If you are viewing this course as a recorded course after the live webinar, you can use the scroll bar at the bottom of the player window to pause and navigate the course.

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Pre-Participation Screenings
Casey Unverzagt, PT, DPT, DSc, OCS, SCS, CSCS
OMPT Fellow in Training

Who Am I?

BS: University of Puget Sound
DPT: Slippery Rock University
Sports Residency: Skyline Hospital, WA
DSc: Andrews University
OMPT Fellowship: EIM
My Practice

Slippery Rock, PA
Objectives

As a result of this course, participants will be able to:

1. Identify at least three signs of the stigmata associated with sudden cardiac death.
2. Describe a well-founded opinion on whether or not pre-participation ECG's should be required.
3. Coordinate and execute a mass pre-participation screening.
4. List at least three components of a musculoskeletal screen for the pre-participation screening.
5. Identify at least three various injury-prevention screens used in the pre-participation screening.
6. Identify at least three various sport-performance tests used in the pre-participation screening.
Pre-Participation Screening: History, Purpose & Mechanics

Cardiac Anomalies & Screening

Injury Prevention Screen

Sports Performance Testing

Purpose of PPE's

Primary Objectives

Detection of conditions that may limit participation or predispose to injury

Detect conditions that may be life threatening or disabling
Purpose of PPE’s

Secondary Objectives

Meet legal requirements:
state, local, club

Determine general health

Entry point into healthcare system

Opportunity to initiate discussion

Historically Speaking

Negative connotation

Looking to disqualify individuals

“Turn your head and cough”
Are They Successful?

AAFP
AAP
ACSM
AAOSSM
AOASM
SPTS/APTA
NATA

Preparticipation Evaluation: An Evidence-Based Review

Wingfield, Kristin MD*; Matheson, Gordon O. MD, PhD*; Meeuwisse, Willem H. MD, PhD†

Are They Successful?

Preparticipation Evaluation: An Evidence-Based Review

Wingfield, Kristin MD*; Matheson, Gordon O. MD, PhD*; Meeuwisse, Willem H. MD, PhD†

The 5 studies that assessed the format or effectiveness of the PPE concluded that it was inadequate. The format of the PPE is not standardized and does not consistently address the American Heart Association recommendations for cardiovascular screening history and physical exams. A variety of health care professionals, some without proper training, administer the PPE.


Are They Successful?

Preparticipation Evaluation: An Evidence-Based Review

A PPE is required by most sport organizations in America, but research as to its effectiveness is very limited. Very few studies in America or elsewhere have been performed on the PPE process. The research available indicates that the PPE is not implemented adequately or uniformly. An opportunity exists to create a standardized, validated PPE that meets medical standards for quality and provides sensitive, specific screening of potential participants in sport and exercise.

PPE vs. PPS

Evaluation
- Performed in office
- Cost
- 1-1
- Established rapport

Screen
- Mass participation
- Free or reduced price
- Low anxiety
- Potential for performance testing

Timing and Frequency
- >6 weeks in advance
- Collegiate
  - Initial, brief annual
- Secondary Education
  - At entry, every 2 years
### PPE/PPS Team

<table>
<thead>
<tr>
<th>MD/DO</th>
<th>Optometrist</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT</td>
<td>Dentist</td>
</tr>
<tr>
<td>ATC</td>
<td>Medical assistant</td>
</tr>
<tr>
<td>RN</td>
<td>Dietician</td>
</tr>
</tbody>
</table>

Support personnel

### Format of PPE's

- **Straight Line**
- **Space Available**
Components

- Check in station
- Vitals
- Medical history
- Musculoskeletal screening
- General medical evaluation
- Athlete fitness testing
- Special population testing/exam
- Check out station

4th Edition PPE
Check In Station

- Official Forms
  - Consent (for minors as well)
  - Medical history form
  - Insurance information
  - Permission to participate in sport
  - Emergency contact form

Vitals

- Blood pressure
- Pulse
- Respiration rate
- Body weight
- Height
- Temperature
- SpO2
Medical History

- General history
  - Previous hospitalization
  - Previous surgery
  - Previous injury status
  - Current injury status
  - OTC and rx medications

Medical History: Cardiovascular

- History of:
  - Congenital or acquired heart disease
  - Exertional chest pain or SOB
  - Exertional syncope or near-syncope
  - Unexplained fatigue
  - HTN, dysrhythmia, murmur
  - Sudden cardiac death in family <50 y/o
Medical History: Cardiovascular

• History of
  • Congenital or acquired heart disease
  • Exertional chest pain or SOB
  • Exertional syncope or near-syncope
  • Unexplained fatigue
  • HTN, dysrhythmia, murmur
  • Sudden cardiac death in family <50 y/o

Medical History: Neurologic

Head or neck injuries
  Concussions
Second impact syndrome
  Seizures
  Burners/stingers
### Medical History: Environmental

**Historical Red Flags**
- Cramping
- Syncope
- Exhaustion
- Heat stroke

### Musculoskeletal Screening

- Posture
- Scoliosis screening
- Flexibility
- AROM
- Muscle performance
- Function

<table>
<thead>
<tr>
<th>Musculoskeletal</th>
<th>Normal</th>
<th>Abnormal Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoulder/arms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip/waist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Functional</td>
<td></td>
<td>Dash walk, single-leg hop</td>
</tr>
</tbody>
</table>
### NATA 90-Second MSK Screen

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stand facing examiner</td>
<td>Acromioclavicular joints; general habitus</td>
</tr>
<tr>
<td>Look at ceiling, floor, over both shoulders, touch ears to shoulder</td>
<td>Cervical spine motion</td>
</tr>
<tr>
<td>Shrug shoulders (resistance)</td>
<td>Trapezius strength</td>
</tr>
<tr>
<td>Abduct shoulders to 90° (resistance at 90°)</td>
<td>Deltoid strength</td>
</tr>
<tr>
<td>Full external rotation of arms</td>
<td>Shoulder motion</td>
</tr>
<tr>
<td>Flex and extend elbows</td>
<td>Elbow motion</td>
</tr>
<tr>
<td>Arms at sides, elbows at 90° (flexed, pronate and supinate wrists)</td>
<td>Elbow and wrist motion</td>
</tr>
<tr>
<td>Spread fingers, make fist</td>
<td>Hand and finger motion, strength, and deformities</td>
</tr>
<tr>
<td>Tighten (contract) quadriceps; relax quadriceps</td>
<td>Symmetry and knee effusions, ankle effusion</td>
</tr>
<tr>
<td>“Deck walk” away and toward examiner</td>
<td>Hip, knee, and ankle motions</td>
</tr>
<tr>
<td>Back to examiner</td>
<td>Shoulder symmetry; scoliosis</td>
</tr>
<tr>
<td>Knees straight, touch toes</td>
<td>Scoliosis, hip motion, hamstring tightness</td>
</tr>
<tr>
<td>Raise upon toes, heels</td>
<td>Calf symmetry, leg strength</td>
</tr>
</tbody>
</table>

Conley et al., 2014

---

### Musculoskeletal Screening

[Image of a figure holding a clapperboard]
Consider a More Thorough Examination

Joint laxity
Special testing
Gait
Vestibular evaluation

General Medical Evaluation

Visual evaluation
Hearing evaluation
Dental evaluation
Heart, lungs, chest
Hernia exam
Testicular exam
**Check Out Station**

- Ensure completion of stations
- Summarize data
- Disposition of the athlete
  - By health care decision maker
  - Given to responsible person
  - Subject to HIPPA guidelines

---

**Final Verdict**

Only 4 Options
Contact Classifications

<table>
<thead>
<tr>
<th>III. High (&gt;50% MVC)</th>
<th>II. Moderate (20-50% MVC)</th>
<th>I. Low (&lt;20% MVC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bobsled/Luge, Field events (throwing), Gymnastics, Martial arts, Sailing, Sport climbing, Water skiing, Weightlifting, Windsurfing</td>
<td>Bodybuilding, Downhill skiing, Skateboarding, Snowboarding, Wrestling</td>
<td>Boxing, Cross-country skiing, Cycling, Decathlon, Rowing, Speed-skating, Triathlon</td>
</tr>
<tr>
<td>Archery, Auto racing, Diving, Equestrian, Motorcycling</td>
<td>American football, Field events (jumping), Figure skating, Rodeo, Rugby, Running (sprint), Surfing, Synchronized swimming</td>
<td>Basketball, Ice hockey, Cross-country skiing (skiing technique), Lacrosse, Running (middle distance), Swimming, Team handball</td>
</tr>
<tr>
<td>Billiards, Bowling, Cricket, Curling, Golf, Riflery</td>
<td>Baseball/Softball, Fencing, Table tennis, Volleyball</td>
<td>Badminton, Cross-country skiing (classic technique), Field hockey, Orienteering, Rowing, Squash, Running (long distance), Soccer, Tennis</td>
</tr>
</tbody>
</table>

A. Low (<40% Max O2)  B. Moderate (40-70% Max O2)  C. High (>70% Max O2)  

Increasing Dynamic Component

Legal Considerations

Athlete’s Right to Participate Liability
Logistics

Pick location and date
Assemble team
Advertise
Confirmation of participants
Completion of process: Setup, PPE, teardown
Follow-up: Stats, paperwork, gratitude

Special Populations

The disabled athlete
The female athlete
Sickle cell trait
Solitary organs
The diabetic athlete
The Olympic athlete
The Disabled Athlete

Preparticipation Physical Evaluation
THE ATHLETE WITH SPECIAL NEEDS:
SUPPLEMENTAL HISTORY FORM

Date of Exam
Name
Sex
Grade
School
Date of birth
Sport(s)

1. Type of disability:
2. Site of disability:
3. Classification (if available):
4. Cause of disability (birth defect, disease, accident, illness, other):

5. List the sports you are interested in playing:

6. Do you regularly use a brace, support, device, or prosthesis?
7. Do you use any special brace or support device for sports?
8. Do you have any teeth, pressure sores, or any other skin problems?
9. Do you have a hearing loss? Do you wear a hearing aid?
10. Do you have a visual impairment?
11. Do you use any special devices for low vision or mobility function?
12. Do you have learning or developmental disabilities?
13. Have you had previous diagnoses?
14. Have you ever been diagnosed with a heat-related (hypothermia) or cold-related (hypothermia) illness?
15. Do you have a chronic disability?

Explain “yes” answer here.

The Disabled Athlete

Preparticipation Physical Evaluation
THE ATHLETE WITH SPECIAL NEEDS:
SUPPLEMENTAL HISTORY FORM

Adrenocortical insufficiency
X-ray evaluation for atlantoaxial instability
Dislocated joints (more than one)
Easy bleeding
Enlarged spleen
Hepatitis
Osteoporosis or osteopenia
Difficulty controlling heart
Difficulty controlling bladder
Numbness or tingling in arms or hands
Numbness or tingling in legs or feet
Weakness in arms or hands
Weakness in legs or feet
Recent change in coordination
Recent change in ability to walk
Spina bifida
Latent allergy

Yes
No
The Disabled Athlete

ORIGINAL RESEARCH
THE PREPARTICIPATION EVALUATION FOR ATHLETES WITH DISABILITY

Jonathan P. Harkness, FRCP(C)
O’Gannon, R. FRCP(C)
H. Agro, FRCP(C)
H. Finlayson, FRCP(C)

WHAT ABOUT THE FEMALE ATHLETE?
The Female Athlete

CLINICAL COMMENTARY
THE NSWLE ATHLETE TRIAD—WHAT EVERY PHYSICAL THERAPIST SHOULD KNOW
Laurie Stickler, PT, DHS, OCS1
Barbara J. Hoogenboom, PT, EdD, SCS, ATC2
Lauren Smith, BS, ATC3

Prevalence in high school, collegiate & elite athletes

1 component: 16-70%
2 components: 3-27%
3 components: 0-16%

The Female Athlete

CLINICAL COMMENTARY
THE FEMALE ATHLETE TRIAD—WHAT EVERY PHYSICAL THERAPIST SHOULD KNOW
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Lauren Smith, BS, ATC3

1. Have you ever had a menstrual period?
2. How old were you when you had your first menstrual period?
3. When was your most recent menstrual period?
4. How many periods have you had in the last 12 months?
5. Are you presently taking any female hormones (estrogen, progesterone, birth control pills)?
6. Do you worry about your weight?
7. Are you trying or has anyone recommended that you gain or lose weight?
8. Are you on a special diet or do you avoid certain types of foods or food groups?
9. Have you ever had an eating disorder?
10. Have you ever had a stress fracture?
11. Have you ever been told you have low bone density (osteopenia or osteoporosis)?
Sickle Cell Trait

Prevent and manage heat exposure
Support adequate nutrition and hydration
Understand the impact of exercise intensity
Provide adequate rest
Develop and implement site-specific action plans

Solitary Organs

Single kidney
Single eye
Single testicle
Diabetic Athlete

Type I vs. II
Regular exercise key to glycemic control
Insulin management requires special attention
Pre and post exercise hypoglycemia
  Delayed-onset hypoglycemia
  Hyperglycemia and ketosis

Diabetes in Sports

**Insulin Guidelines**

Measure glucose prior to activity
<120 mg/dL: 30g CHO & 14g protein
120-180 mg/dL: 15g CHO & 7-8g protein
180-240 mg/dL: 15g CHO only
Must Have

Diabetes in Sports
Christine Shugart, MD; Jonathan Jackson and Karl B. Fields
Sports Health: A Multidisciplinary Approach 2010 2: 29
DOI: 10.1177/1941738110347974

Sports Health
A Multidisciplinary Approach

Sports

Must Have

National Athletic Trainers’ Association Position Statement: Management of the Athlete With Type 1 Diabetes Mellitus
Carolyn C. Jimenez, PhD, ATC; Matthew H. Corcoran, MD, CDE; James T. Crawley, MEd, PT, ATC; W. Guyton Hornsby, Jr, PhD, CDE; Kimberly S. Peer, EdD, LAT; Rick D. Philbin, MBA, MEd, ATC; Michael C. Riddell, PhD
National Athletic Trainers’ Association
Health Care for Life & Sport

continuedTM
The Elite Athlete

The International Olympic Committee (IOC) Consensus Statement on Periodic Health Evaluation of Elite Athletes
March 2009

Pre-Participation Screening: History, Purpose & Mechanics

Cardiac Anomalies & Screening

Injury Prevention Screen

Sports Performance Testing
Cardiac Anomalies & Screening

Background
Sudden Cardiac Death
Cardiac Anomalies
Cardiac Screening
ECG Controversy

Piermario Morosini: 2012

Age: 25
Soccer
Italy
Miklos Fehrer: 2004

Age: 24
Soccer
Portugal

Claire Crawford: 2016

Age: 16
Volleyball
Georgia
Fabrice Muamba: 2012

Age: 23
Soccer
England

Scope of Problem

10-12 million young athletes
Protect their safety
Honesty
SCD in the News

- Darryl Kyle – St Louis Cardinals  
  - 2002
- Hank Gathers – Loyola Marymount  
  - 1990
- Flo Hyman – US Olympic Volleyball  
  - 1986
- Jim Fixx – Runner and Fitness guru  
  - 1984
- “Pistol” Pete Maravich – NBA Star  
  - 1988

Consider Watching

ESPN 30 for 30
Guro of Go

https://www.youtube.com/watch?v=vcD5UXfr1Y
Incidence

Four cases per one million athletes
~25x/year in athletes <30
Significant cause of sports-related deaths in US across all ages

Incidence

High school athletes:
1 in 150,000

Collegiate athletes:
1 in 65,000

Masters athletes:
1 in 25,000
Epidemiology

90% SCD in males

More common with dynamic aerobic exercise:
- Hockey, football,
- basketball, squash,
- triathlons, running

AA>Caucasians
**Exercise & the Heart**

- Increased cardiac output
- Raises HR and stroke volume
- High systolic BP
- Decreased peripheral vascular resistance

**Sudden Cardiac Death**

- Electrical disturbances in the heart causes arrest or arrhythmia
- With or without external trauma
- Typically without warning
- Can have prodromal signs
- Death <1 hour
Sudden Cardiac Death, <35 years old

Usually structural CVD

Most likely:
1) Hypertrophic cardiomyopathy
2) Coronary artery anomaly
3) Commotio cordis

Causes of SCD

Data compiled from American Heart Association
Hypertrophic Cardiomyopathy (HCM)
Coronary Artery Anomalies
Commotio Cordis
Myocarditis
ARVC
HCM

Typically inherited as autosomal dominant gene

Over 100 individual genetic defects can result in the condition

60% of people have affected first-degree relative

Marfan's Syndrome

Fibrillin gene defect

Alters connective tissues throughout body

Leads to ruptured aortic aneurysm

Skeletal, ocular, cardiovascular changes
Marfan’s: Skeletal

- Tall stature
- Thin
- Arm span exceeding height
- Pectus excavatum
- Joint hypermobility
- Scoliosis

Skeletal Hypermobility
**Marfan's: Ocular**

- Myopia
- Chromic myopia
- Ectopia lentis (upward)
- Retinal detachment
- Hypoplasia of dilator muscle
- Flat cornea

---

**Marfan's: Cardiovascular Changes**

- Aortic distension
- Mitral valve prolapse
- Aortic or mitral regurgitation
- Dysrhythmias
Marfan's: Abraham Lincoln

2010 Revised Ghent Nosology

**In the Absence of Family History**

1. Aortic Root Dilatation Z score ≥ 2 AND Ectopia Lentis
2. Aortic Root Dilatation Z score ≥ 2 AND FBN1
3. Aortic Root Dilatation Z score ≥ 2 AND Systemic Score ≥ 7pts
4. Ectopia lentis AND FBN1 with known Aortic Root Dilatation

**In the Presence of Family History**

1. Ectopia lentis AND Family History of Marfan syndrome (as defined above)
2. A systemic score ≥ 7 points AND Family History of Marfan syndrome (as defined above)
3. Aortic Root Dilatation Z score ≥ 2 above 20 yrs. old, ≥ 3 below 20 yrs. old) + Family History of Marfan syndrome (as defined above)
Myocarditis

Inflammatory process of the myocardium

Typically from echovirus, adenovirus, influenza

Dyspnea, orthopnea

Exercise intolerance

Tachycardia

Diarrhea, malaise, myalgia

Persistent and productive cough

Myocarditis

Diagnosed with percutaneous endomyocardial biopsy

Chest x-ray

Treatment: rest, steroids, NSAID’s

Heart transplant in severe cases

Death from ventricular arrhythmia
Myocarditis: Make it Real

With a common cold, flu, or sinus infection, should an athlete continue to exercise?
Commotio Cordis

13-year-old Little Leaguer Hayden Walton dies after being hit in the chest with ball

Commotio Cordis

Anatomically normal heart
Males>females
Mean age 13.6 years
80% blow from projective
20% hit from another player
Timing, not force
Commotio Cordis: Survival Rates

- Decreased
- Survivors
Prevention

Consider chest protection
Age appropriate baseballs
Train EMR’s
Have AED accessible

Potential Cause?
**Congenital Coronary Artery Anomalies**

Abnormal artery is compressed as the ascending aorta dilates with exercise

- Blood flow to the heart is limited
- Hypoperfusion of myocardium occurs and is primary cause of death
- Early symptoms include fatigue, exercise-induced syncope, chest pain

Pistol Pete

**SCD in >35 years old**

- Coronary heart disease: >75% of the time
- Factors: smoking, HTN, obesity, high cholesterol, inactivity, DM
What can We Do?

Knowledge is Power

The more you know, the more you look for.
AHA 12 Point Screen

9 Vital Questions

1. Have you ever passed out or nearly passed out during exercise?
2. Have you ever passed out or nearly passed out after exercise?
3. Have you ever had discomfort, pain, or pressure in your chest during exercise?
4. Does your heart race or skip beats during exercise?
5. Has a doctor ever told you that you have a heart murmur?
6. Has a doctor ever ordered a test for your heart (for example, EKG, ECG)?
7. Has anyone in your family died for no apparent reason?
8. Does anyone in your family have a heart problem?
9. Has any family member or relative died of heart problems or of sudden death before age 50?
Physical Exam: Stigmata

Tall, thin build
Long arms, leg, fingers
Flexible joints (Beighton signs)
Scoliosis
Pectus excavatum or carinatum
High palate, small jaw
Crowded teeth
Flat feet
Stretch marks
Ocular lens dislocation
Nearsightedness, blurred vision
Corneal flatness, strabismus, exo or endotropia

Return to Play Options

No participation in any sport

Modified participation

Participation after further testing or treatment

Full, unlimited participation
Energy Drinks???
Energy Drinks

Viewpoint

Energy Drink Overconsumption in Adolescents: Implications for Arrhythmias and Other Cardiovascular Events

Fabian Sanchis-Gomar, PhD, MD,a Helios Pareja-Galeano, PhD,b Gianfranco Cervellin, MD,c Giuseppe Lippi, MD,c and Conrad P. Earnest, PhDd

Table 1. Possible manifestations of energy drink abuse in adolescents

- Tachycardia
- Atrial fibrillation or flutter
- Ventricular arrhythmias
- QT prolongation
- ST-segment elevation
- Increased anxiety and depression
- Dizziness
- Sleeplessness
- Shortness of breath
- Loss of control and a feeling of imminent death
- Development of uncontrollable phobias and fears
- Increased plasma aggregation
- Decreased endothelial function
- Myocardial infarction
- Hemodynamic failure
- Syncope
- Sudden cardiac death
- Cumulative cardiovascular load
- Cerebral blood flow reduction

Preventative ECG Testing: Should We Do It?

continued
What We Know

The natural history and absolute risk of conditions associated with SCA/D in athletes identified with a cardiac disorder during screening is largely unknown with limited outcomes-based evidence.

Exercise is a known trigger and can unmask occult cardiac disease to precipitate SCA/D.

Athletes display a differential risk for SCA/D based on age, sex, race, sport, and level of play.

The ECG increases early detection of some cardiac disorders associated with SCA/D.

Drezner et al, 2016

What We Know

The current PPE history and physical examination, although pragmatic and widely practiced, is limited in its ability to identify athletes with conditions at risk for SCA/D.

Drezner et al, 2016
The Problem

Electrocardiogram interpretation accuracy and reliability are challenges with the principal concern of adding false-positive results to the PPE screening process.

Results from centers with considerable experience in athlete ECG screening have demonstrated improved detection of cardiac conditions with potential risk for SCA/D and decreased false-positive rates.

Associated costs of performing prophylactic ECG’s is insurmountable

Drezner et al, 2016

Arguments For & Against ECG’s
Arguments For & Against ECG’s

Italian ECG’s during PPE for competitive athletes…
• is mandated by law
• includes a 12-lead ECG both at rest and after a submaximal, 3-minute exercise step test
• is only performed by fully certified Sports Medicine Physicians

Roberts et al., 2014

Arguments For & Against ECG’s

Pre-participation screening of student athletes for cardiovascular disease using a single, appropriately interpreted ECG and cardiovascular focused history and physical examination reduces sudden cardiac death and has an acceptable cost-effectiveness ratio of $76,000 per life year saved as compared with a strategy of no screening.

Wheeler et al., 2010
Arguments For & Against ECG’s

• In contrast to the Italian experience, Israel implemented a similar mandatory ECG screening program, but has not reported any reduction in SCD
• ECG screening was instituted by legislative action possibly as a response to a cluster of athlete deaths and not by data-driven decision making.

FALSE POSITIVE TEST

Roberts et al., 2014

Arguments For & Against ECG’s

“A mathematical modeling of population risk and benefit using the Italian data applied to the UK athlete population concluded that a required ECG would be of more harm than benefit from a public health perspective, with a small impact on population health and a potentially great cost to athletes with unnecessary restriction of activity due to false positive findings. The end result of the analysis demonstrated that preventing 1 SCD each year would exclude nearly 800 athletes from competition.”

FALSE POSITIVE TEST

Roberts et al., 2014
Consensus Verdict

We have insufficient evidence on whether to perform ECG screening in all athletes. Cost, iatrogenic complications, and unnecessary activity restrictions due to false positive findings must be considered when deciding on mandated ECG screening.

The ECG may be important in specific populations that have an evidence base to show increased risk and should be a part of the exam for anyone with truly positive responses and supporting history to the risk-based cardiac screening questions.

Roberts et al., 2014

Key Resources

AMSSM Position Statement on Cardiovascular Preparticipation Screening in Athletes: Current Evidence, Knowledge Gaps, Recommendations, and Future Directions

The absence of definitive outcomes-based evidence at this time precludes AMSSM from endorsing any single or universal CV screening strategy for all athletes including legislative mandates. This statement presents a new paradigm to assist the individual physician in assessing the most appropriate CV screening strategy unique to their athlete population, community needs, and resources.

Drezner et al, 2016
Future Resources

Inter-Association Task Force Recommendations on Emergency Preparedness and Management of Sudden Cardiac Arrest in High School and College Athletic Programs: A Consensus Statement

Jonathan A. Drezner, MD,* Ron W. Courson, ATC, PT;† William O. Roberts, MD,‡
Vincent N. Mosesso, Jr, MD.§ Mark S. Link, MD,¶ and Barry J. Maron, MD∥

Pre-Participation Screening: History, Purpose & Mechanics

Cardiac Anomalies & Screening

Injury Prevention Screen

Sports Performance Testing
The Crux of It

Remember the Purpose?

Detection of conditions that may limit participation or predispose to injury

Detect conditions that may be life threatening or disabling

When Would I Do This?

Sports teams
Extra fee for service
Sufficient staff, space, equipment
What Are My Options?

Y Balance Test

Functional Movement Screen (FMS)

Closed Kinetic Chain Dorsiflexion Test

Tuck Jump Assessment

Landing Error Scoring System (LESS)

Move2Perform

Y Balance Test

Star Excursion Balance Test
Y Balance Test

Anterior
Posteromedial
Posterolateral

Y Balance Test
**Y Balance Test**

![Score Sheet for Y Balance Test & Limb Length]

**Functional Movement Screen**

Screen

7 Different Movements

Scored 0-3

Top score of 21

3 “clearing movements”

Gray Cook & Lee Burton
Functional Movement Screen

Underlying assumptions
   Concept
   Target population

WHAT IS FMS?

Functional Movement Screen: Optimal Performance Pyramid

BUFFER ZONE

Functional Skill

Functional Performance

Functional Movement

BUFFER ZONE
1: Deep Squat
2: Hurdle Step
3: In Line Lunge
4: Shoulder Mobility

4: Shoulder Mobility
4: Shoulder Mobility Clearing Test

5: Active Straight Leg Raise
5: Active Straight Leg Raise

6: Trunk Stability Pushup
6: Trunk Stability Pushup

6: Trunk Stability Pushup Clearing Test
7: Rotary Stability

[Images of exercises]

7: Rotary Stability

[Images of exercises]
### 7: Rotary Stability Clearing Test

![Image](image.png)

### Client One

<table>
<thead>
<tr>
<th>TEST</th>
<th>RAW SC</th>
<th>FINAL</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
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Does it Really Work to Predict Injuries?

**Purpose:** to determine the relationship between professional football players’ score on the FMS and the likelihood of serious injury

**ORIGINAL RESEARCH**

**CAN SERIOUS INJURY IN PROFESSIONAL FOOTBALL BE PREDICTED BY A PRESEASON FUNCTIONAL MOVEMENT SCREEN?**

Kyle Kiesel, PT, PhD, ATC, CSCS
Phillip J. Plekoe, PT, DSc, OCS, ATC
Michael L. Voight, PT, D1Fsc, OCS, SCS, ATC
The Magic Number

\[ \leq 14 \]

Specificity: 0.91
Sensitivity: 0.54
Odds ratio 11.67
Positive Likelihood Ratio: 5.92
Negative Likelihood Ratio: 0.51

Is There An Application Besides Football?

Purpose: determine if compensatory movement patterns predispose female college athletes to injury, and if a FMS tool can be used to predict injuries in this population
38 NCAA Division II Athletes

**Results**

A lower score on the FMS™ was significantly associated with injury, with 69% of those scoring 14 or less sustaining an injury, and experiencing a 4-fold increase in injury risk.
More Than Meets the Eye

Evaluation of the Functional Movement Screen as an Injury Prediction Tool Among Active Adult Populations: A Systematic Review and Meta-analysis

<table>
<thead>
<tr>
<th>Study</th>
<th>True Positives, n</th>
<th>False Positives, n</th>
<th>False Negatives, n</th>
<th>True Negatives, n</th>
<th>Sensitivity, %</th>
<th>Specificity, %</th>
<th>Positive Predictive Value, %</th>
<th>Negative Predictive Value, %</th>
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<tr>
<td>Kiesel et al.</td>
<td>7</td>
<td>6</td>
<td>3</td>
<td>30</td>
<td>53.8</td>
<td>90.9</td>
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<td>Chorba et al.</td>
<td>11</td>
<td>8</td>
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<td>O’Connor et al.</td>
<td>42</td>
<td>228</td>
<td>51</td>
<td>553</td>
<td>15.6</td>
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<td>Peate et al.</td>
<td>43</td>
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<td>Shojaedin et al.</td>
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<tr>
<td>Kiesel et al.</td>
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<td>85.7</td>
<td>42.8</td>
<td>72.5</td>
</tr>
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</table>

*Six studies included 1729 cases.

Dorrel et al., 2015: *Sports Health*
Closed Kinetic Chain Dorsiflexion Test (CKC-DF)

<9-10cm abnormal

Tibial shaft angle <35-38 degrees abnormal

Predictive of injury in cricket and soccer

Common compensatory strategies?
Tuck Jump Assessment

10 seconds
10 errors (Yes/No)
Maximum effort
Reliability (inter/intra)
Tuck Jump Assessment

Landing Error Scoring System (LESS)

Drop height: 30 cm
Horizontal distance: 50% body height
Jump for maximum vertical height after landing
Focus on initial landing and max knee flexion
Quantify the number of movement errors
The Landing Error Scoring System as a Screening Tool for an Anterior Cruciate Ligament Injury–Prevention Program in Elite-Youth Soccer Athletes

1. Knee Flexion @ Initial Contact: > 30 degrees
   - Yes (0)
   - No (+1)

2. Knee Varus @ Initial Contact: Knees over midfoot
   - Yes (0)
   - No (+1)

3. Hip Flexion @ Initial Contact: Hips are flexed
   - Yes (0)
   - No (+1)

4. Trunk Flexion @ Initial Contact: Trunk is flexed
   - Yes (0)
   - No (+1)

5. Lateral Trunk Flexion @ Initial Contact: Trunk is vertical
   - Lateral deviation of sternum over hips (+1)

6. Ankle Plantar Flexion @ Initial Contact: Yoke to meet
   - Yes (0)
   - No (+1)

7. Foot Position @ Initial Contact: Toes > 30 of ER
   - Yes (+1)
   - No (0)

8. Foot Position @ Initial Contact: Toes > 30 of IR
   - Yes (+1)
   - No (0)

9. Stance Width @ Initial Contact: < Shoulder width
   - Yes (+1)
   - No (0)

10. Stance Width @ Initial Contact: > Shoulder width
    - Yes (+1)
    - No (0)

11. Initial Foot Contact: Symmetric
    - Yes (+1)
    - No (0)

12. Knee Flexion Displacement: > 45 degrees
    - Yes (+1)
    - No (0)

13. Knee Valgus Displacement: > great toe
    - Yes (+1)
    - No (0)

14. Hip Flexion Displacement: Hips flex more than at initial contact
    - Yes (+1)
    - No (0)

15. Trunk Flexion Displacement: Trunk flexes more than at initial contact
    - Yes (+1)
    - No (0)

16. Joint Displacement (Sagittal Plane)
    - Soft (0)
    - Average (+1)
    - Stiff (+2)

17. Overall Impression
    - Excellent (0)
    - Average (+1)
    - Poor (+2)

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Pauda et al., 2015  161

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162
<table>
<thead>
<tr>
<th>Landing Error Scoring System (LESS)</th>
<th>Operational Definition of Error</th>
<th>Scoring</th>
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<tbody>
<tr>
<td>Knee Flexion: Initial Contact</td>
<td>The knee is flexed less than 30° at initial contact.</td>
<td>0 = Absent</td>
</tr>
<tr>
<td>Hip Flexion: Initial Contact</td>
<td>The thigh is in line with the trunk at initial contact.</td>
<td>1 = Present</td>
</tr>
<tr>
<td>Trunk Flexion: Initial Contact</td>
<td>The trunk is vertical or extended on the hips at initial contact.</td>
<td>0 = Absent</td>
</tr>
<tr>
<td>Ankle Planter Flexion: Initial Contact</td>
<td>The foot lands heel to toe or with a flat foot at initial contact.</td>
<td>1 = Present</td>
</tr>
<tr>
<td>Medial Knee Position: Initial Contact</td>
<td>The center of the patella is medial to the midfoot at initial contact.</td>
<td>0 = Absent</td>
</tr>
<tr>
<td>Lateral Trunk Flexion: Initial Contact</td>
<td>The midline of the trunk is flexed to the left or the right side of the body at initial contact.</td>
<td>1 = Present</td>
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<tr>
<td>Stance Width: Wide</td>
<td>The feet are positioned greater than shoulder width apart (acromion processes) at initial contact.</td>
<td>0 = Absent</td>
</tr>
<tr>
<td>Stance Width: Narrow</td>
<td>The feet are positioned less than shoulder width apart (acromion processes) at initial contact.</td>
<td>1 = Present</td>
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<td>Foot Position: External Rotation</td>
<td>The foot is externally rotated more than 30° between initial contact and maximum knee flexion.</td>
<td>0 = Absent</td>
</tr>
<tr>
<td>Foot Position: Internal Rotation</td>
<td>The foot is internally rotated more than 30° between initial contact and maximum knee flexion.</td>
<td>1 = Present</td>
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<tr>
<td>Symmetric Initial Foot Contact</td>
<td>One foot lands before the other foot or 1 toe lands heel to toe and the other foot lands toe to heel.</td>
<td>0 = Absent</td>
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<tr>
<td>Knee Flexion Displacement</td>
<td>The knee flexes less than 45° between initial contact and maximum knee flexion.</td>
<td>1 = Present</td>
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<tr>
<td>Hip Flexion Displacement</td>
<td>The thigh does not flex more on the trunk between initial contact and maximum knee flexion.</td>
<td>0 = Absent</td>
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<tr>
<td>Trunk Flexion Displacement</td>
<td>The trunk does not flex more between initial contact and maximum knee flexion.</td>
<td>1 = Present</td>
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<tr>
<td>Medial-Knee Displacement</td>
<td>At the point of maximum medial knee position, the center of the patella is medial to the midfoot.</td>
<td>0 = Absent</td>
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<tr>
<td>Joint Displacement</td>
<td>Soft: the participant demonstrates a large amount of trunk, hip, and knee displacement.</td>
<td>0 = Soft</td>
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<tr>
<td>Overall Impression</td>
<td>Average: the participant shows some, but not a large amount of, trunk, hip, and knee displacement.</td>
<td>1 = Average</td>
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<tr>
<td></td>
<td>Stiff: the participant goes through very little if any, trunk, hip, and knee displacement.</td>
<td>2 = Stiff</td>
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<td>Excellent: the participant displays a soft landing with no frontal-plane or transverse-plane motion.</td>
<td>0 = Excellent</td>
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<td>Average: all other landings.</td>
<td>1 = Average</td>
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<td>Poor: the participant displays large frontal-plane or transverse-plane motion, or the participant displays a stiff landing with some frontal-plane or transverse-plane motion.</td>
<td>2 = Poor</td>
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</table>
Pre-Participation Screening: History, Purpose & Mechanics

Cardiac Anomalies & Screening

Injury Prevention Screen

Sports Performance Testing

**Sports Performance Testing**

**Agility**
- T Test
- Pro Agility Test
- Lower Extremity Functional Test

**Power**
- 1-RM
- Broad Jump
- Vertical Jump
- Medicine Ball Throw

**Max Aerobic Test**
- Bruce Treadmill
- Balk Treadmill
- PACER Test
- 1.5 mile run

**Submax Aerobic Test**
- Harvard Step Test
- 12-Minute Run
- Modified Bruce Treadmill
Pro-Agility Test

Line 2

Line 1

TIMER

START

FINISH

5 yards

5 yards
Lower Extremity Functional Test (LEFT)

9.14m “North to South”
3.03m “East to West”
Thank You!

Casey Unverzagt, PT, DPT, DSc, OCS, SCS, CSCS
OMPT Fellow in Training
caseyunverzagt@yahoo.com

References: PPE

References: Cardiac


References: Injury Prevention