Load Monitoring in Milwaukee Professional Sports

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Goals

- Discuss use of load monitoring in pros
- Motion analysis in basketball
- Motion analysis in baseball
- Heart rate variability in baseball
Sports science application & success

Australia

Great Britain
Bucks Basketball

- Director of Performance
- 2 Athletic Trainers
- 2 Strength & Conditioning Specialists
- 2 Physical Therapist
- 1 Chef/Dietician
- 1 Data analyst
- Partnership with Academic Sports Group
- Wellness survey (daily)
- Motion analysis (practices)
Motion analysis in basketball

- Motion trackers
  - 3D Direction
  - Intensity
- 75,000 data points per second
- 2 hour practice sessions
Force after R ankle sprain

![Force diagram for R ankle sprain](image-url)
Brewers Baseball

- Motion analysis
- PPE risk analysis
- Heart rate variability
Heart Rate Variability: Monitoring Recovery & Optimizing Performance in Professional Baseball Pitchers

Roger Caplinger, MS, ATC
Milwaukee Brewers Baseball Club
Kyle T. Ebersole, PhD, ATC
University of Wisconsin - Milwaukee
What is HRV?

- Heart Rate Variability (HRV)
  - Quantifies variability in R-R interval length

- Represents autonomic balance between sympathetic (SNS) & parasympathetic (PSNS) pathways acting on the heart

- HRV is a measure of sympathovagal balance
Literature History

- Body of literature & applications has evolved from clinical to exercise science & more recently, to sport sciences

- According to pubmed.com as of 3/11/16
  - “HRV” = 19,959 papers
    - 1925 was first paper; 31% since 2011
  - “HRV & exercise” = 2,457 papers
    - 1970 was first paper; 36% since 2011
  - “HRV & sport” = 1,201 papers
    - 1970 was first paper; 46% since 2011
  - “HRV & baseball” = 0 papers
Authors concluded that abnormal somatic tissue response to accumulating trauma may modulate ANS activity at the level of HRV.
But….how do you define fatigue?

- In general, the only consistency in definition is the reference to “decline in performance”
- Task dependency of fatigue emphasizes the need for ecologically valid approaches to study fatigue
- Fatigue is a process, not a single point
- Specific to the person

Pitch counts and innings limits are probably a good idea, but no one knows exactly how much rest is necessary, Fleisig says. “Every person is different than every other person. That’s humanity.” The trick, he believes, is spotting when a pitcher is tired or hurting or getting him to tell you that—“human interaction,” he says. Human
Why HRV & Baseball Pitchers?

- Pitchers represent 65% of all injuries to Major League Baseball Players
- Loss of ROM & decrease in pitch velocity are examples of indicators for potential fatigue or injury risk
- Based on available clinical literature & emerging sport science literature, HRV was explored as a possible tool to measure “fatigue” in baseball pitchers
Working Model

- Resting HRV + Game HR
- Off-Day Training
- Recovery
- Performance

Monitor → Optimize
Guide → Maximize
Methods

- Daily resting sample
  - Supine for 10 minutes upon arrival to clubhouse
  - HRV Dashboard provides daily updated chart for staff & player that plots daily & 5 day moving average RMSSD value based on individually set confidence intervals
Data Collected Overview

- Data from 60 players across 3 years
- A total of 5,949 days of resting HRV data
- Loss of ~20% of data each year due to player compliance
  - >85% is linked specifically to a few individual pitchers.
- Data analysis based on establishing 95% confidence intervals from last week in Spring Training through 1st week of regular season (Plews et al 2012, 2013, 2014)
Resting HRV vs Rotation Day

- Resting HRV one day after completing a normally scheduled start (i.e., Day 2) is significantly lower than all other rotation days.

- Resting HRV measures returned to baseline (i.e., Day 1) values before the next scheduled start.

- A pitch outing may alter ANS function, on day 2 and recovery should be expected by day 3.

Conversation #1: Training load adjusted

Conversation #2: discovered that the player had his own off-site training program resulting in very high volume of training
2015 - Appleton
HRV15_35
Training Volume and HRV

↓ TP = ↑ HRV
Game Heart Rate

Zephyr Bioharness Shirt
Game Heart Rate

- 83-87% max HR while pitching
- 56-59% max HR in the dugout
- Pitching HR reached by the 5th warm-up pitch
- Used to inform off day training intensity

Pitches
Cornell, Paxson, Caplinger, Seligman, Davis, Flees, Ebersole.
Journal of Strength & Conditioning Research, in review.
Are We On The Right Path?
Other MLB HRV studies

- 230 players, 3321 workouts, 4407 sleep episodes
- Data retrospectively able to predict 12 overuse injuries
- Able to see behavioral changes
  - EtOH (less = better recovery)
- Non-travel days
  - 45 extra minutes sleep with 10% better recovery
- Travel
  - 2 days to return to baseline
- Higher recovery = higher fastball & bat speeds
2012 - 2015 Summary

- Resting HRV changes sensitive to illness, medications & training load changes
- HRV responses are best managed on an individual basis
- Recovery across days within rotation varied
- Appears to be a relationship between ROM changes and HRV changes
- Use of the “HRV dashboard” promoted player buy-in
- Weekly conversations with Strength Coaches & Athletic Trainers are essential to case manage the application of the data
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- **Suki Hobson**
  - Milwaukee Bucks
Summary

- Load monitoring, wearable technology & biomarkers appear to be the wave of the future
  - Currently in research
  - Cutting edge in performance evaluation
  - Future in training modification
  - Lots of data, but not much definitive outcomes
    - Use with caution at this point, may be spending a lot of money for no significant results
Thank you