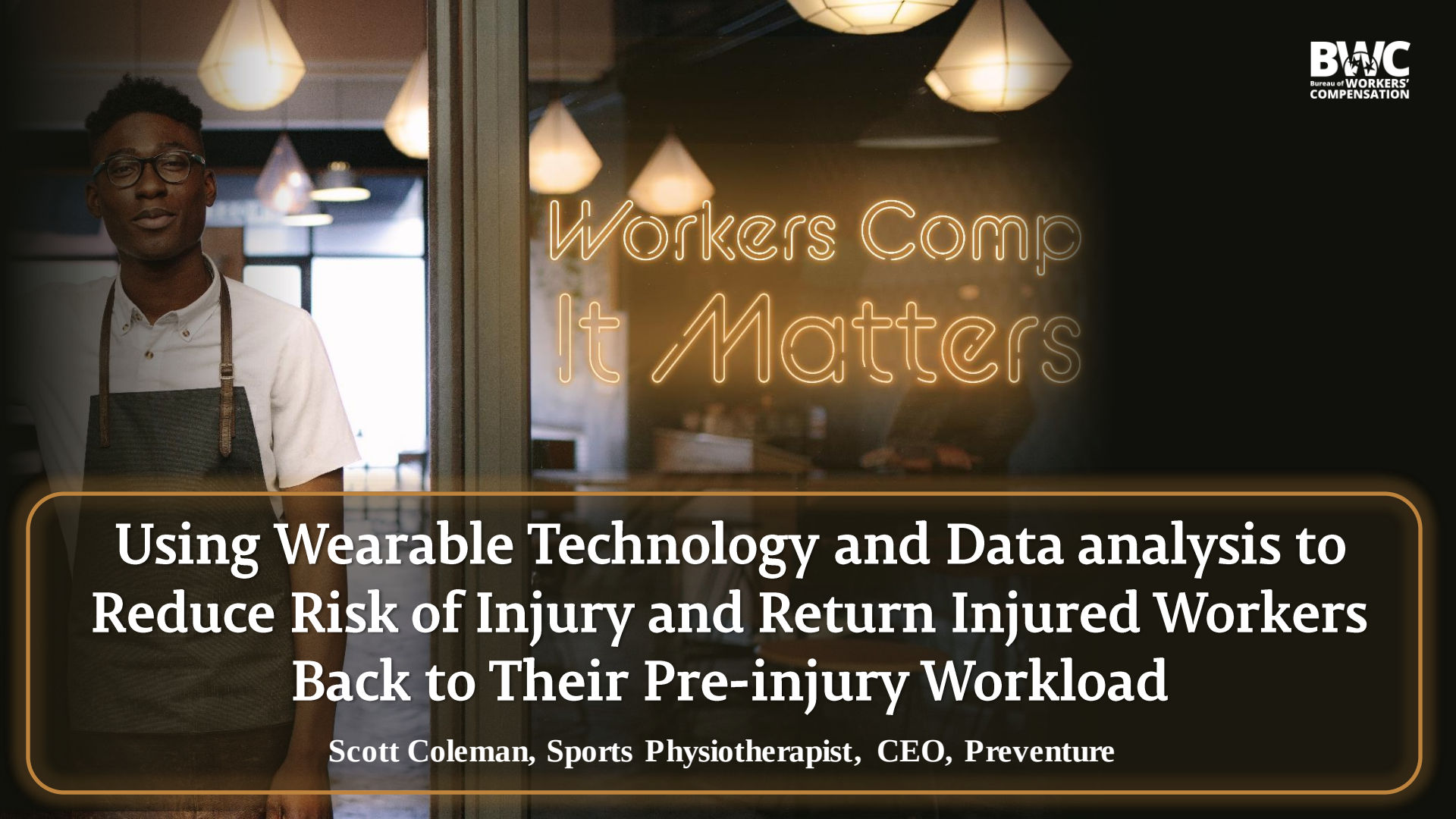


Using Wearable Technology and Data analysis to Reduce Risk of Injury and Return Injured Workers Back to Their Pre-injury Workload

Scott Coleman, Sports Physiotherapist, CEO, Preventure

Preventure

Using Wearable Technology and Data analysis to Reduce Risk of Injury and Return Injured Workers Back to Their Pre-injury Workload

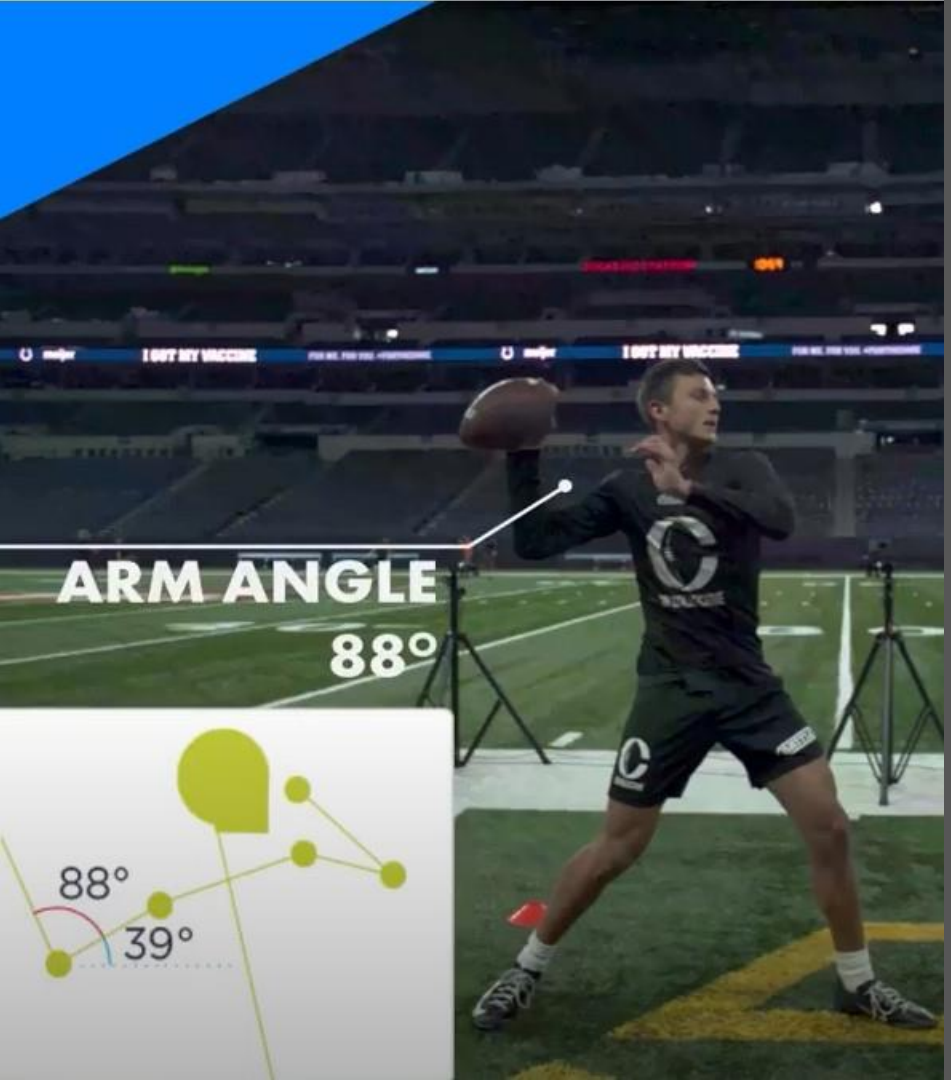
Current Problems with Workplace Injury Prevention and RTW Programs

Education / training methods are ineffective at changing behaviour

Limited by time and resources

Approaches are not specific to individual injury risks

Assessments are observation and opinion-based



The Most Effective Injury Prevention and RTW Programs

Sports-based programs (supported by research)

You need to measure movement *quality* and *quantity*

Establishing specific baselines using load

"Load is the process of quantifying the amount of physical training that an athlete undertakes using variables relevant for their sport (accelerometer data,

Preventative Measures

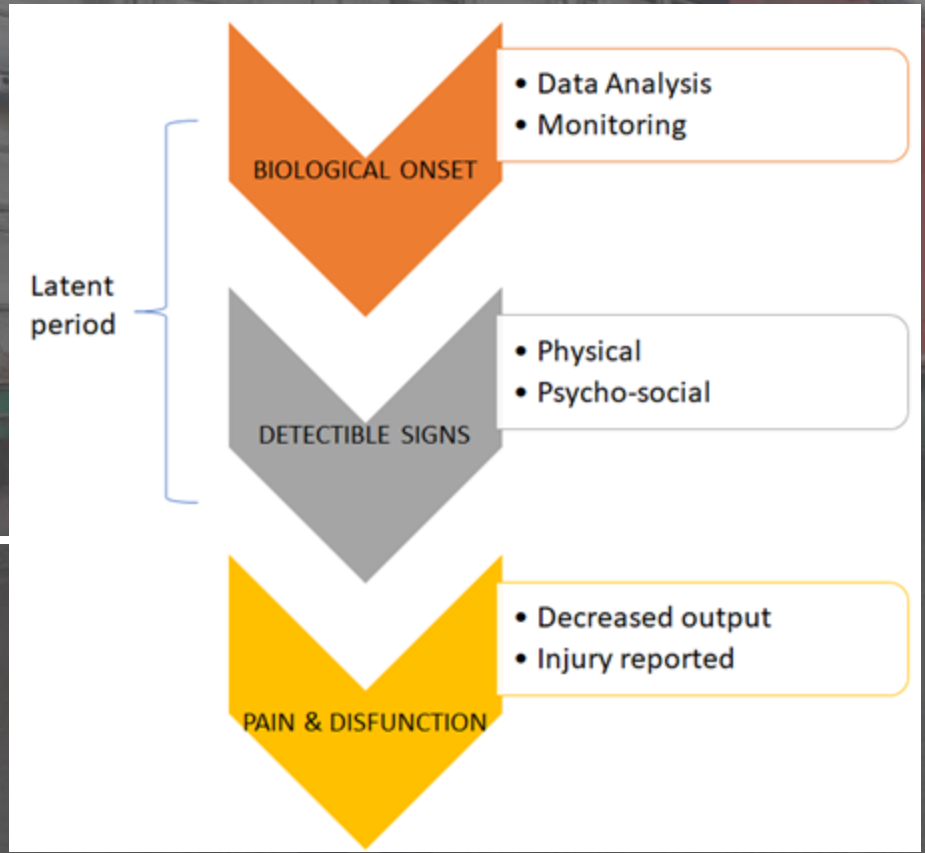
Primary Prevention

- Task assessments
- Screening

Secondary Prevention

- Early detection of onset

Tertiary Prevention



Monitoring Load for Secondary and Tertiary Prevention

Simply measuring range of motion is not enough

Types of Load

- External Load (biomechanical)
- Internal Load (physiological)
- Chronic Load (long duration)
- Acute Load (short duration)
- Acute / Chronic Load ratio (Training Stress Balance)

Calculating Load

Table 1 Summary and Evaluation of Some Common Methods Used to Monitor Athlete Training Load and/or Responses

Method	Cost	Hardware needed	Software needed	Ease of use	Valid	Reliable	Used to interpret	Used to prescribe	Variables
Internal Measures									
RPE	L	N	Y/N	H	M–H	M–H	Y	Y	Single variable in AU (time dependent)
Session rating of perceived exertion	L	N	Y/N	H	M–H	M–H	Y	Y	Single variable in AU (time dependent)
TRIMP[a]	L–M	Y	Y	M	M–H	M–H	Y	N	Single variable in AU (time dependent)
Wellness questionnaires*	L	N	Y/N	M–H	M	M–H	Y	Y/N	Ratings, checklists, AU scale measures
Psychological inventories (eg, POMS, Rest-Q-Sport)*	L–M	N	Y/N	M–H	M–H	M–H	Y	Y	Ratings, checklists, AU scale measures
Heart-rate indices	L–M	Y	Y	H	H	M–H	Y	Y	Heart rate, time in zones, HR variability/recovery measures, etc
Oxygen uptake	H	Y	Y	L	H	H	Y	Y	VO_2, metabolic equivalents
Blood lactate	M	Y	Y/N	M	H	H	Y	Y	Concentration
Biochemical/hematological assessments	M–H	Y	Y/N	L	H	M–H	Y	Y	Concentrations, volumes
External Measures									
Time	L	Y	Y/N	H	H	H	Y	Y	Units of time (s, min, h, d, wk, y)
Training frequency	L	N	N	H	H	H	Y	Y	Session count
Distance/mileage	L	Y/N	Y/N	H	H	H	Y	Y	Units of distance (m, km)
Movement repetition counts	L	Y/N	Y/N	M–H	H	M–H	Y	Y	Activity counts (eg, steps, jumps, throws)
Training mode	L	Y/N	N	H	H	H	Y	Y	Weight training, run, cycle, swim, row, etc
Power output	M–H	Y	Y	L–M	H	H	Y	Y	Relative (W/kg) and absolute power (W)
Speed	L–M	Y	Y/N	M–H	H	H	Y	Y	Speed measures (m/s, m/min, km/h)
Acceleration	L–M	Y	Y	L	H	H	Y	Y	Acceleration measures (m/s^2)
Functional neuromuscular tests	L–M	Y	Y/N	M	M–H	H	Y	Y	Countermovement-jump and drop-jump measures
Acute:chronic-workload ratio	L–M	Y/N	Y	M	M–H	M–H	Y	Y	Size of acute training load relative to chronic load
GPS measures	M	Y	Y	M	M–H	M	Y	Y	Velocity, distance, acceleration, time in zones, location
Metabolic power	M	Y	Y	L–M	L–M	M	Y	N	Energy equivalent
Time–motion analysis video (automated)	H	Y	Y	L	M–H	M	Y	Y	Velocity, location, acceleration
Time–motion analysis video (nonautomated)	M–H	Y	Y	L	M–H	M	Y	Y	Velocity, location, acceleration
Accelerometry	M	Y	Y	L–M	M–H	M	Y	N	*x-y-z g* force
Player load	M	Y	Y	M	M	M	Y	Y	Single variable in AU (time dependent)

Abbreviations: L, low; M, medium; H, high; Y, yes; N, no; AU, arbitrary units.

*Measures of training response.

Calculating Load

Internal Load (physiological)

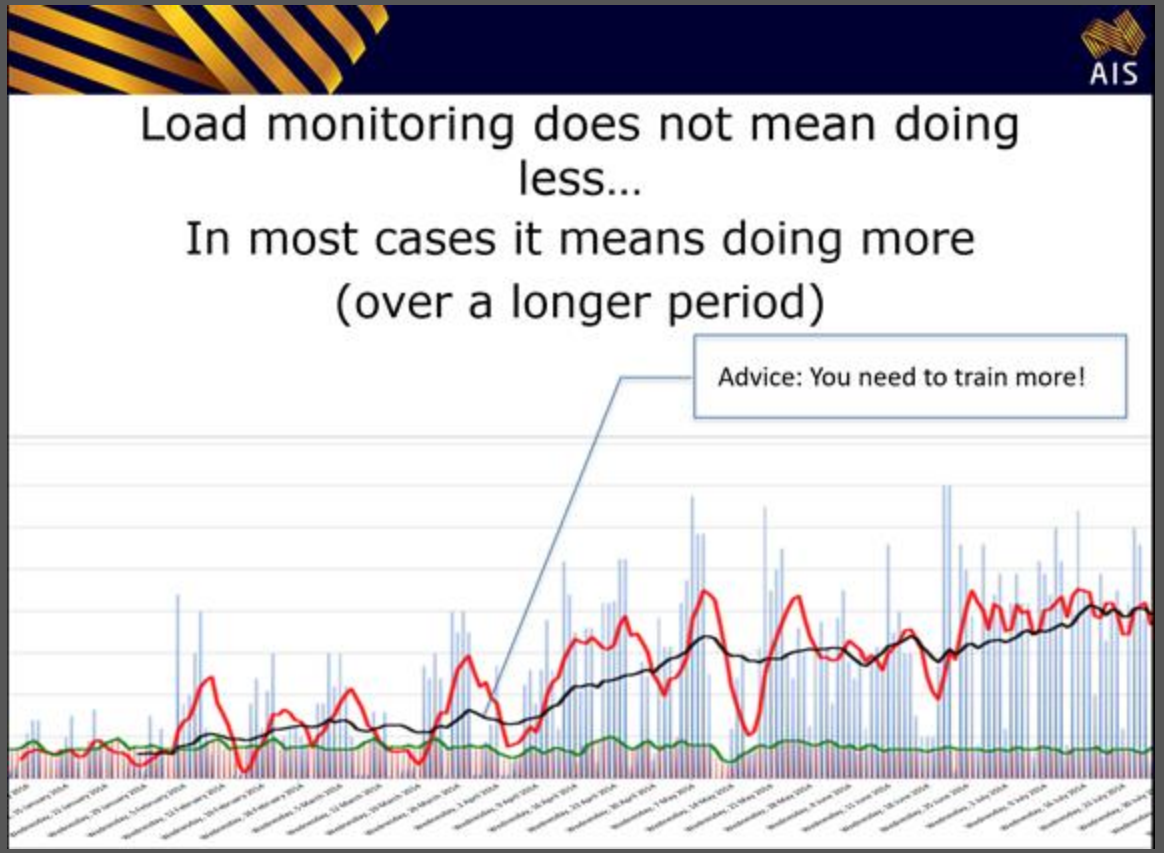
- RPE / Wellness Questionnaires
- HR
- Galvanic Skin Resistance
- Temperature
- VO2 & Blood Lactate

External Load (biomechanical)

- Time / Duration
- Accelerometry
- GPS

Monitoring vs Reducing Load

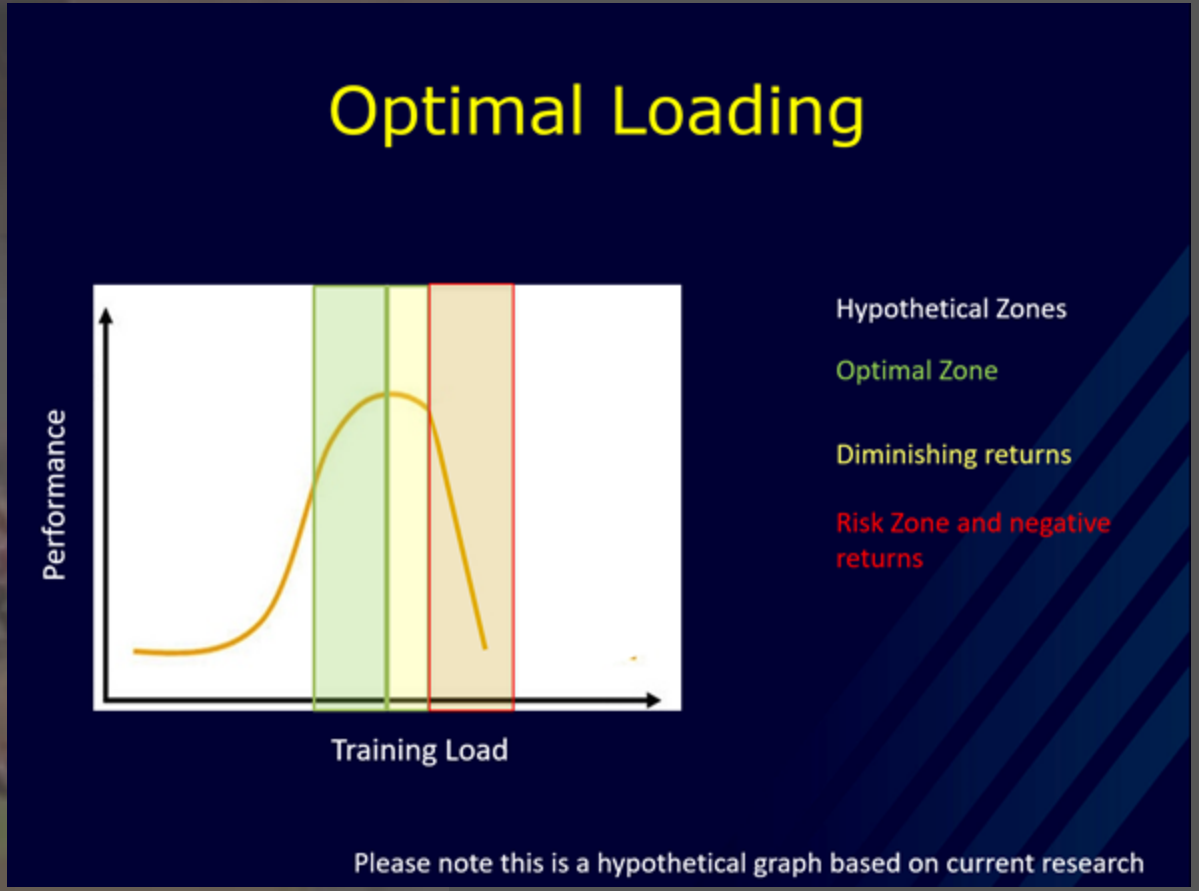
Avoiding peaks and troughs



Ben Ray Smith - Australian Institute of Sport and Athletics Australia

Optimal Load

Establishing baselines for each occupation, task and location that are relevant and specific.



Ben Ray Smith - Australian Institute of Sport and Athletics Australia

Addressing the Needs of the Worker

Valid and reliable wearable technology to measure worker movements

Data analysis to identify and reduce risks and build confidence in movement

Providing live feedback to drive behaviour change

(Carlson A. et al. 2003; Winston F K et al. 2010; Thaler R & Sunstein C. 2008)

...in combination with education and exercise

(Harrington , 2004; Deok Ju Kim, 2015; Sigurdsson

Addressing the Needs of the Employer

RTW using data analysis

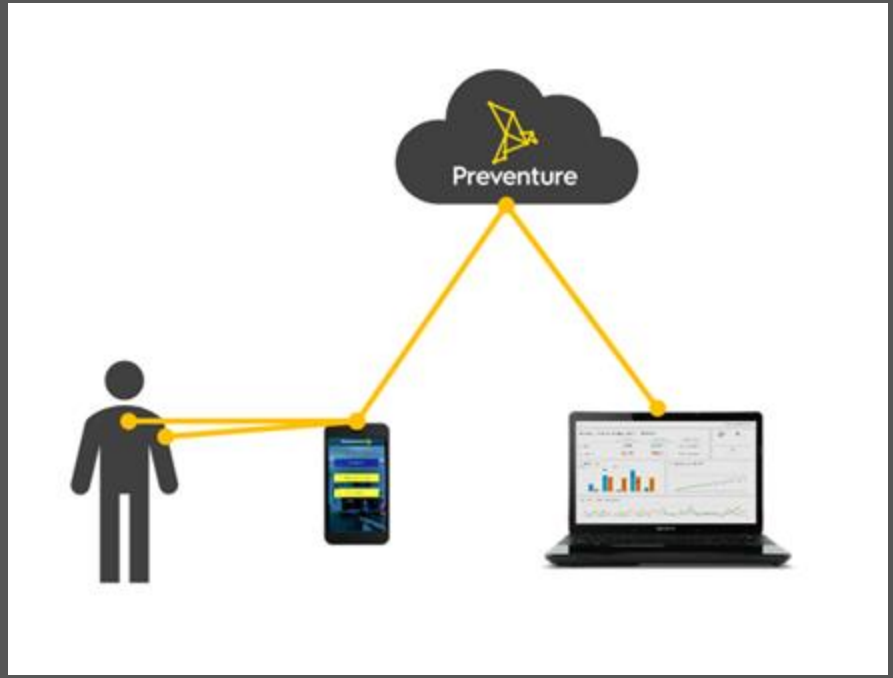
- Identify injury risks for work tasks
- Gradual, progressive increase in workload

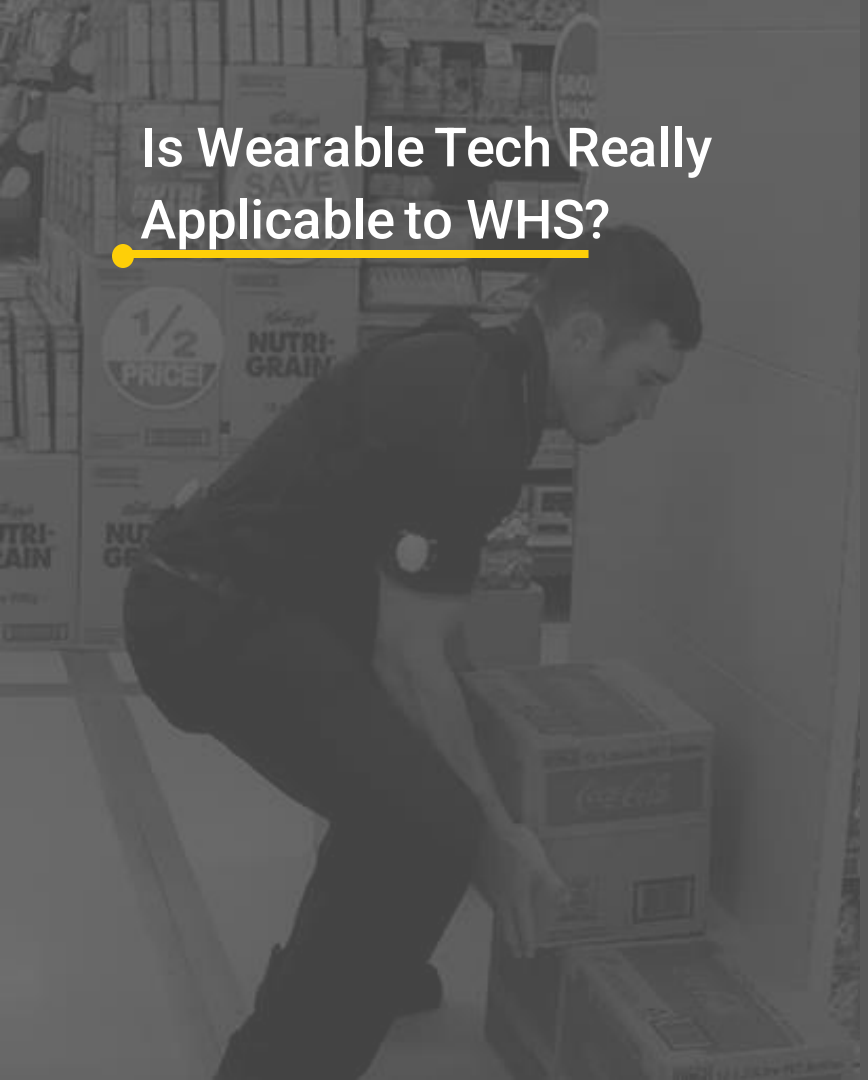
Reducing risk of re-injury

- Worker Load Management (acute and chronic)
- Sustained Postures

Creating a safe work environment

Wearable Tech Enables Remote WHS Service Delivery





Is Wearable Tech Really Applicable to WHS?

Recent survey research :

80% of OHS professionals would consider using wearable tech

Most valuable data ;

- Awkward postures
- Forceful exertions
- Repetitive movements / fatigue

(Schall, 2018)

Current Solution to Deliver WHS Services Remotely

1. Acute Load = Task Assessments

- Job Task Dictionary
- Best practice benchmarks for training
- Assess new workers or injured workers

2. Chronic Load = Movement Coach

- Occupation Profiles
- Identify high risk workers
- Gradually build up to full workload for RTW

Current Solution

Case Study 1 Fatigue Monitoring

Key Findings

1. The worker began the shift moving in a way that reflected the manual handling training that they had received, with minimal high load movements (chart 1).

2. However, towards the end of the shift the worker fatigued, resulting in poor movement control and poor lifting technique with increased trunk flexion and rotation (chart 2), increasing their injury risk.

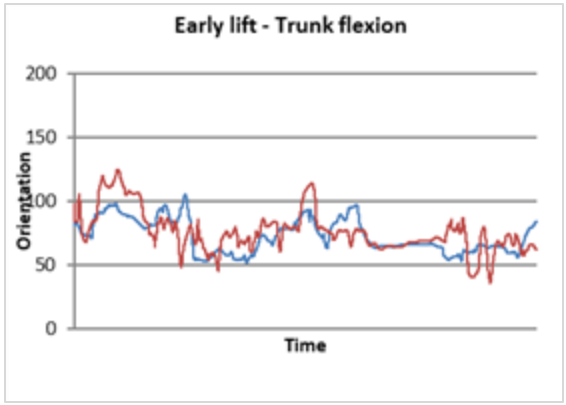


Chart 1 – Controlled lift

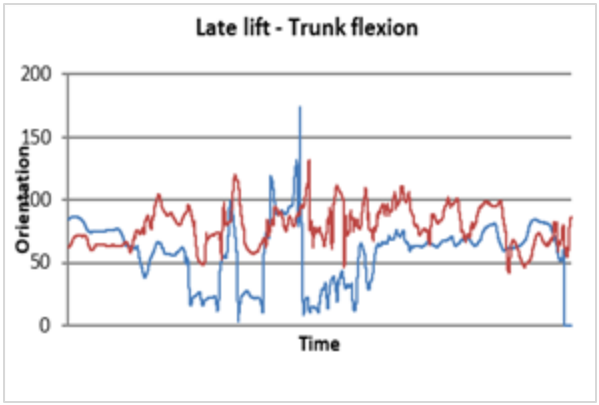


Chart 2 – Less controlled lift

Preventure

Case Study 2
Task Repetition

Key Findings The reports identified periods throughout the shift when the load on the worker was significantly increased. This was consistent for all workers involved in the assessment.

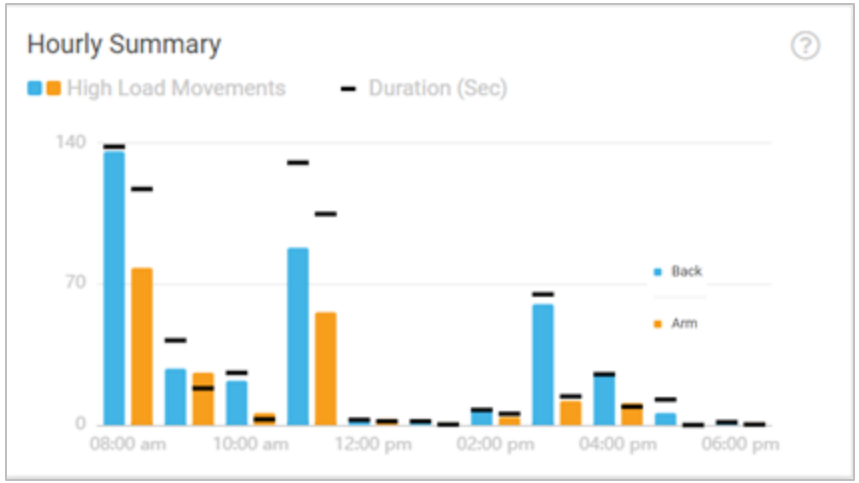


Chart 1 – Hourly summary.

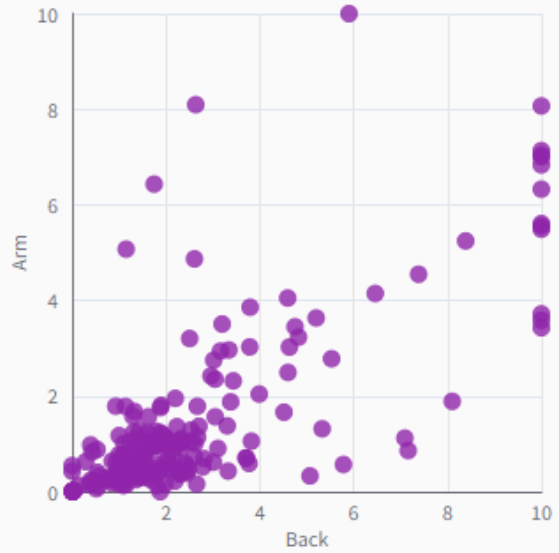
Preventure

User-friendly Data

Movement Coach

Report Score Distribution

Load Scores / 10



Occupation Overview

Top 3 Occupations (Avg Load Scores)

Arm View All

Housekeeping	5.8
Cleaner	4.3
Warehouse Super…	2.5

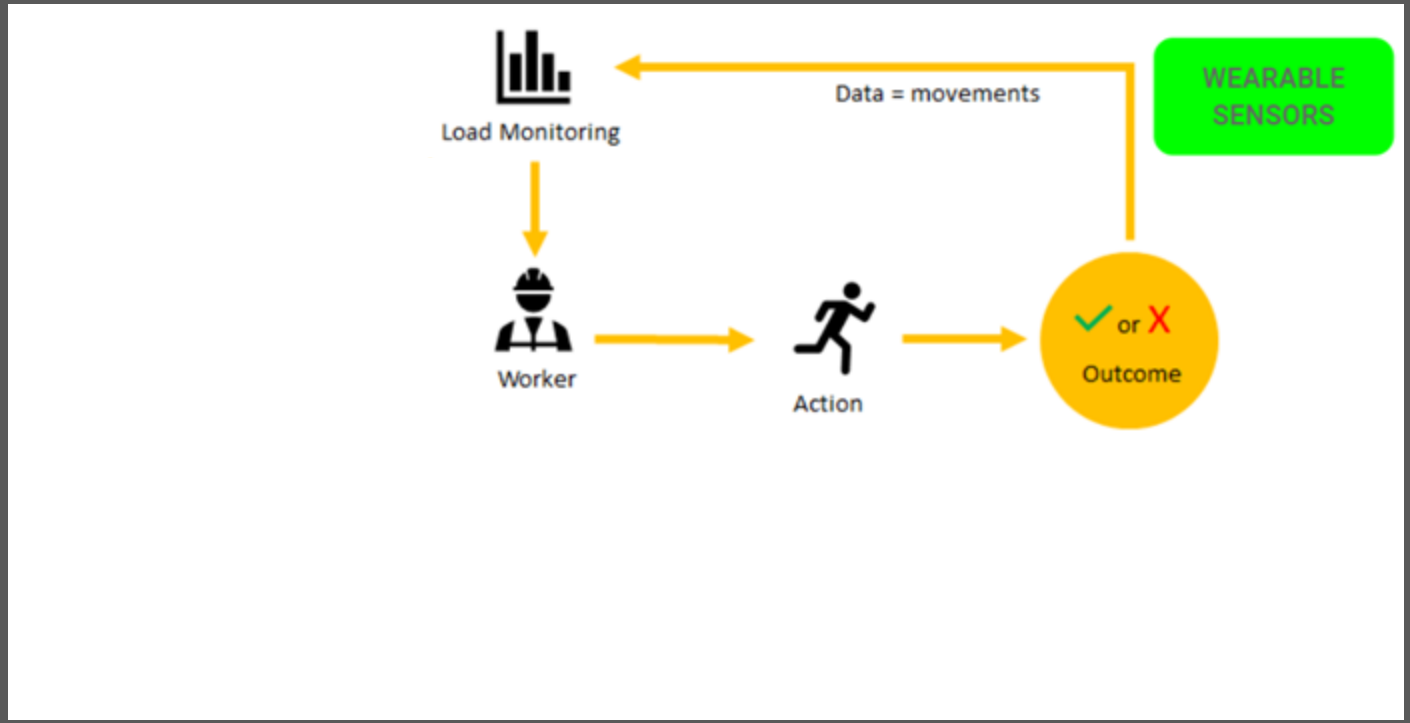
Back View All

Housekeeping	10.0
Cleaner	5.0
Warehouse Super…	3.6

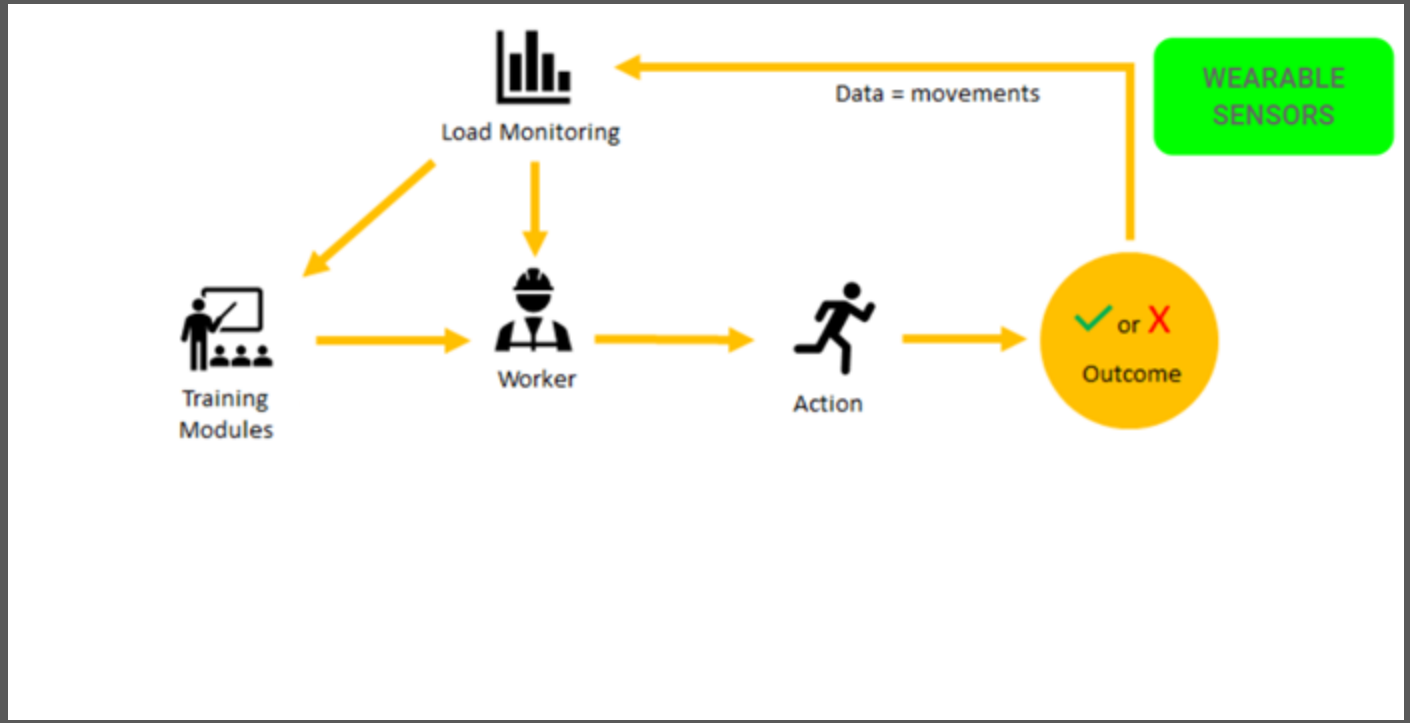
Legs View All

Forklift Operator	7.1
Housekeeping	4.3
General Hand	4.2

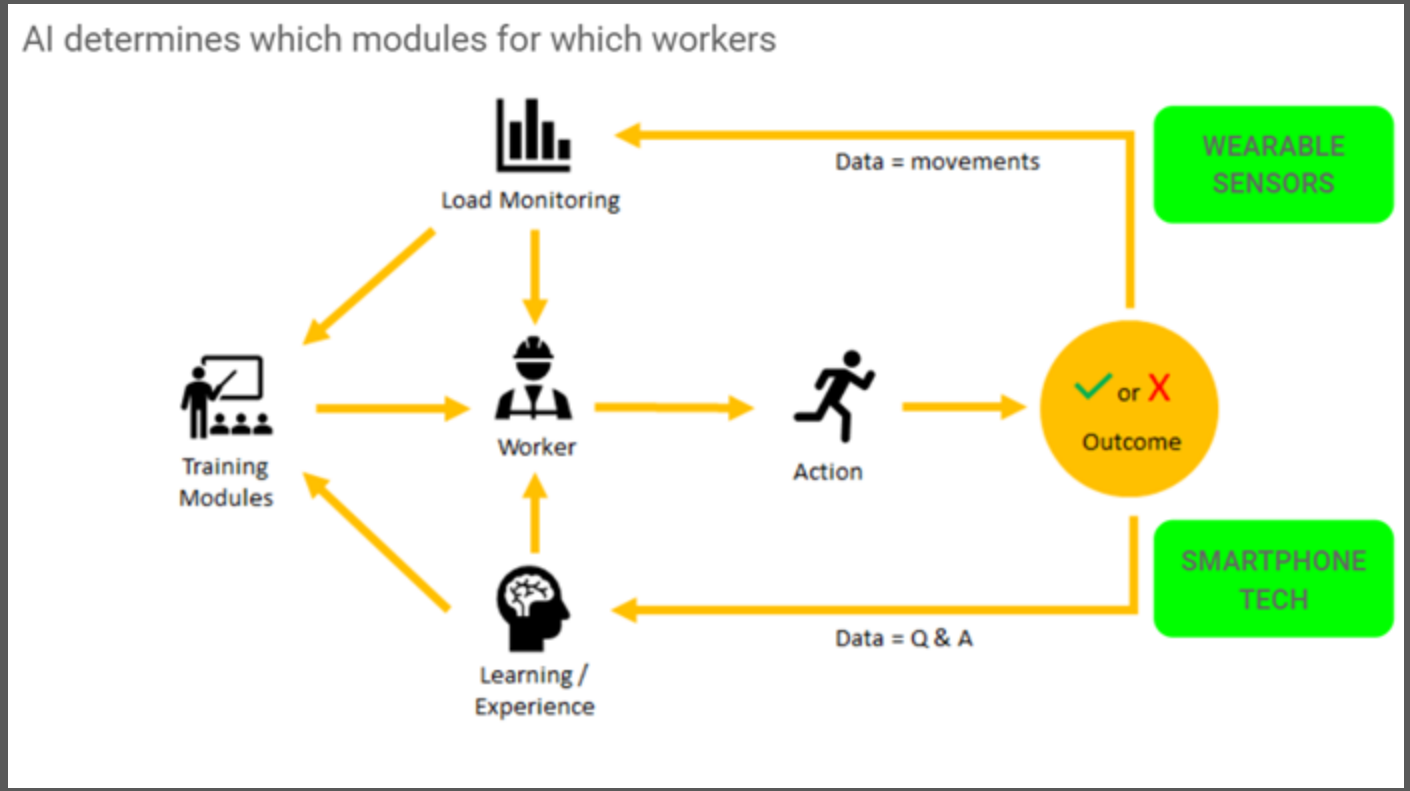
Worker Feedback



Worker Feedback



Worker Feedback

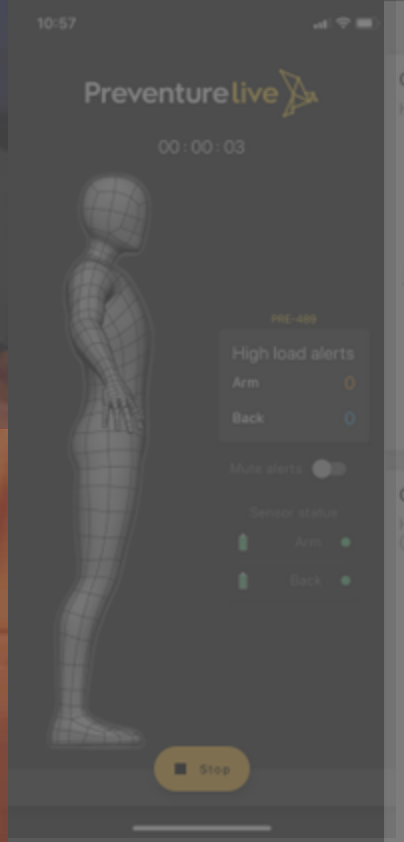


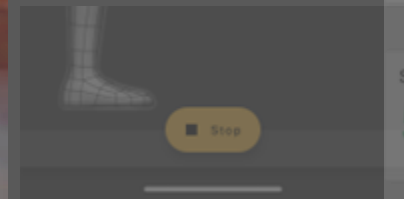
Data-driven RTW

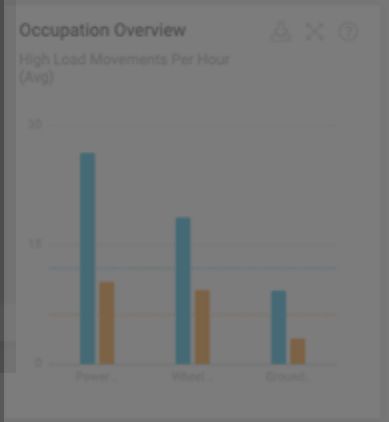
1

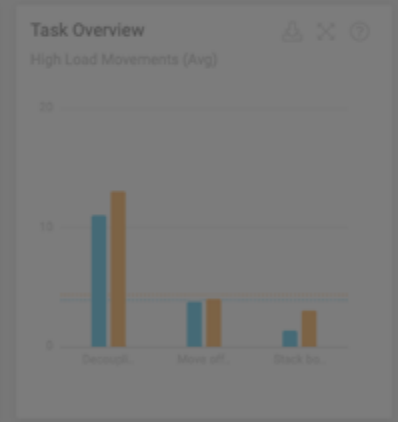
SET BENCHMARKS

Use the sensors to measure the load on uninjured workers for each task and throughout a full shift









Data-driven RTW

1

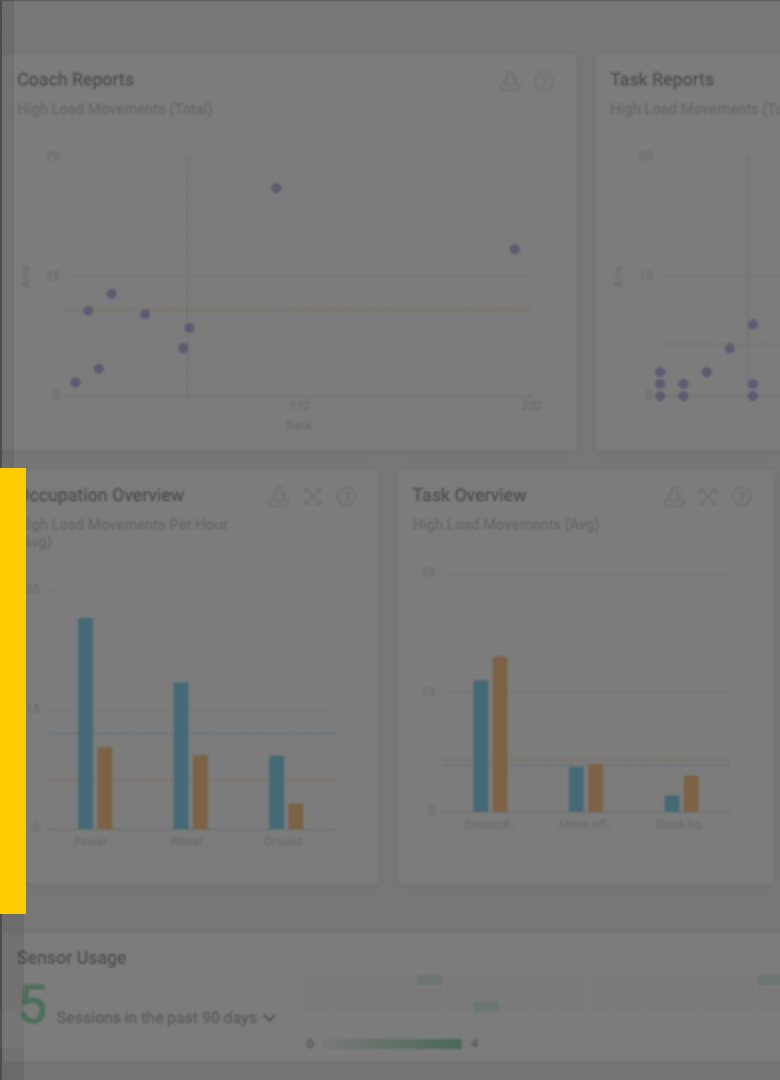
SET BENCHMARKS

Use the sensors to measure the load on uninjured workers for each task and throughout a full shift

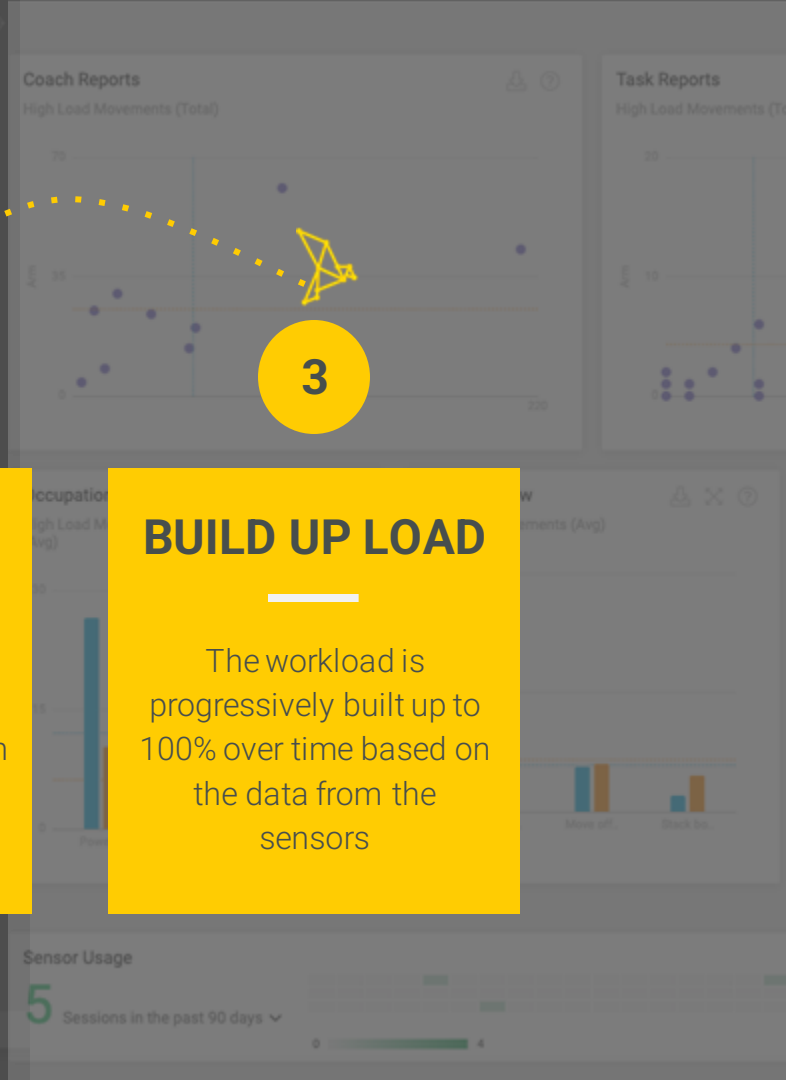
2

ASSESS CAPACITY

The worker is assessed against benchmarks to safely return them to each task at the right time



Data-driven RTW



1

SET BENCHMARKS

Use the sensors to measure the load on uninjured workers for each task and throughout a full shift

2

ASSESS CAPACITY

The worker is assessed against benchmarks to safely return them to each task at the right time

3

BUILD UP LOAD

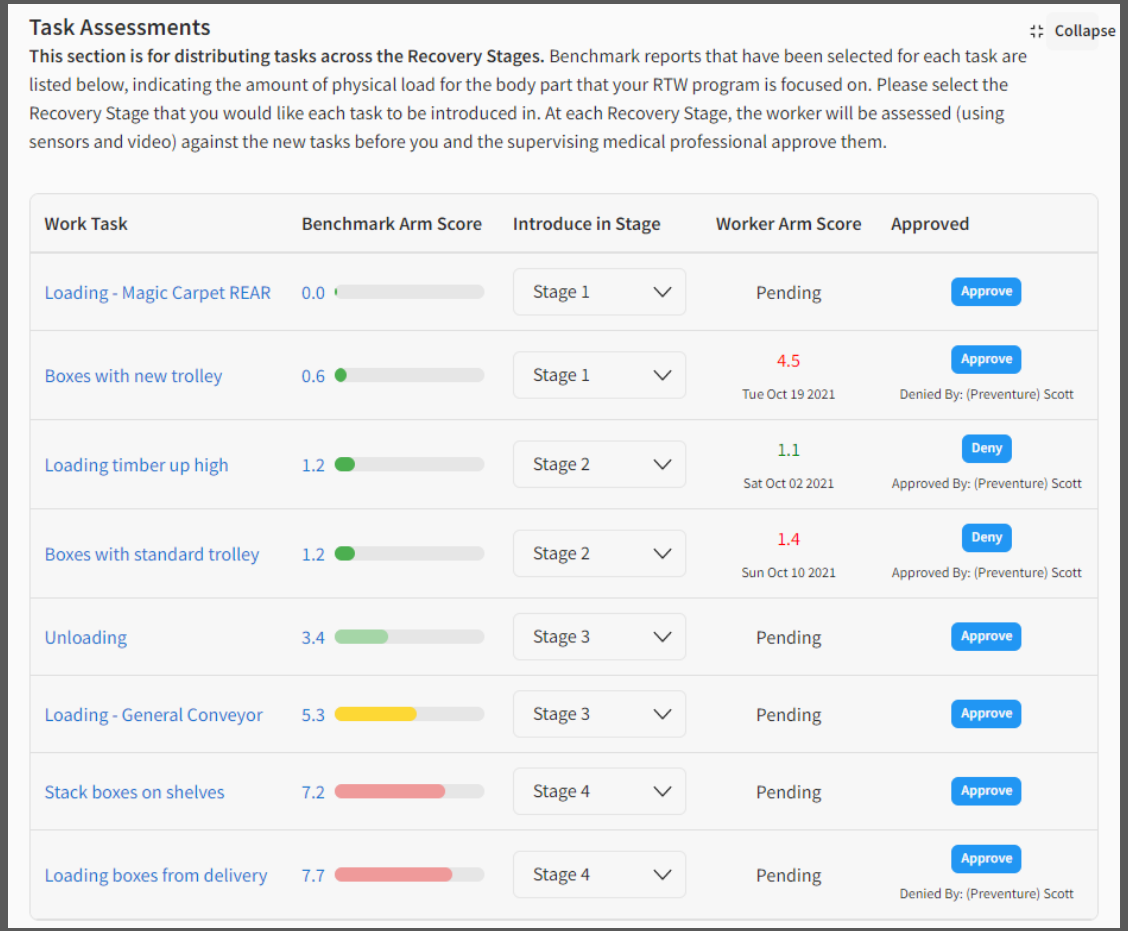
The workload is progressively built up to 100% over time based on the data from the sensors

Data-driven RTW

Keeping it simple by;

- Measuring the physical demands of each task

- Introducing tasks based on data



Task Assessments

Collapse

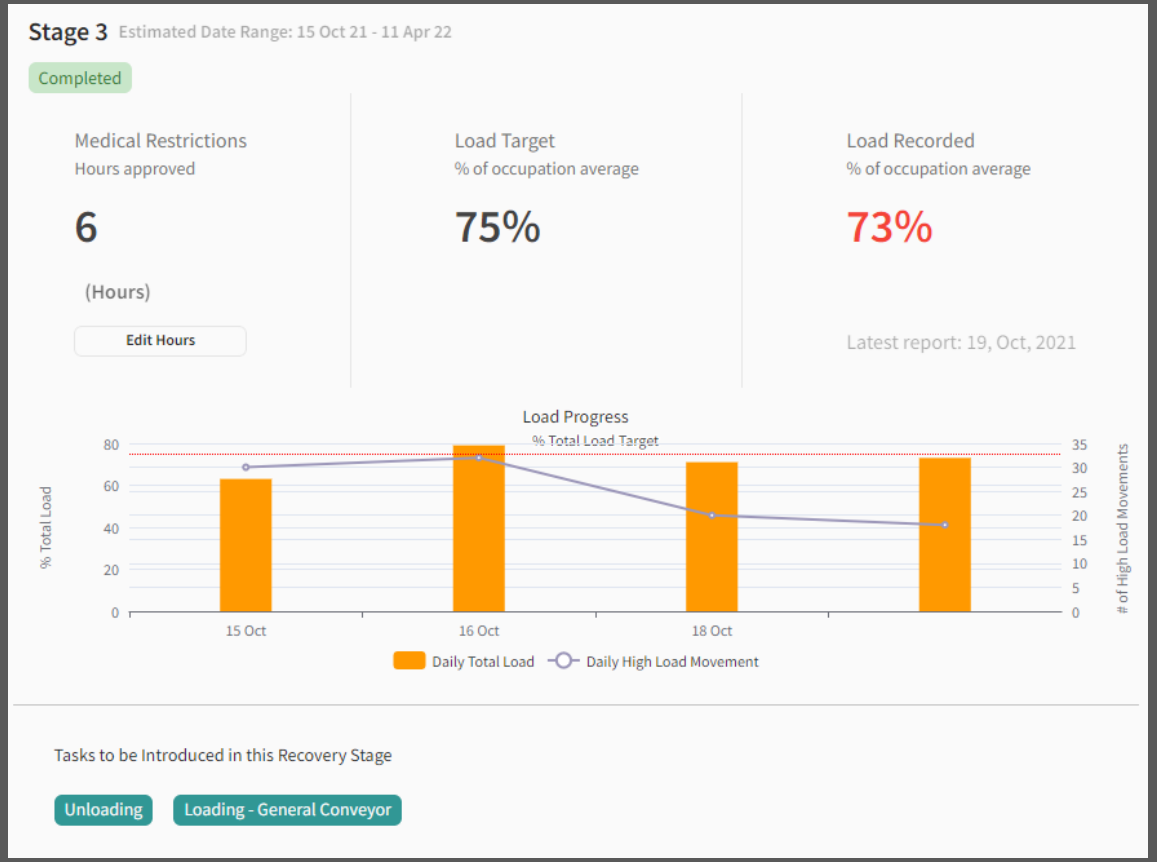
This section is for distributing tasks across the Recovery Stages. Benchmark reports that have been selected for each task are listed below, indicating the amount of physical load for the body part that your RTW program is focused on. Please select the Recovery Stage that you would like each task to be introduced in. At each Recovery Stage, the worker will be assessed (using sensors and video) against the new tasks before you and the supervising medical professional approve them.

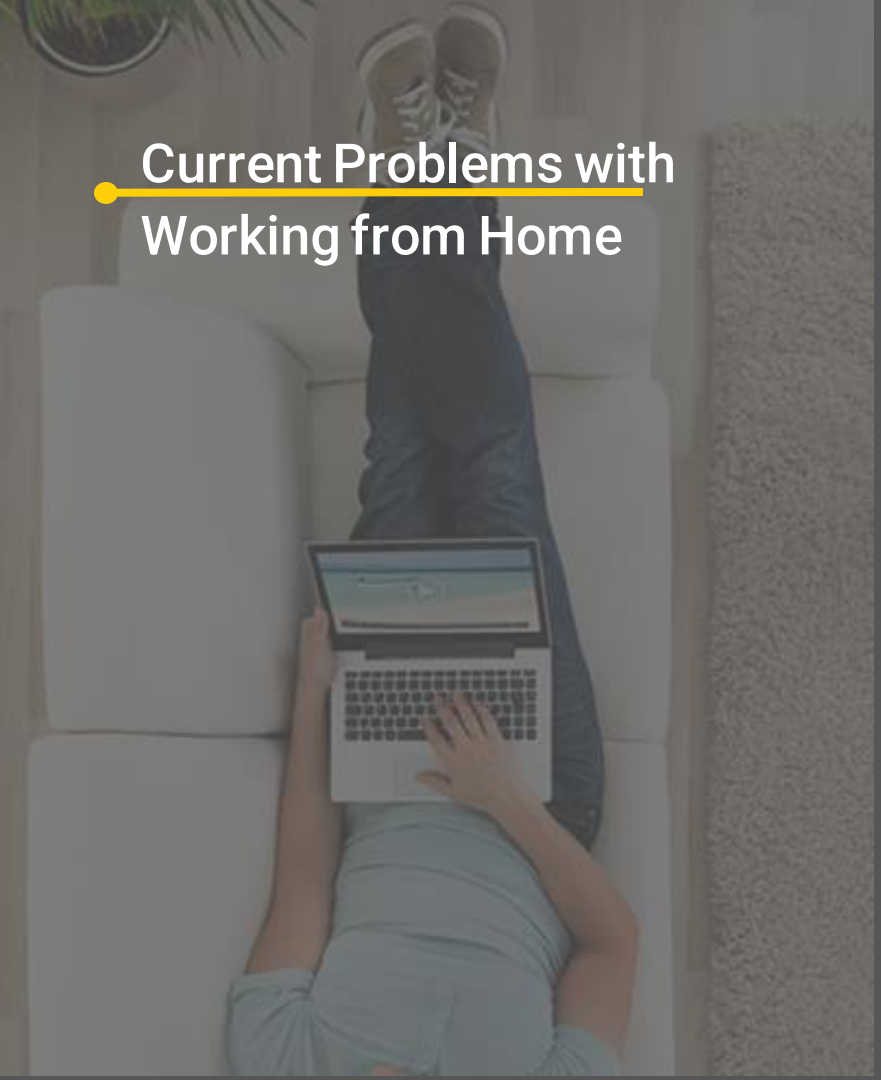
Work Task	Benchmark Arm Score	Introduce in Stage	Worker Arm Score	Approved
Loading - Magic Carpet REAR	0.0	Stage 1	Pending	Approve
Boxes with new trolley	0.6	Stage 1	4.5 Tue Oct 19 2021	Approve Denied By: (Preventure) Scott
Loading timber up high	1.2	Stage 2	1.1 Sat Oct 02 2021	Deny Approved By: (Preventure) Scott
Boxes with standard trolley	1.2	Stage 2	1.4 Sun Oct 10 2021	Deny Approved By: (Preventure) Scott
Unloading	3.4	Stage 3	Pending	Approve
Loading - General Conveyor	5.3	Stage 3	Pending	Approve
Stack boxes on shelves	7.2	Stage 4	Pending	Approve
Loading boxes from delivery	7.7	Stage 4	Pending	Approve Denied By: (Preventure) Scott

Data-driven RTW

Keeping it simple by;

- Measuring the “light duties” load on the worker
- Gradually building up the load to build physical resilience





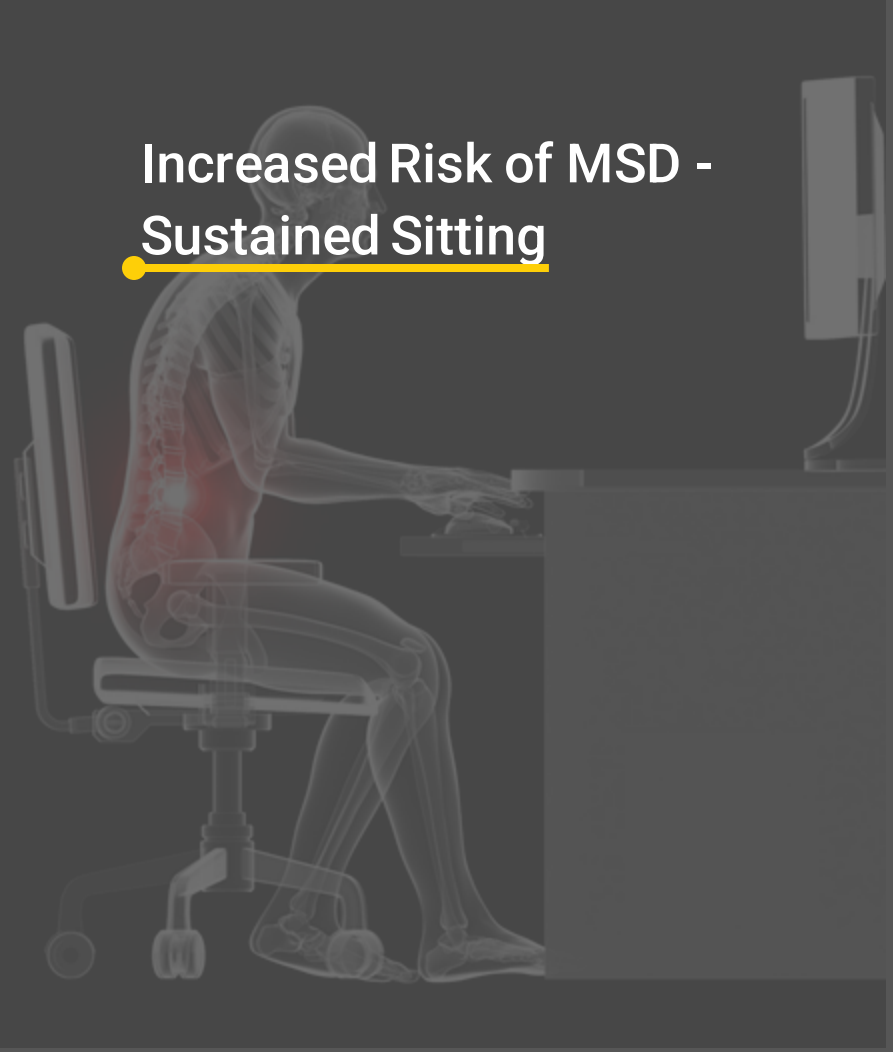
Current Problems with Working from Home

Increased risk of musculoskeletal disorders (MSD)

Reduced physical activity

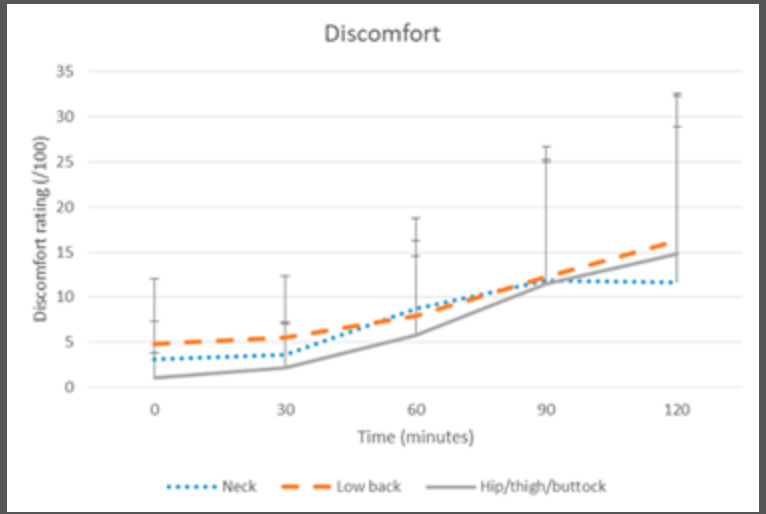
Creating a safe and productive environment

Increased Risk of MSD - Sustained Sitting



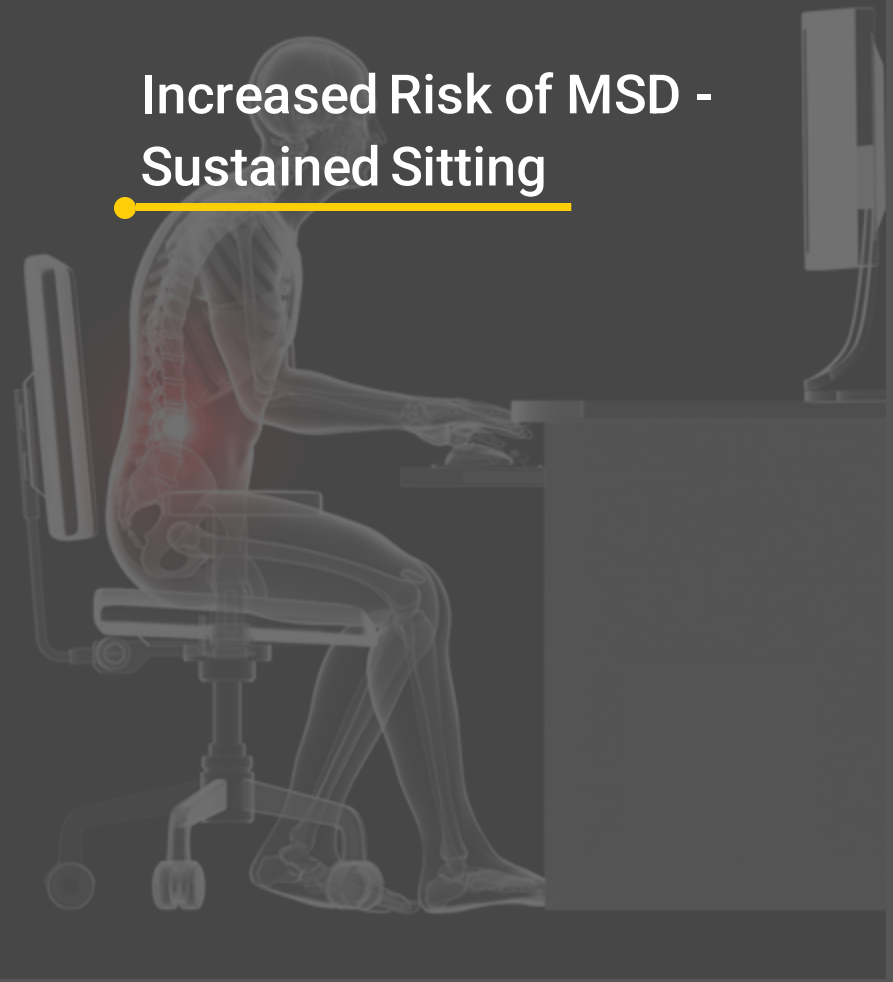
Some research reviews indicated an increased risk of MSD with prolonged occupational sitting

(Ariens, 2000; Côté P. et al, 2008; Baker R et al, 2018)



Baker R (2018) Int. J. Environ. Res. Public Health 2018

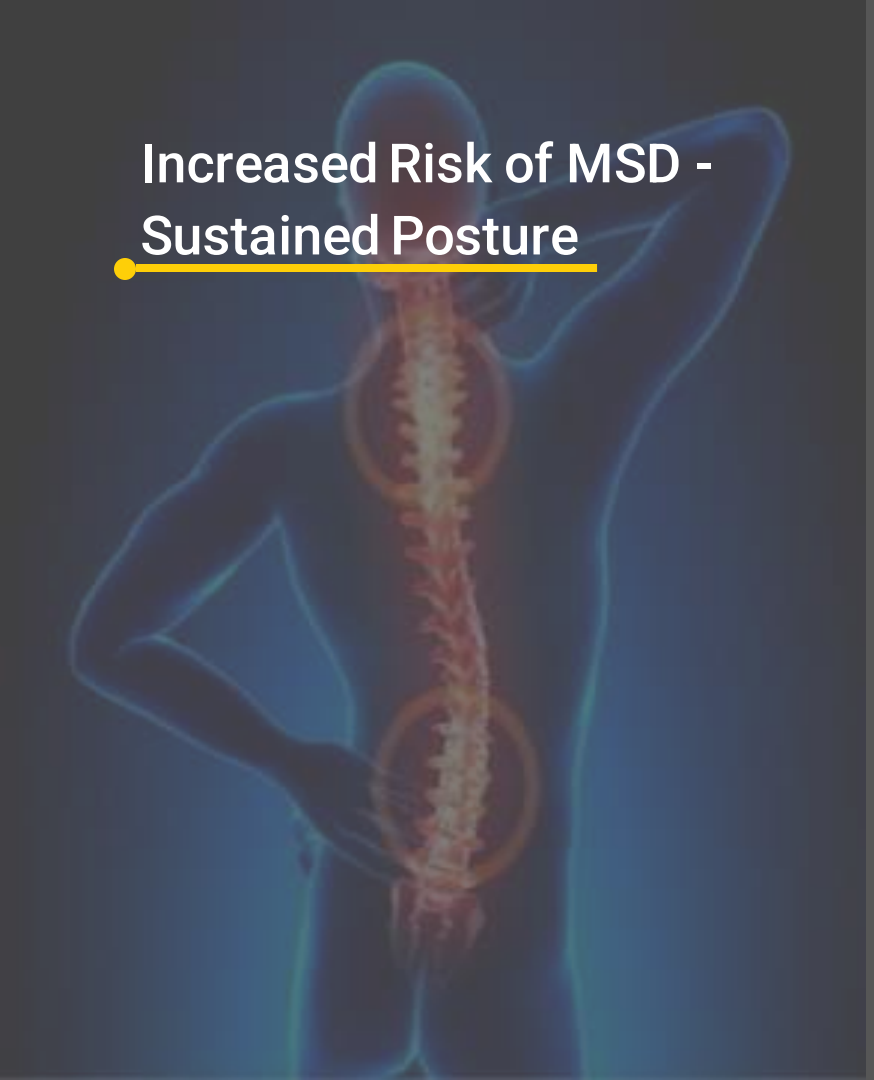
Increased Risk of MSD - Sustained Sitting



However, more recent reviews have failed to support this theory

(Straker L et al., 2016; Janwantanakul P. et al. 2012; Waersted M, 2010).

“It is not the sitting position itself that increases MSD risk, it is the sustained posture that often occurs whilst sitting.”



Increased Risk of MSD - Sustained Posture

Sustained posture (>10 min) DOES increase risk of MSD - either sitting or standing.

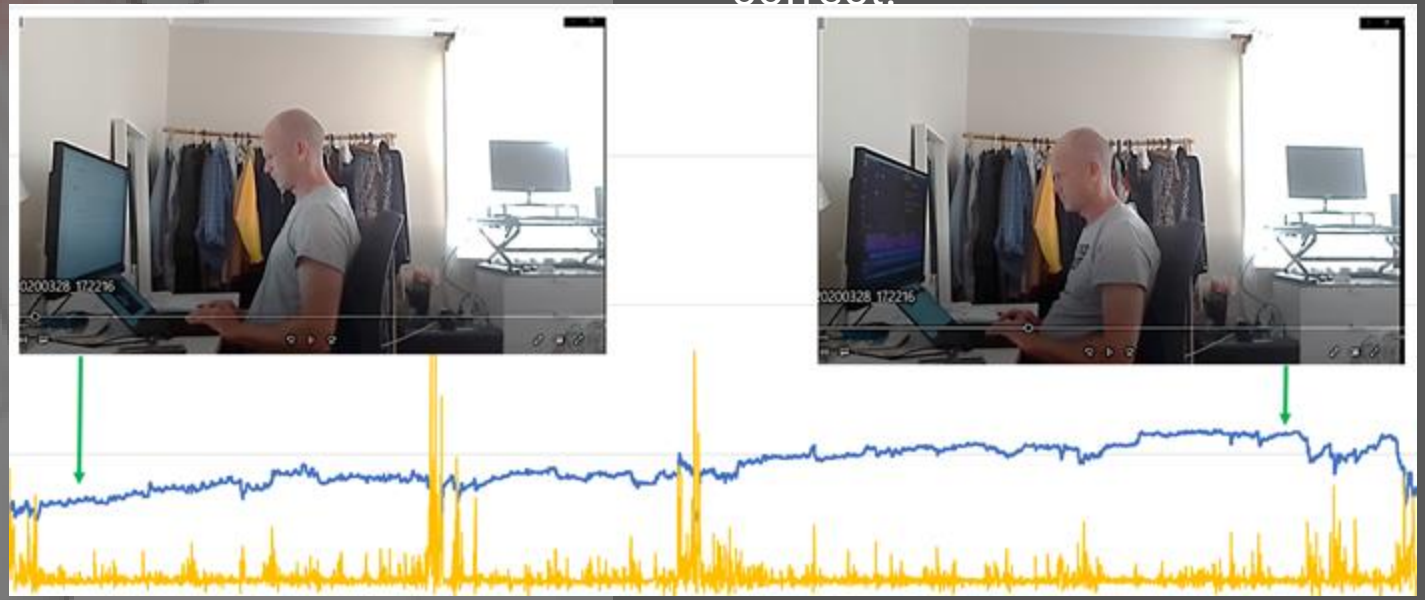
(Falla D & Farina D, 2007; Straker L et al., 2011 & 2016; Ariens G A. et al. 2000)

This is due to;

- prolonged isometric muscle contractions resulting in muscle pain, and
- muscle fatigue increasing load

Increased Risk of MSD - “Poor Posture”

Poor sitting posture DOES indicate poor ergonomics. If an individual worker’s posture changes from upright to slouched after working for 20-30min, their workstation is not correct.

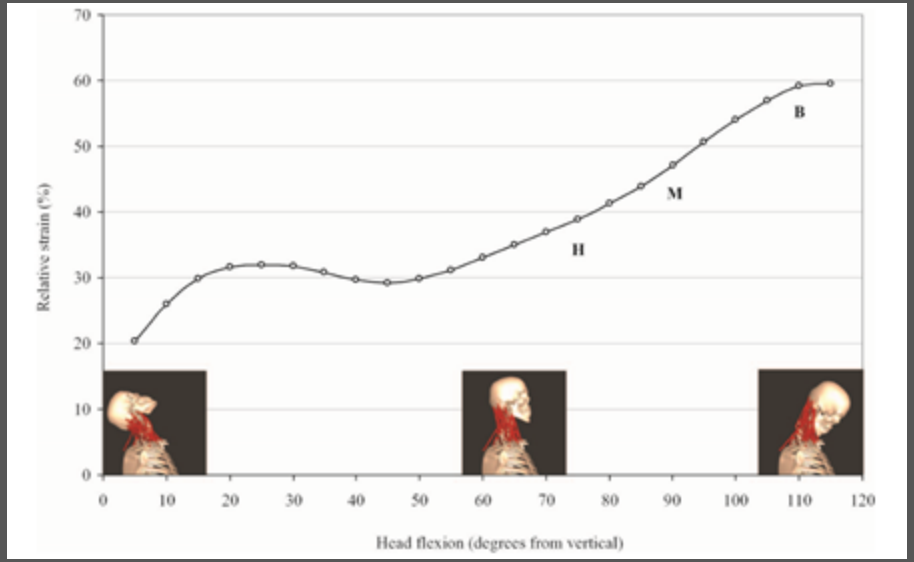


L et al.

Increased Risk of MSD - “Poor Posture”

Effects of visual display position on strain

(Straker L et al. 2009)



Addressing the Needs of the Worker

Slouch Alerts

- Prompt posture correction
- Identify poor ergonomics

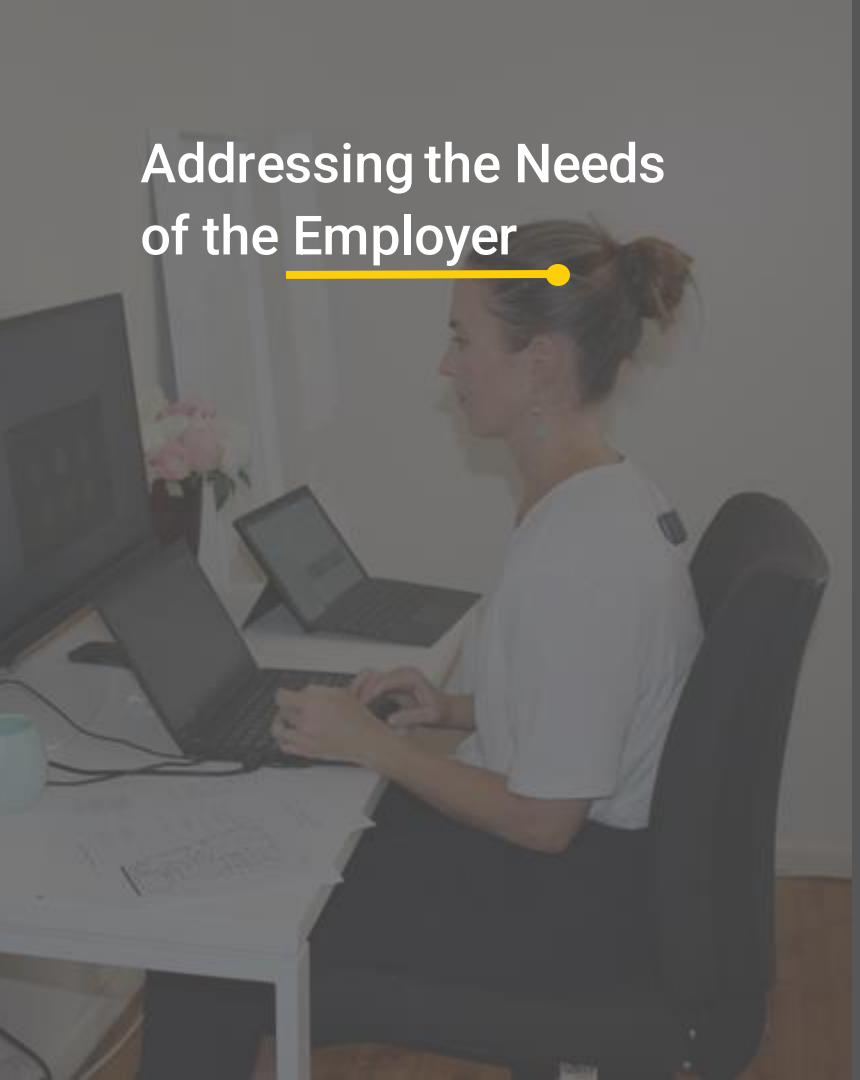
Stretch Alerts

- Prompt movement after sustained postures
- Specific exercises

Step Count

- Monitor activity levels

Addressing the Needs of the Employer



Reducing risk of MSD

- Workstation ergonomics
- Sustained Postures

Creating a safe work environment

- Slip / trip / fall

Encouraging healthy behaviour

- Stretch alert
- Step tracking

Maintaining worker engagement is key

- Team challenges

Addressing the Needs of the Employer

Monitoring progress and identifying trends

Questions?

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(02) 8599 7116

https://preventure.live