Objectives:
· Identify the sports PT role in the evaluation and treatment of athletes utilizing Olympic and powerlifting in training
· Discuss epidemiology of injuries seen in relation to weight training
· Apply a strategy to identify faulty lifting mechanics and movement dysfunction with use of video analysis and efficient clinical evaluation.
· Review Olympic lifting and powerlifting performance and learn to incorporate corrective exercise to improve technique.

Role of sports PT:
· Overall growth of crossfit affiliates: 15,500+ affiliates worldwide (est as of 2017)
· Overall growth of barbell clubs: 26,000+ current members of USAW
· Increasing use of Olympic lifts in high school and collegiate weight rooms
· With this growth there is an overall need for a better understanding in the PT realm of the demands of the sport

Use of resistance training in sports performance
· Bolger et al 2015 concluded resistance training including squats improved sprinting performance
· Harries et al 2012 concluded resistance training in adolescents improved muscular power

Epidemiology of injuries:
- Injury rates for Crossfit participants average 2.3/1000 hours trained
- Injury rates for powerlifting average 1.0-4.4/1000 hours trained
- Injury rates for Olympic lifting average 2.4-3.3/1000 hours trained
- Most common sites of injury are low back, shoulder, knee
- Injuries are commonly strains of muscle or tendon
- Risk factors in adolescents include: Improper supervision and technique coaching, high volume/load (poor programming), inadequate recuperation.
- Risk factors for injury in Crossfit include: higher weekly training volumes, competitions, and increased height/body mass (most likely due to higher training loads)

Examination of the strength athlete:
· Regional interdependence: the concept that seemingly unrelated impairments in a remote anatomical region may contribute to, or be associated with, the patient’s primary complaint. (Wainner 2001)
· This highlights the need for a head to toe evaluation with these athletes
· Utilization of the SFMA for a uniform assessment of our athletes
Demands for Performance

- Focus on current theory and strategies and in the weight room

Overview of Power Lifting

- Considered to be most beneficial for developing muscle strength
- High force, low velocity (Hoffman et al., 2008)
- Can improve muscular strength and decrease severity and incidence of sports injuries in children (Chaouachi et al., 2014)

Barbell Squat Variations

- Movement and mobility requirements
  - Ankle
  - Knee
  - Hip
- Depth requirements
  - High Bar
  - More upright posture
  - Low Bar
  - Forward trunk lean
  - Common for competition

Traditional Deadlift

- Uses and mobility requirements
- Variations in mobility and strength requirements
  - Traditional deadlift
  - Sumo deadlift
  - Romanian deadlift
  - Stiff-legged deadlift
  - Comparison between barbell squat and traditional deadlift (Hales et al., 2009)
  - The individual lifts are markedly different, no specific or direct cross-over effect

Barbell Bench Press

- Requirements and theory

Overview of Olympic Weight Lifting

- Considered to be specific to sports performance
- Involving large muscle mass
- Explosive, multi-joint movements
- Fast movement velocity
- Speed intention
- High force, high velocity
- Strength, power, and speed

Power Lifting and Olympic Lifting for Sports Performance in the Research

- Olympic Lifting vs Power Lifting
  - Vertical jump: Olympic lifting > Power Lifting (Hoffman et al., 2004)
  - No significant difference in vertical jump improvement between the Olympic lifting and power lifting groups (Channel et al., 2008)
· Olympic Lifting, Resistance Training, and Plyometric Training
  o Concluded that Olympic weight lifting is generally equal to or superior than the other two forms of lifting (Chaouachi et al., 2014)

· Olympic lifting vs other modes of training
  o Vertical jump training
    § No differences between the groups in speed or power testing (Teo, et al. 2016)
  o Free weight training (Helland et al., 2017)
    § Improved sprint performance in Olympic lifting
    § Improved jump performance with free weights
  o Motorized training (Helland et al., 2017)
    § Improved strength and jump performance in motorized training group
  o Systematic review and meta-analysis

Take-Home Points and Clinical Application
· If we want to get the athlete back to top performance, may consider performing these exercises
  · Need to have an understanding of benefits and form for these exercises as many youth athletes are now performing
  · More research is needed in rehab population on benefits and safety of these exercises

Powerlifting clinical pearls

Barbell Bench Press
Form & Technique:
  · Hand Placement
    o Biacromial Distance:
      § Measure distance between the outside edges of the acromion processes
      § Take the number from this measurement, and multiple it by 1.5
      § This is the distance apart your index fingers should be on the bar
      § At 1.5 times biacromial width, the shoulder are placed at the ideal 45-degrees of abduction during the lift
      § 45 degrees of abduction potentially allows for greatest amount of force to be transferred from body to bar
      § This hand placement helps keep forearms vertical, and the wrists, and elbows under the bar to protect the shoulders
      § Reducing bench press grip to < 1.5 biacromial distance potentially minimizes injury risk and does not affect muscle recruitment patterns
    · Set-Up
      o Bride on Bench Test: “Weight through your traps and pits to pockets!”
      § On the bench, place hands on the bar, put feet on the bench and bridge hips up letting the weight fall through your traps
      § Now, re-create that tightness you had in your traps when you bridged up
      § Scapular retraction
      § Check Full Body Tightness
      § Push on legs to check tightness; should not move
      § The bench press is a full body lift
    · Grip
      o Traditional - thumb wrapped around bar
Safer, recommended for beginners & patients
- False - thumb not wrapped
- Increased lat activation*
- Risk of grip slipping and injury
  - Un-Racking
    - “Pull the weight out. Do not press.”
    - Pulling the bar out of the rack
- Pulled out using lats to maintain shoulder and upper back tightness
- Verbal cue, “Act as if you’re pulling the bar apart with your hands” to help maintain upper back tightness
- Can be challenging if the rack you’re using is deeply contoured
  - The Press: J-Curve Press
    - Bar begins directly over your wrists, elbows, and shoulders
    - Bar should travel inferiorly
    - Bar should strike or stop at the inferior chest
- Helps keep forearms vertical, and the wrists and elbows under the bar throughout the press to protect the shoulders
- “DO NOT BOUNCE THE BAR OFF OF YOUR CHEST!”

Barbell Deadlift
Form & Technique:
  - Grip
    - Double Overhand - both hands pronated
- Recommended for beginners and patients
  - Mixed - One hand Pronated, the other Supinated
- Stronger grip than double pronated
- Risk for muscular imbalances & rupturing biceps
- Not recommended for patients
  - Hook - trap thumb between the barbell and first 2-3 fingers
- Strongest grip when mastered
- Painful for beginners and not recommended for patients
  - Approach
    - Bar needs to be as close to shins as possible
    - Bar needs to travel in straight, vertical line
    - The more horizontal movement you have…
- Increase stress on spine
- Hurts efficiency
- Increased risk of injury
  - Hand Placement
    - Just wider than Shoulder Width Apart
- The closer your hands are gripped, less distance the bar has to travel
  - Increased efficiency
  - Less risk for injury
  - Set-Up
    - Grip bar & engage lats
- Use the verbal cue, “Pull the bar apart with your hands.”
- Helps to stabilize thoracic and lumbar spine
Also helps to avoid excessive lumbar extension or flexion
- Foot Placement - shoulder width or less
- If too wide, knees will run into arms
- Hips below shoulders
- Hips below shoulders throughout the entire deadlift
  - Ascent
    - Take “slack” out of the bar first
    - Keep bar as close to body as possible
    - Maintain hips below shoulders
    - Once bar passed knees, hip hinge and squeeze glutes to lock-out
  - Descent
    - Maintain bar as close to body as possible
    - DO NOT let shoulders dip below your hips
    - If repping, DO NOT BOUNCE THE BAR
- Bouncing throws off form and increases risk for injury

Barbell Back Squat
Form & Technique:
  - Bar Placement
    - High Bar - Barbell resting on traps
      - Upright, vertical torso
      - Increased load on quadriceps
      - Narrow stance, increased knee flexion require
    - Low Bar - barbell resting below traps, on scapula
      - Decreases total distance the bar travels
      - Increased trunk flexion
      - Increased load on hips
      - Typically, individual can handle increased load
      - Wider stance, increased hip flexion require
  - Squat Movement
    - Hips back first, knees will follow
      - “Moving knees first leaks power.”
    - Hit your low spot
      - “Pull yourself into the hole!”
      - “Point your belt buckle forward.”
    - To help facilitate neutral spine alignment
      - Push through the ground with quads first
      - Facilitates ER at the hips, providing increased stability
        - Hinge hips at lock out
        - Avoid knee valgus collapse throughout

Olympic Weightlifting clinical Pearls

Phase of olympic lifting
  - 1st pull - separating the bar from the ground to the knee
    - Plantar flex to get knees out of the way of the bar
- Maintain back angle and posture

**2nd pull** - passing the knees and accelerating the bar up to full triple extension of knees and hip to get max vertical displacement of the bar
  - Keep bar close to legs
  - Stay over the bar until hip/thigh contact
  - Use hip/thigh contact with bar to increase momentum

**3rd pull** - rapid active pull of the lifter body under the bar
  - Upright trunk when receiving
  - Proper clean receiving position - front rack
  - Proper snatch receiving position - Overhead squat

**Recovery** - standing up weight to complete snatch or clean

**Jerk** -
  - Dip - small squat with upright trunk + timing the “whip”
  - Drive - extension of knee and hips to generate upward momentum of the bar
  - Dip - pull self underneath bar using split / squat - during lock out of UE
  - Recovery - standing up weight to complete Jerk
  - Front foot then back foot when using split jerk

**Olympic lifting derivatives**

- Hang position variation - start with bar at the knees - eliminates 1st pull to improve 2nd and 3rd pull
- From Blocks - starting position is resting on block to avoid 1st pull similar to working from the hang. Resting on the blocks removes momentum from the stretch shortening cycle. Can work of bracing at challenging positioning
- Tall variations - bar starts at hips to force max triple extension and speed of 3rd pull
- Power variation - limit squat depth of 3rd pull to above 90 degrees.
- Muscle variation - no squat during the 3rd pull - use strength and momentum to get bar to full upright position
- Pulls- perform just 1st pull or can do 1st and 2nd pull - can go heavier than 1 RM avoid stress of receiving the bar
- High pull - pull with extra arm pull at top of 2nd pull but does not have 3rd pull
- Jump shrug - lighter weight on a pull with max vertical jump at apex of 2nd pull

**Components of technical proficiency** -

**Bar trajectory** - does the bar get to correct location efficiently
  - Consistency of motion
  - Keeps the bar close to the body
  - Vertical trajectory received over head for snatch or in front rack
  - Good trajectory does not need forward or backward hop

**Bar height** - at apex of 2nd pull compared to deepest possible bar depth at bottom of 3rd pull
  - Amount of weight will alter bar height
    - Too heavy will leave not enough vertical displacement to properly receive
    - Too light and you are not optimizing your flexibility and potential of 3rd pull
  - More depth at bottom of clean and snatch will allow for less demand for vertical bar displacement
• Strive to get apex of the 2nd pull to equal max depth of the 3rd pull with the most amount of weight on the bar

**Speed of 3rd pull**
- The more time it takes for the lifter to descend under the bar allows more time for gravity to decrease bar height
- Should not alter trajectory or height of the bar to rush the 3rd pull

**Vertical displacement correctives**
- Increased Leg strength
- Heavy Pulls
- Muscle and power variations

**Bar trajectory correctives**
- Medium weight pulls
- No hook grip
- No jumping
- No contact with body

**3rd pull speed corrective**
- Tall / hang variations
- Snatch balance
- Footwork drills

**How to use lifting derivatives in the clinic**
- Hang position or block variation - avoid deep knee and hip flexion if setup is painful
- From Blocks - work of bracing and motor control at challenging positions
- Power and muscle variation - avoid bottom position and stress of end range flexion
- Pulls- avoid painful receiving positions
- Pulls, jump shrug - less complex and can be done when you do not have enough time to teach full lift. Shows similar rate for force development as olympic lifts.

**Lifting Evaluation**

- Steps for lifting evaluation
  1. SFMA and markup body diagram
  2. Collect subjective while they warm up
  3. Video their lift
  4. Review lift and compare to SFMA
  5. Provide lifting specific correctives and drill based on evaluation finding

- The finished product the athlete receives is
  1. Body diagram
  2. Copy of Dartfish video analysis
  3. Weightlifting specific correctives and drills based on evaluation findings