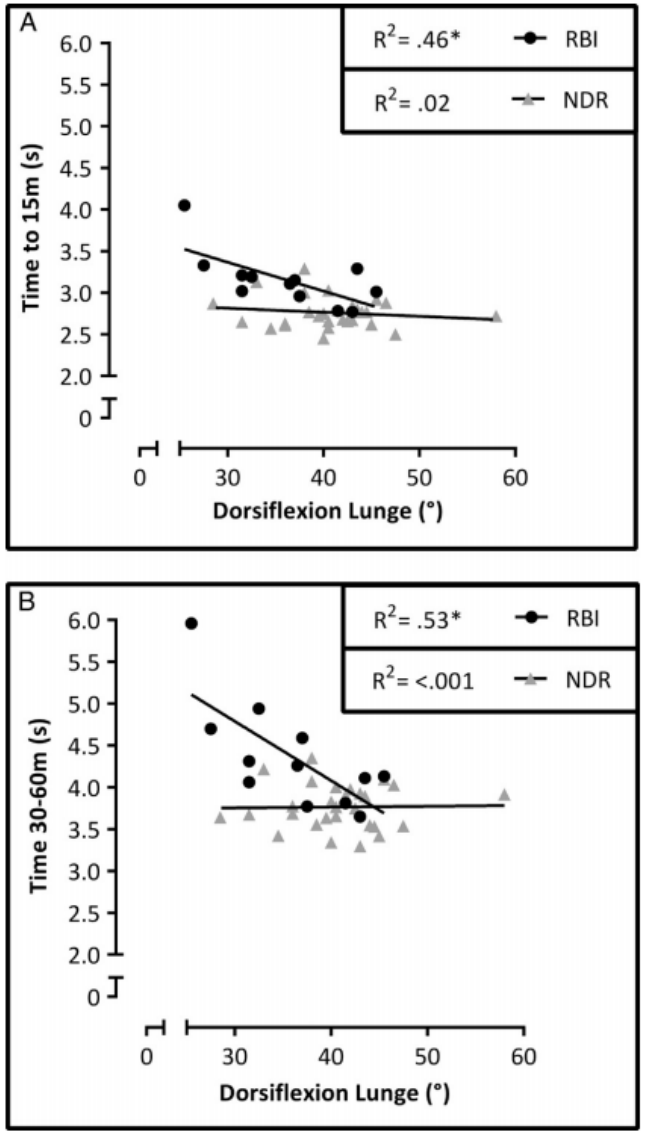


FIGURE 4—A, B, Dorsiflexion lunge versus acceleration (0–15 m) and dorsiflexion lunge versus maximal velocity (30–60 m) respectively. In each panel, the coefficient of determination (R^2) is presented on the top right of the panel for RBI and for NDR. In each case, R^2 is significant for RBI but not for NDR ($P < 0.05$).

Connick et al., 2015

ROM and coordination tests were ratio-scaled = use of inferential statistics to quantify impact on running performance

Valid measures of impairment must also be:

- Specific to eligible impairment of interest
- Reliable
- Precise
- Quantitative
- Parsimonious (account for greatest possible variance in sports performance)
- Training resistant

Project Title

The relationship between impairment, functional ability and performance in Para-Equestrian dressage riders: evidence-based recommendations for revising current Para-Equestrian Classification systems.

Project Aim:

To develop a comprehensive understanding of the effect of different physical impairment types on performance in dressage, which will inform recommendations for an evidence-based, sport-specific Classification system for Para-Equestrian dressage.

CLASSIFICATION IN PARA-DRESSAGE

1. **Grade I** –Athletes have severe Impairments affecting all limbs and trunk. The Athlete usually requires the use of a wheelchair. They may be able to walk with an unsteady gait. Trunk and balance are severely impaired.
2. **Grade II** – Athletes have either a severe Impairment of the trunk and minimal Impairment of the upper limbs or moderate Impairment of the trunk, upper and lower limbs. Most Athletes in use a wheelchair in daily life.
3. **Grade III** – Athletes have severe Impairments in both lower limbs with minimal or no Impairment of the trunk or moderate Impairment of the upper and lower limbs and trunk. Some Athletes may use a wheelchair in daily life
4. **Grade IV** - Athletes have a severe Impairment or deficiency of both upper limbs or a moderate Impairment of all four limbs or short stature. Athletes are able to walk and generally do not require a wheelchair in daily life. Also includes Athletes having a visual Impairment equivalent to B1.
5. **Grade V** -Athletes have a mild Impairment of movement or muscle strength or a deficiency of one limb or mild deficiency of two limbs. Also includes Athletes with visual Impairment equivalent to B2.

NAME:				
DIAGNOSIS: Refer to Certificate of Diagnosis for full details				
WHEELCHAIR:	No ☐	Yes ☐	*Power* ☐	*Manual* ☐
NEEDS EXTERNAL SUPPORT WHEN STANDING			No ☐	Yes ☐
SPECIFY- CRUTCHES, STICKS, AIDS				
ADDITIONAL HEALTH ISSUES				
ASTHMA	No ☐	Yes ☐	Comment:	
EPILEPSY	No ☐	Yes ☐		
SPINAL DEFORMITY	No ☐	Yes ☐		
HEARING IMPAIRMENT	No ☐	Yes ☐		
LEARNING IMPAIRMENT	No ☐	Yes ☐		
OTHER RELEVANT INFORMATION:				
VISION IMPAIRMENT	CLASS B1 TOTALLY BLIND ☐			
	CLASS B2 PARTIALLY BLIND ☐			
STATIC BALANCE	SIT	STAND	Comment:	
NORMAL	☐	☐		
SLIGHT IMPAIRMENT	☐	☐		
MODERATE IMPAIRMENT	☐	☐		
NO BALANCE	☐	☐		
DOMINANT HAND	LEFT ☐	RIGHT ☐		

Coordination Tests (1-7)	Calculated Scores		
	Left		Right
TEST 1: FINGER-NOSE BELOW SHOULDER	Maximum Score	80	40	80
TEST 2: REPETITIVE PRONATION/SUPIN.		70	60	70
TEST 3: WRIST FLEX/EXT IN MID PRON/SUP.				
TEST 4: FINGER - THUMB	FINAL SCORE	0.0	####	0.0
TEST 5: PELVIS ROCKING FORWARD/BACK		####	####	#####
TEST 6: PLACING HEEL ON FOUR SPOTS				
PLACING TOES ON FOUR SPOTS				
TEST 7: TAPPING FEET / CIRCUMDUCTION				

Notes regarding observation riding:

Athlete observed riding at this competition:	Yes ☐	No ☐	N/A ☐

	Active R.O.M for reference	POWER 0-5		RANGE 0-5		CO-ORD	
		L	R	L	R	L	R
NECK	0-20 FLEXION						
	0-20 EXTENSION						
	0-20 SIDE FLEXION						
	0-90 ROTATION						
SHOULDER	0-10 RETRACTION					TEST 1 (*7)	
	0-60 FLEXION						
	0-10 ABDUCTION						
	0-45 EXT.ROTATION						
	0-30 INT ROTATION						
ELBOW	45-90 FLEXION						
	90-45 EXTENSION						
	0-10 PRONATION					TEST 2 (*2)	
	0-10 SUPINATION						
WRIST	0-30 FLEXION					TEST 3 (*3)	
	0-60 EXTENSION						
	0-10 RADIAL DEV						
FINGERS	60-90 FLEXION					TEST 4 (*4)	
	90-60 EXTENSION						
	INTRINSICS						
THUMB	0-60 OPPOSITION						
TRUNK	0-30 THOR. FLEXION						
	0-30 THOR. EXTENS						
	0-20 SIDE FLEXION						
	0-45 ROTATION						
PELVIS	0-5 POST TILT					TEST 5 (*2)	
	0-5 ANT TILT						
HIP	0-45 FLEXION					TEST 6 (*8)	
	-45-0 EXTENSION						
	0-40 ABDUCTION						
	ADDUCTION						
	0-15 EXT. ROTATION						
	0-15 INT. ROTATION						
KNEE	0-45 FLEXION						
	45-0 EXTENSION						
	0-15 INT. ROTATION						
	0-25 EXT. ROTATION						
FOOT	0-20 DORSIFLEX					TEST 7 (*4)	
	0-20 P.FLEX						
	0-15 INT.ROTATION						
	0-15 EXT. ROTATION						

- Current athlete assessment examines
  - Balance
  - Coordination
  - Joint ROM
  - Manual Muscle Testing
  - Riding observation
- Based on work conducted in 1990 (Meaden, 1990)
- Up-to-date, scientific evidence required.
- Can we determine valid:
  - Measures of impairment?
  - Measures of performance?
  - The strength of association between measures of impairment and performance?

MEASUREMENTS OF DRESSAGE PERFORMANCE

ARTICLE 432 MARKING

1. All movements, and certain transitions from one to another, which have to be marked by the Judges, are numbered on the Judge's sheet.

2. They are marked from zero (0) to ten (10) by each Judge, zero (0) being the lowest and ten (10) the highest mark.

3. The scale of marks is as follows:

10	Excellent	7	Fairly good	4	Insufficient	1	Very bad
9	Very good	6	Satisfactory	3	Fairly bad	0	Not executed
8	Good	5	Sufficient	2	Bad		

1.	A X C	Enter in working trot Halt. Immobility. Salute. Proceed in working trot. Track left	10					Quality of pace, halt, and transitions. Straightness. Contact and poll. Bend through turn at C.	
2.	CH HXF F	Working trot Medium trot Working trot	10					Regularity and quality of trot, elasticity, engagement of hindquarters.	
3.	FA	Transitions at H and F Working trot	10					Lengthening and shortening of steps and frame, maintenance of rhythm, quality of trot.	
4.	AD D	Down the centre line Volte right (10m Ø)	10					Regularity, balance and bend through turn and in volte, size and shape of volte.	
5.	DXG G GC C	Down the centre line Volte left (10m Ø) Down the centre line Track right	10					Regularity, straightness and balance on centre line, bend and balance, size and shape of volte. Bend in turn at C,	

m and regularity)	10			1	
e to move forward, steps, suppleness of gagement of the hind	10			1	
3. Submission (attention and confidence, harmony, lightness and ease of the movements, straightness, acceptance of the bridle and lightness of the forehand)	10			2	
4. Equestrian feel and skill of the athlete. Accuracy.	10			2	
TOTAL	**340**				

VS.

PARA EQUESTRIAN DRESSAGE TEST 2018 **20x40 Arena** **GRADE III**

INDIVIDUAL TEST

Event : _____ Date : _____ Judge : _____ Position ☐

Competitor No : _____ Name : _____ NF : _____ Horse : _____

Time 5'00" (for information only) Minimum age of horse: 6 years

No	Letter	Movement	Marks	Mark	Correction	Coefficient	Final Mark	Directive Ideas	Remarks
1.	A X C	Enter in working trot Halt. Immobility. Salute. Proceed in working trot. Track left	10					Quality of pace, halt, and transitions. Straightness. Contact and poll. Bend through turn at C.	
2.	CH HXF F	Working trot Medium trot Working trot	10					Regularity and quality of trot, elasticity, engagement of hindquarters.	
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5.	DXG G GC C	Down the centre line Volte left (10m Ø) Down the centre line Track right	10					Regularity, straightness and balance on centre line, bend and balance, size and shape of volte. Bend in turn at C,	

Speed, Acceleration:

Distance:

Weight:

LINKING VALID MEASURES OF IMPAIRMENT TO MEASURES OF PERFORMANCE

1. Balance
2. Coordination
3. Range of motion
4. Strength

The scale of marks is as follows

10. Excellent	4. Insufficient
9. Very Good	3. Fairly Bad
8. Good	2. Bad
7. Fairly Good	1. Very Bad
6. Satisfactory	0. Not Performed
5. Sufficient	

Marks of .5 may be used

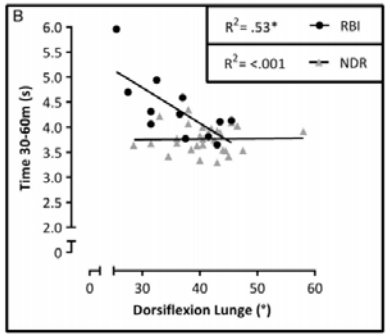
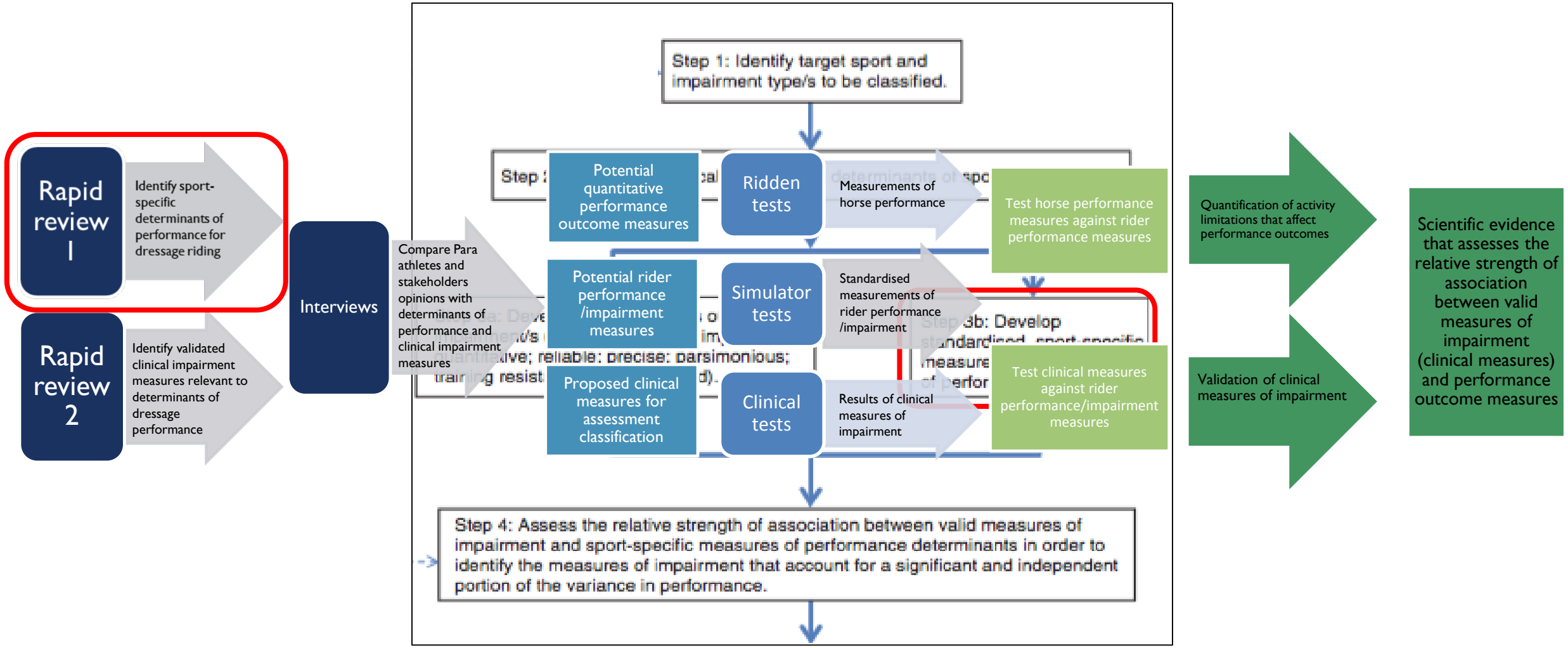
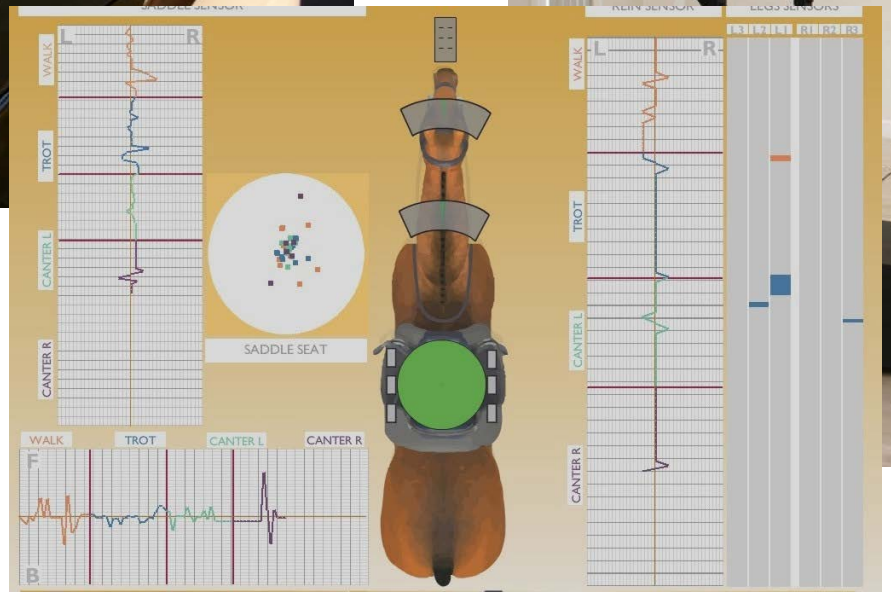


FIGURE 4—A, B, Dorsiflexion lunge versus acceleration (0–15 m) and dorsiflexion lunge versus maximal velocity (30–60 m) respectively. In each panel, the coefficient of determination (R^2) is presented on the top right of the panel for RBI and for NDR. In each case, R^2 is significant for RBI but not for NDR ($P < 0.05$).

RESEARCH PROJECT OUTLINE



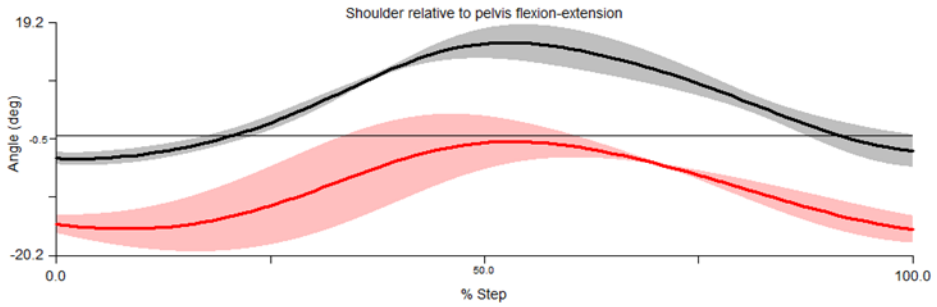
MEASUREMENTS OF RIDER PERFORMANCE



MEASUREMENTS OF RIDER PERFORMANCE

Trot = 25 deg flex-ex motion

Trunk-pelvis-horse interaction



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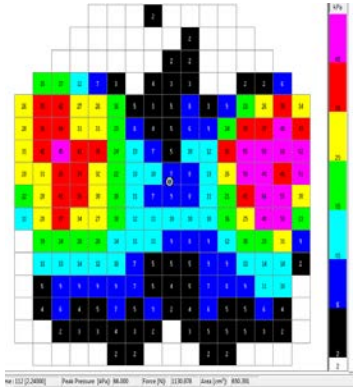
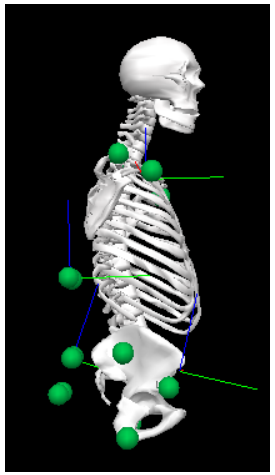
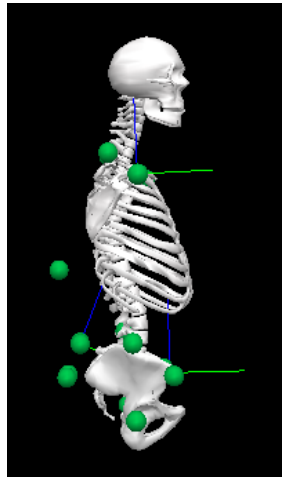






Alexander et al. (2015)

Outcome Measure	Gait/ Movement	Literature	Advanced/ Elite Rider Values	Non-rider/ beginner rider values	Performance Effect
Trunk Segment Flexion/ Extension (A/P, Pitch)	Walk	Bystrom et al. (2010)	5.95 ± 0.07		
		Lovett et al. (2005)			
	Sitting Trot	Alexander et al. (2015)	10.12 ± 4.65	9.5 ± 2.3	No sig diffs in ROM between beginner and pro, but beginner riders max and mean values showed sig more forward trunk angle than pros (Eckardt and Witte, 2016)
		Bystrom et al. (2009)			
		Eckardt et al. (2014)			
		Eckardt and Witte (2016)			
		Terada et al. (2006)			
	Posting Trot	Lovett et al. (2005)	4.1		
	Canter	Eckardt and Witte (2016)	12.55 ± 11.10	20.5 ± 5.6	No sig diffs in rom between beg and pro (Eckardt and Witte, 2016)
		Lovett et al. (2005)			

MEASUREMENT OF HORSE PERFORMANCE

- Qualitative scoring
  Judge

- Paces
- Impulsion
- Submission

Quantitative measurements

IMU sensors attached to the horse

Stride frequency, Stride duration

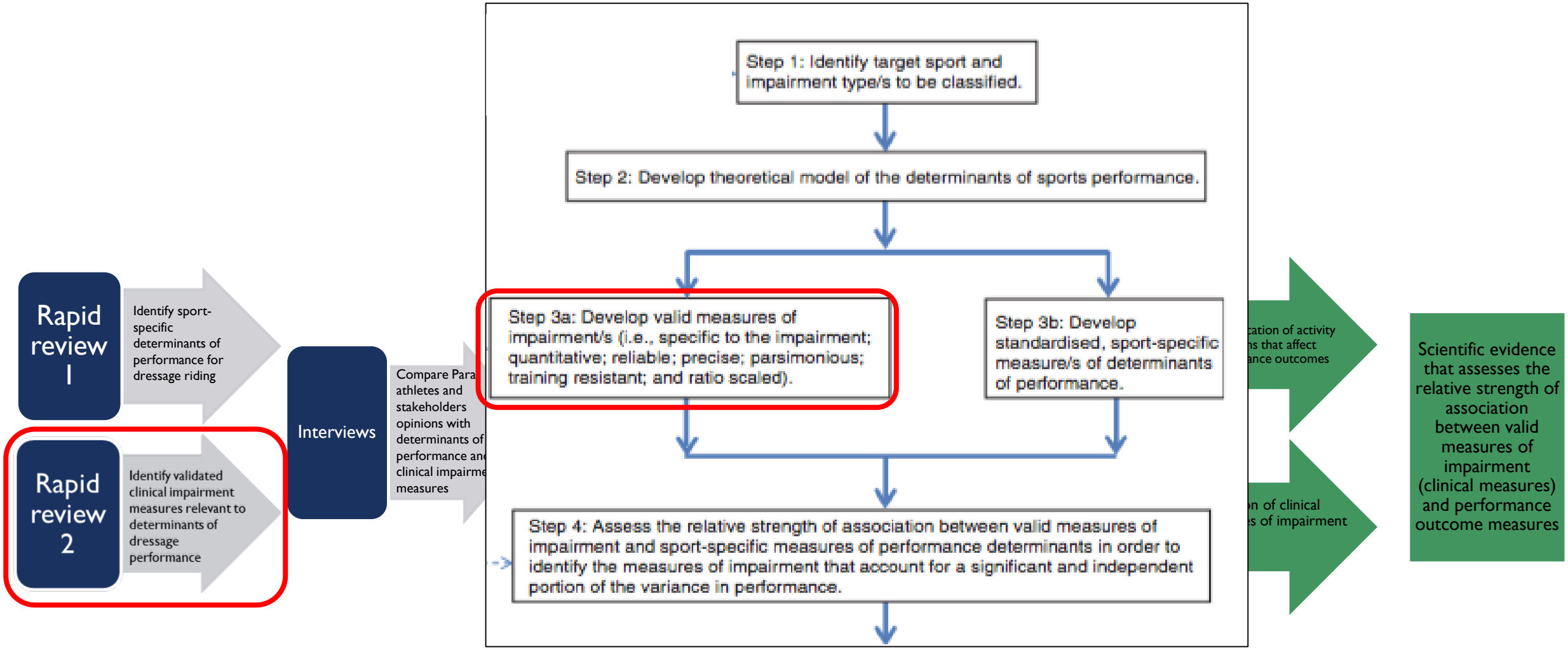
Velocity, Trunk elevation, Stride length

Accuracy of transitions & Movements

Gait/ Movement	Outcome Measure		Literature	Performance Effect Better Performers Exhibit…
Trot	Stride frequency	Temporal	Biau and Barrey (2004)	Greater
	Stride Regularity		Biau and Barrey (2004)	Greater
	Stride Symmetry		Biau and Barrey (2004)	Greater
	Vector of propulsion	Impulsion	Biau and Barrey, 2004	Increased
	Vector of breaking		Biau and Barrey, 2004	Increased
	Dorsoventral displacement (m)	Trunk Motion	Biau and Barrey, 2004	Increased
	Dorsoventral activity (g^2/ Hz)		Biau et al. (2002), Biau and Barrey (2004)	Increased

Gait/ Movement	Outcome Measure		Literature	Performance Effect Better Performers Exhibit…
Trot	Stride frequency	Temporal	Biau and Barrey (2004)	Greater
	Stride Regularity		Biau and Barrey (2004)	Greater
	Stride Symmetry		Biau and Barrey (2004)	Greater
	FL Stance Duration		Deuel and Park (1990a, b)	Shorter FL stance duration
	HL Stance Duration		Holmstrom et al. (1994), Clayton et al. (1997)	Longer HL stance duration
	Swing Duration		Deuel and Park (1990a, b)	Shorter HL and longer FL swing duration
	Diagonal Advanced Placement		Clayton et al. (1997), Holmstrom et al. (1994), Tans et al. (2009)	Positive (HL impacts first)
	Tarsal Joint Motion	Joint ROM	Holmstrom et al. 1994	Increased flexion at stance
	Tarsal Joint Angular Velocity		Holmstrom et al. 1997	faster during stance
	Stride Length	Linear	Deuel and Park (1990a, b)	Longer stride length
	Stride Velocity		Deuel and Park (1990a, b)	Faster velocity

THE RELATIONSHIP BETWEEN IMPAIRMENT, FUNCTIONAL ABILITY AND PERFORMANCE IN PARA-EQUESTRIAN DRESSAGE RIDERS: EVIDENCE-BASED RECOMMENDATIONS FOR REVISING CURRENT PARA-EQUESTRIAN CLASSIFICATION SYSTEMS.



RAPID REVIEW 2 – IMPAIRMENT MEASURES

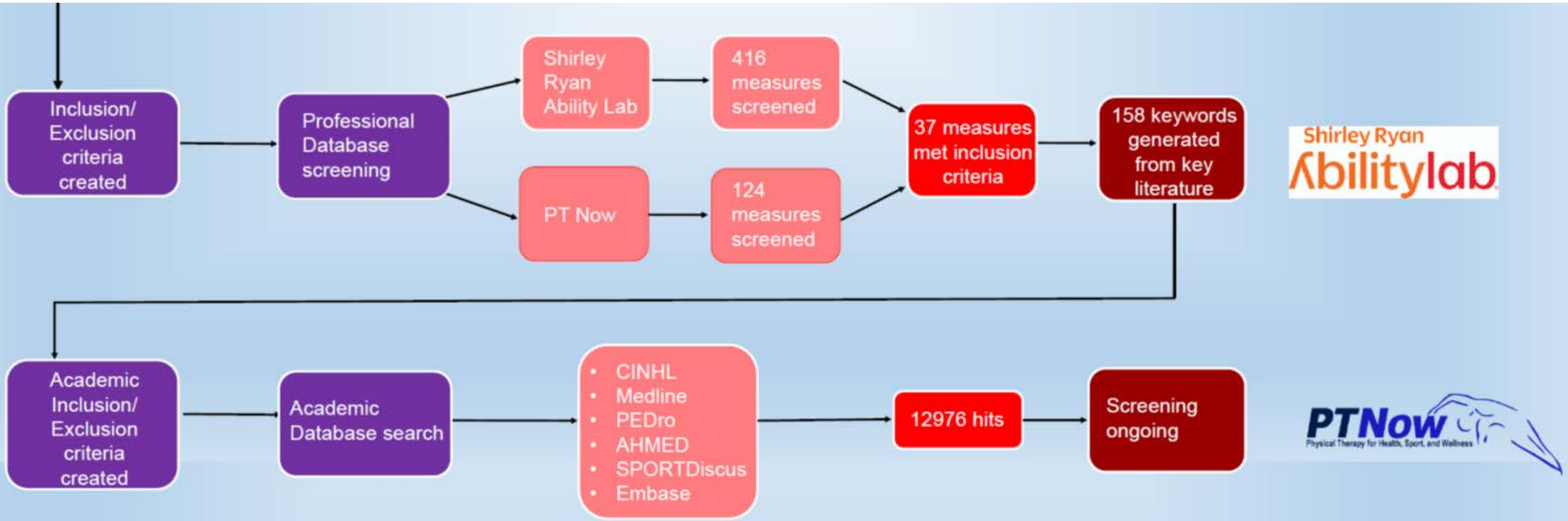
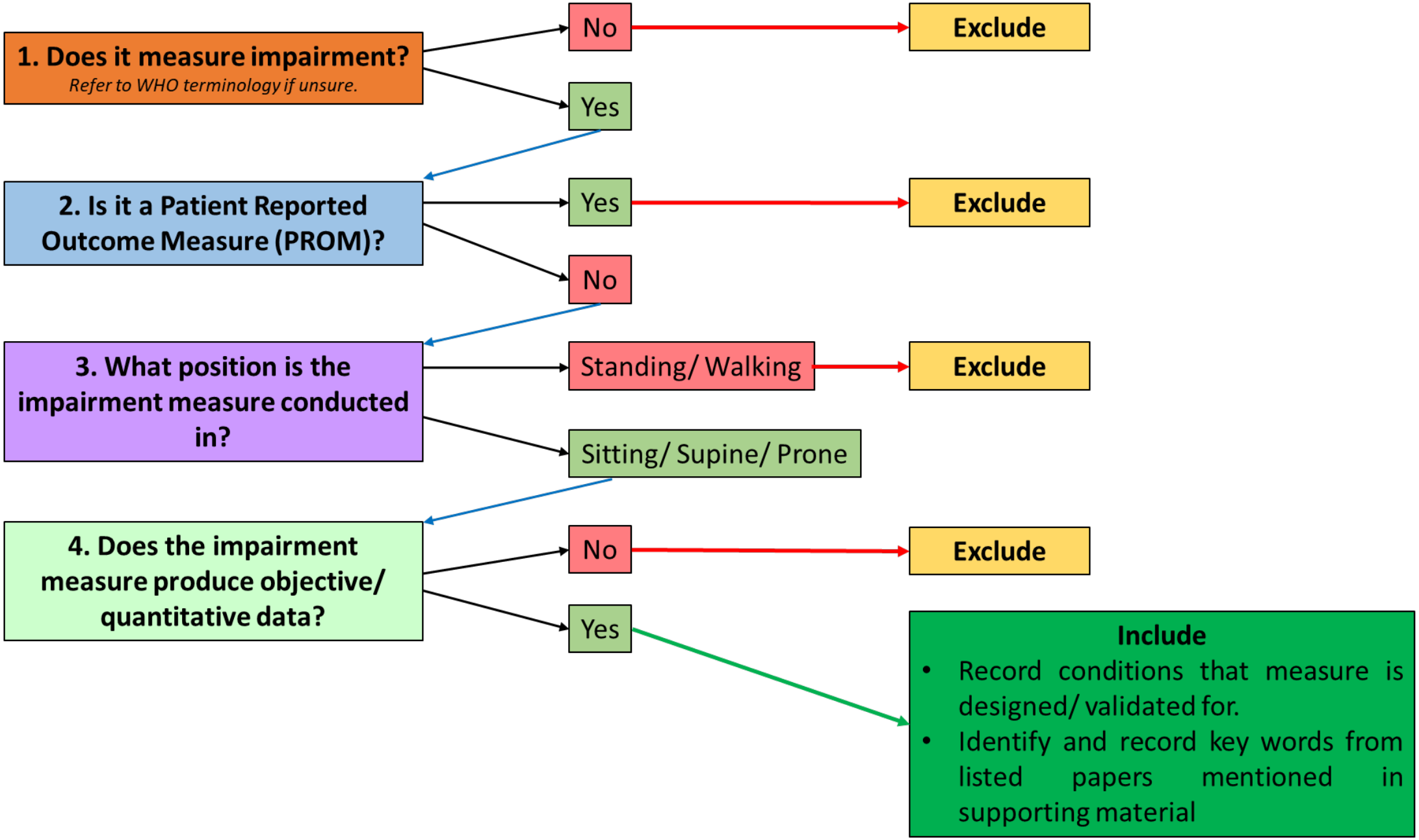


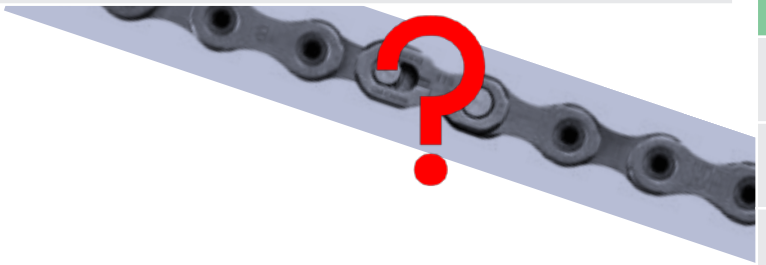
Fig 2. Flowchart illustrating the process of rapid review two


1. Does it measure impairment?
Refer to WHO terminology if unsure.
No
Exclude
Yes
2. Is it a Patient Reported Outcome Measure (PROM)?
Yes
Exclude
No
3. What position is the impairment measure conducted in?
Standing/ Walking
Exclude
Sitting/ Supine/ Prone
4. Does the impairment measure produce objective/ quantitative data?
No
Exclude
Yes
Include
• Record conditions that measure is designed/ validated for.
• Identify and record key words from listed papers mentioned in supporting material

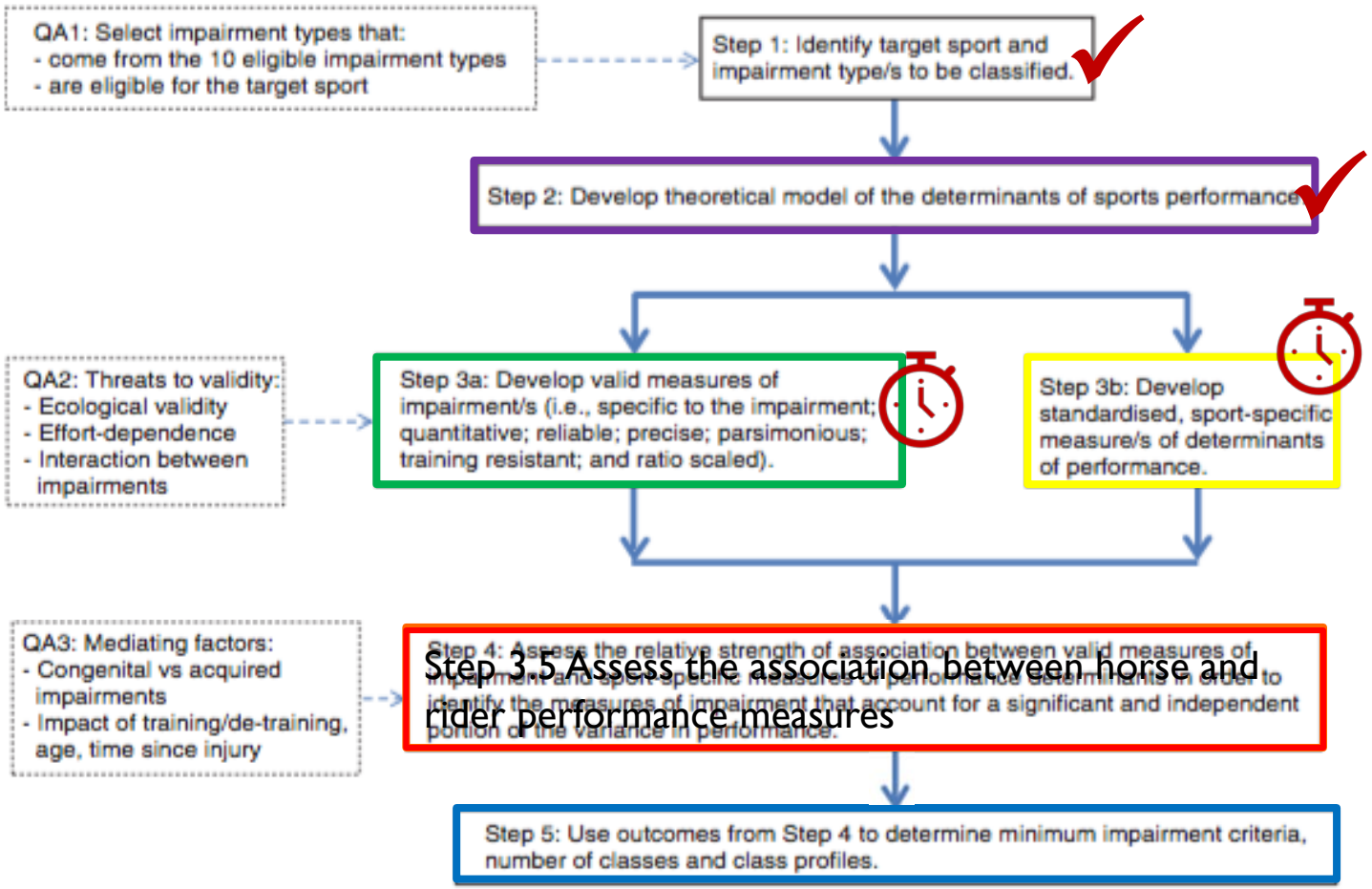
NEXT STAGES…

LINKING RIDER PERFORMANCE TO HORSE PERFORMANCE

RIDER PERFORMANCE	
Pelvic Segment A/P Tilt, Pitch	ROM not sig different between pro and beginner riders, but the pro riders had sig greater min values (pelvis tilted more forward) (Munz et al, 2014)
Pelvic Segment Lateral Flexion (M/ L, Roll)	no significant differences between pro and beginner riders (Munz et al., 2014)



HORSE PERFORMANCE	
Stride frequency	Greater in better performers
Stride Regularity	Greater in better performers
Stride Symmetry	Greater in better performers



Step 3.5 Assess the association between horse and rider performance measures

Dressage Scores

Rapid Review 2
- Trunk Impairment Scale
- Hand Held Dynamometry

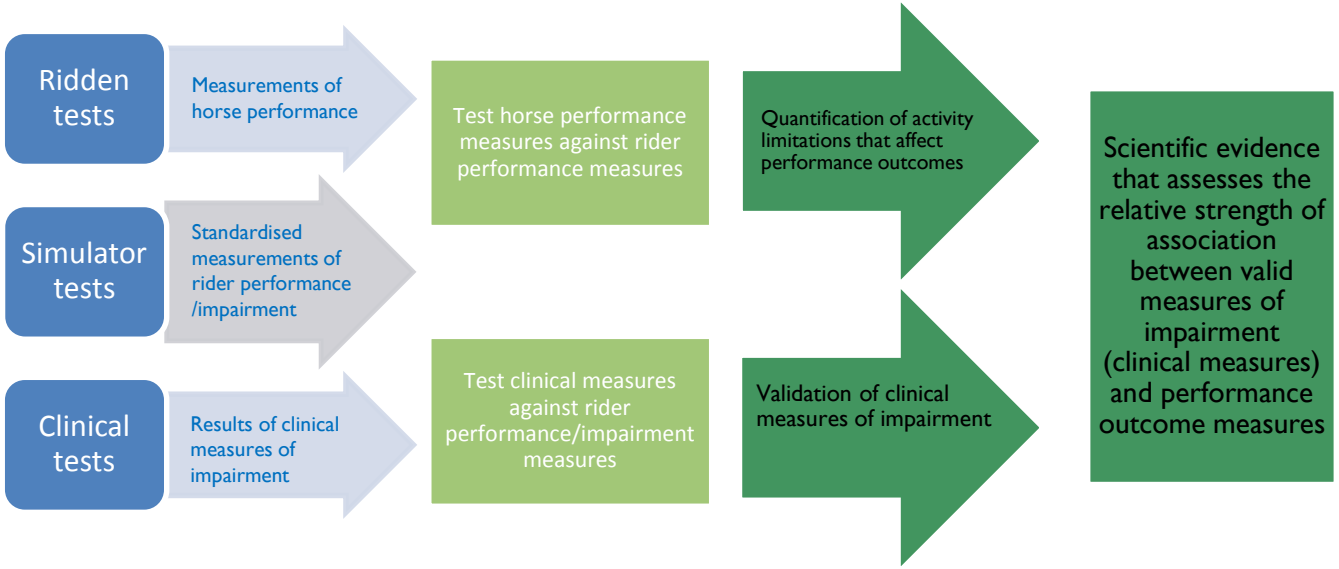
Rapid Review 1
- Horse Performance Measures
- Rider Performance Measures

Step 3.5 Assess the association between horse and rider performance measures

Year 3 – Biomechanics Study

Recommendations TBD

NEXT STEPS


Ridden tests
Measurements of horse performance
Simulator tests
Standardised measurements of rider performance /impairment
Clinical tests
Results of clinical measures of impairment
Test horse performance measures against rider performance measures
Test clinical measures against rider performance/impairment measures
Quantification of activity limitations that affect performance outcomes
Validation of clinical measures of impairment
Scientific evidence that assesses the relative strength of association between valid measures of impairment (clinical measures) and performance outcome measures

Measurements of horse performance

Standardised measurements of rider performance /impairment

Results of clinical measures of impairment

measures

LINKING RIDER PERFORMANCE TO HORSE PERFORMANCE TO MEASURES OF IMPAIRMENT

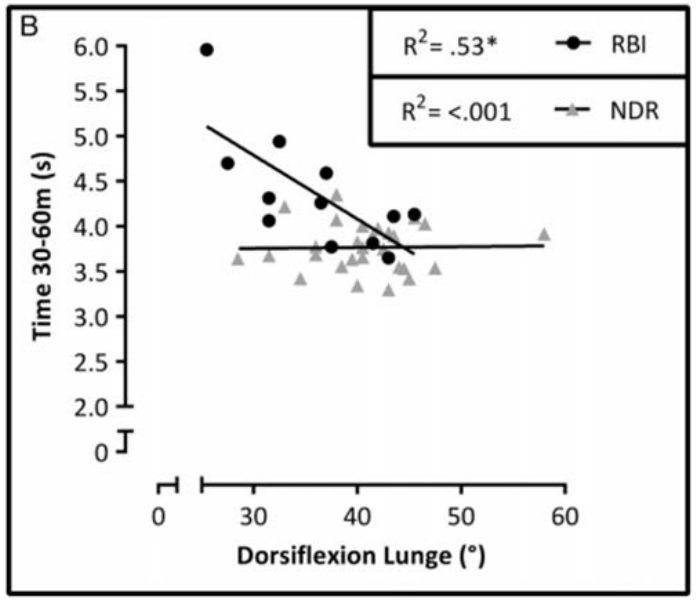


FIGURE 4—A, B, Dorsiflexion lunge versus acceleration (0–15 m) and dorsiflexion lunge versus maximal velocity (30–60 m) respectively. In each panel, the coefficient of determination (R^2) is presented on the top right of the panel for RBI and for NDR. In each case, R^2 is significant for RBI but not for NDR ($P < 0.05$).

Increased
Trunk Posterior Tilt

Increased
Trunk Strength

Performance Measure

Impairment Measure

THANK YOU

QUESTIONS?