Ergonomics for Occupational Hygienists

February 28th 2006 (International RSI Day)

Richard Wells M.Eng., Ph.D.
University of Waterloo

- **A Presentation for the Canadian Council of Occupational Hygiene and the Canadian Centre for Occupational Health and Safety**
- **Broadcast live from McMaster University, Hamilton, Ontario**

Outline

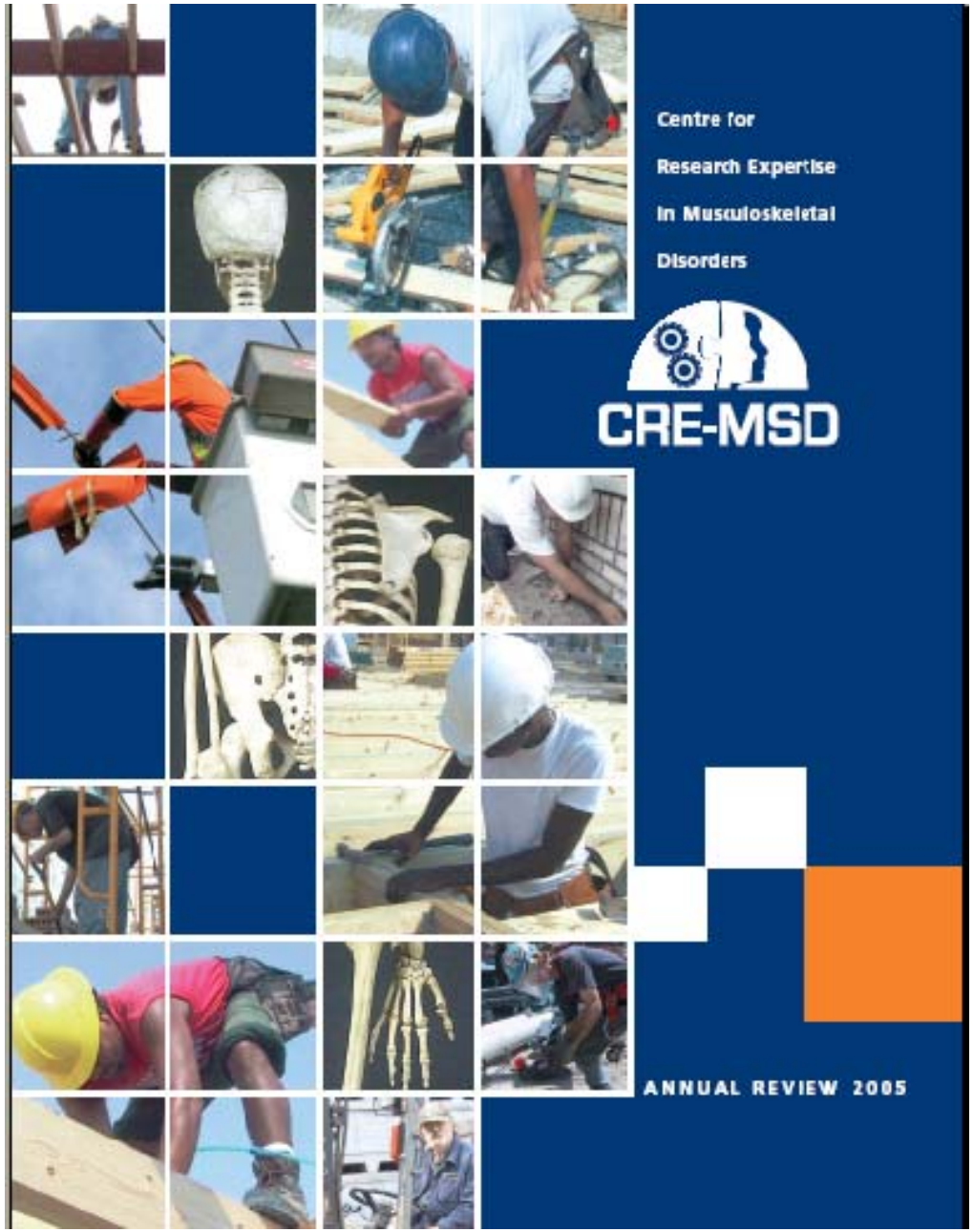
- RSI Day
- Centre of Research Expertise for the Prevention of MSDs
- Key Messages
- Musculoskeletal Disorders (MSDs)
- Force as an Physical Agent
- Hazard Identification
- Risk Assessment Examples
  - ACGIH Hand Activity TLV
  - ACGIH TLV for Lifting
- Control Strategies
- Overview of Guidelines/Regulation
- Summary and Key Messages

RSI Day

- Feb 29th is the only non-repetitive day of the year and is International RSI Awareness Day
- RSI Day evolved from an idea by a Canadian injured worker.
- Highlights the work hazards that cause strain injuries, undertakes workplace activities on strains prevention and presses for preventive action by employers and governments

CRE-MSD

Centre of Research Expertise for the Prevention of Musculoskeletal Disorders



www.cre-msd.uwaterloo.ca

Centre of Research Expertise for the Prevention of Musculoskeletal Disorders

Vision:

Bringing together researchers and workplace parties to identify the key questions, research the best answers, and to pass on the best knowledge that will lead to the prevention of musculoskeletal disorders at work

Mission:

To develop, through basic and applied research, the foundations for effective prevention of work-related musculoskeletal disorders

Centre of Research Expertise for the Prevention of Musculoskeletal Disorders

Activities:

1. **The identification of mechanisms of development of work-related musculoskeletal disorders**
2. **The development of assessment tools and interventions to prevent musculoskeletal disorders**
3. **The implementation and evaluation of workplace interventions to prevent musculoskeletal disorders**

Support:

CRE-MSD receives substantial funding through a grant provided by the Workplace Safety and Insurance Board and its Research Advisory Council. In addition, the Centre benefits from the support of the University of Waterloo.

Prevention of Musculoskeletal Disorders: Key messages

1. MSD have a large monetary and personal burden

2. MSDs are often difficult to diagnose, have a variable time course and are underreported

3. MSD pathophysiology is under active investigation

4. There is a strong work-related component

Prevention of Musculoskeletal Disorders: Key messages …continued

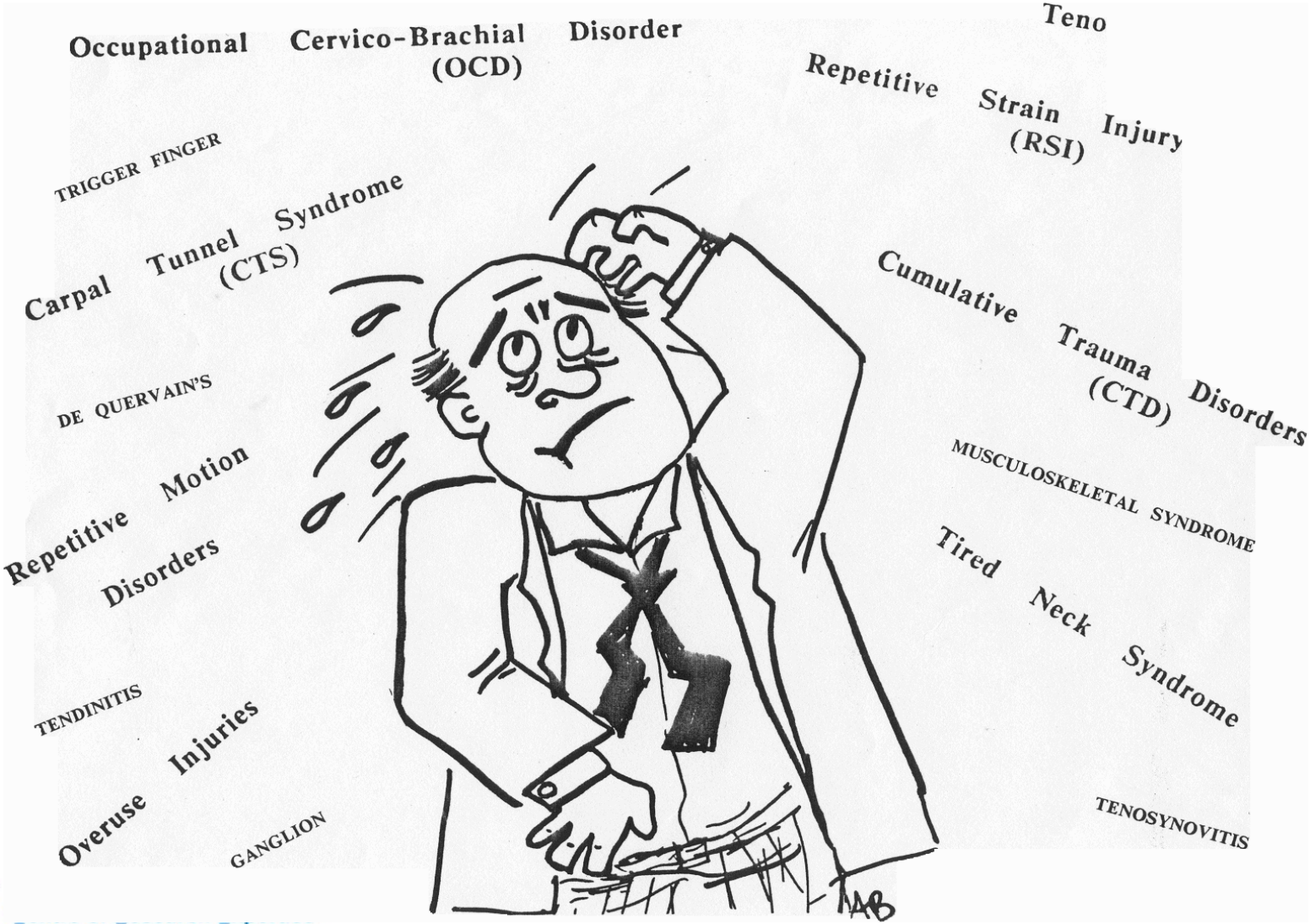
5. Prevention of MSDs can be approached in the same way as other occupational health and safety processes

6. Guidelines and tools for hazard identification and risk assessment exist

7. Interventions to prevent MSD have been shown to work

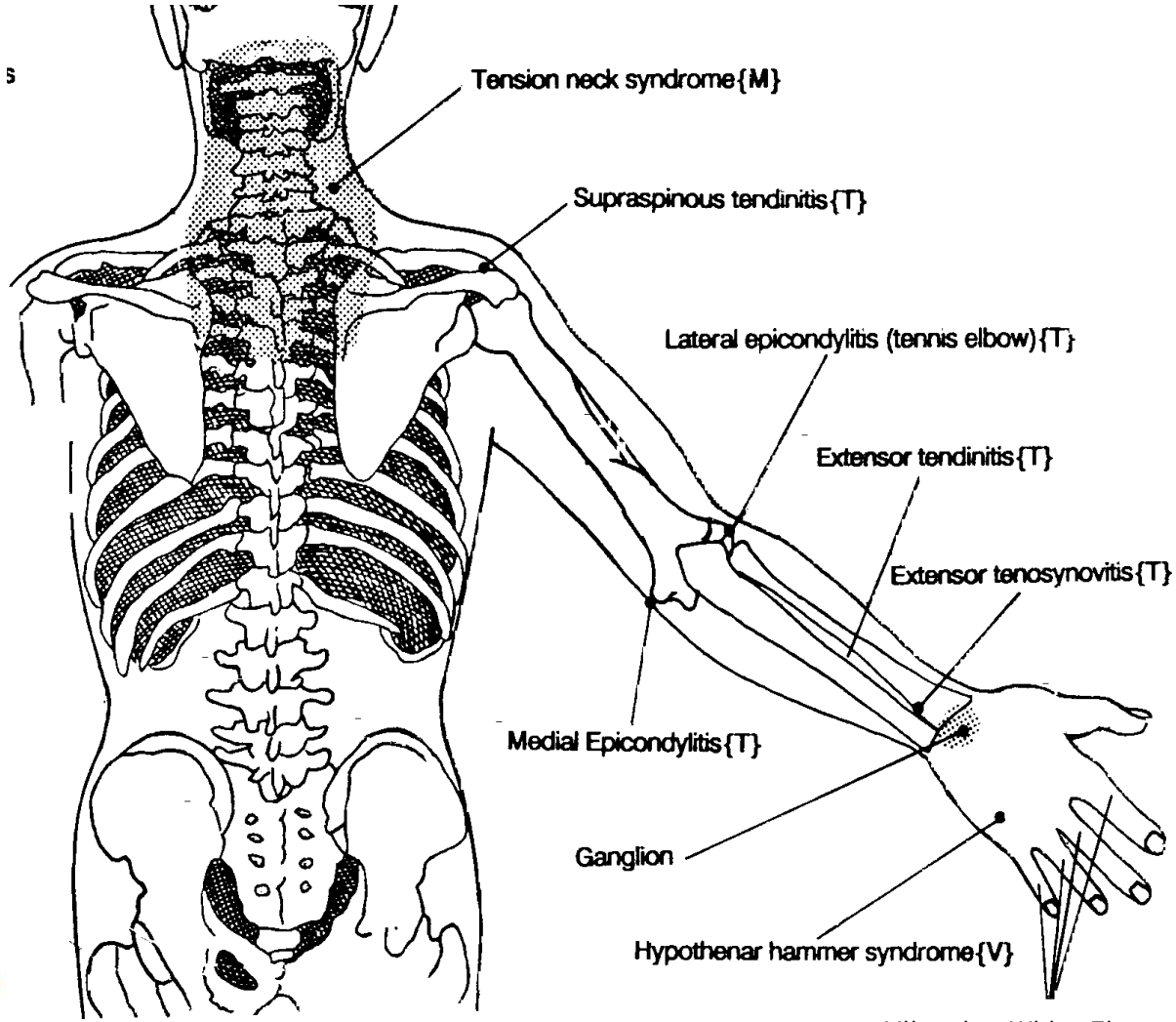
8. Interventions should be based on an understanding of the root causes of the problem in the particular context

Musculoskeletal Disorders: What's in a name?



Musculoskeletal Disorders:

Work-related musculoskeletal symptoms most commonly affect the neck, back, shoulders, wrists and fingers, but can also occur in legs and feet.



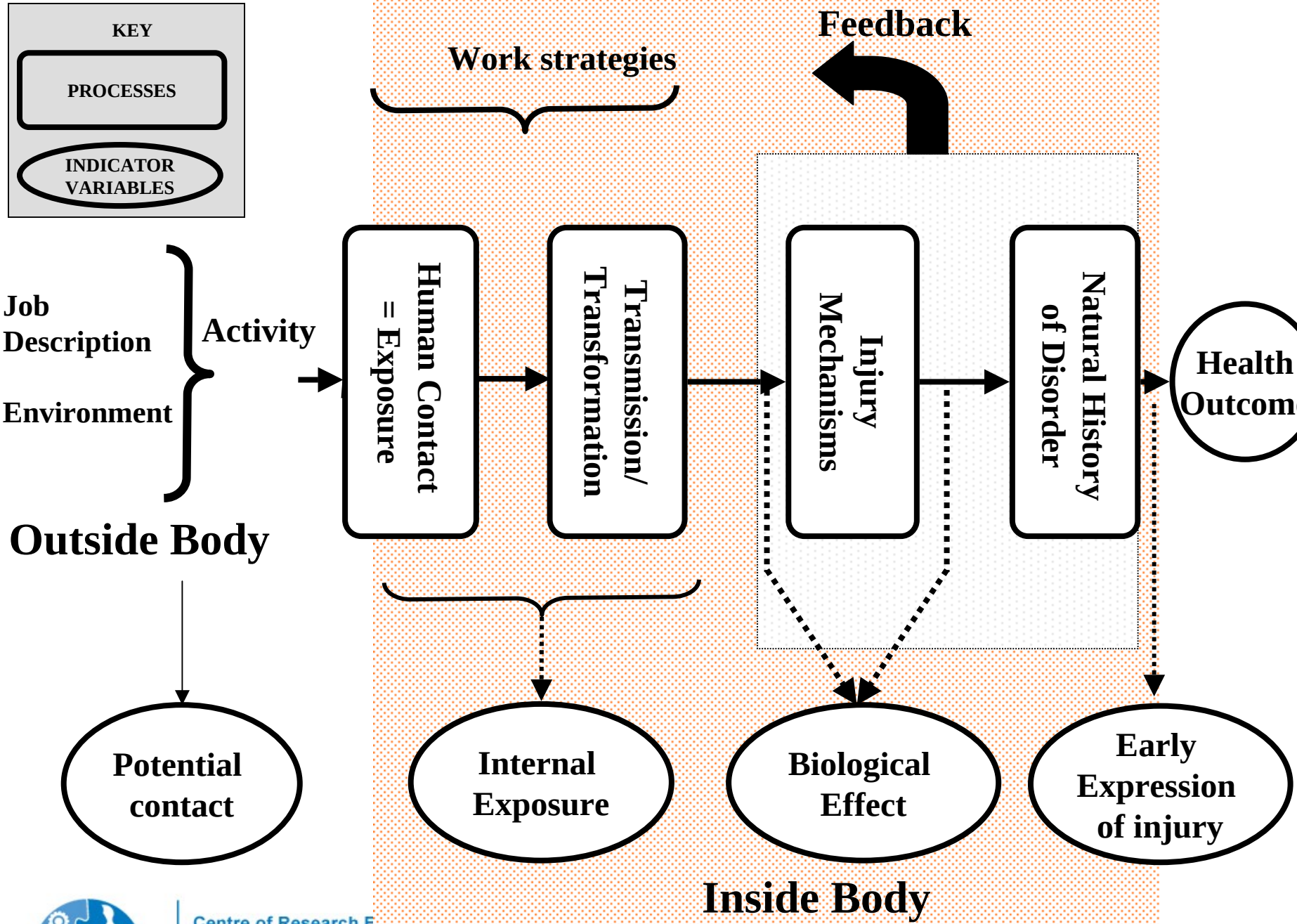
Vibration White Finger

Force as a Physical Agent

The development of musculoskeletal disorders can be thought of in the same way as many other physical agents, e.g. vibration or sound.

In the same way that many aspects of hand arm and whole body vibration are ill understood, many aspects of musculoskeletal disorders are still being researched and defined.

Lioy et al., (1998); Wells et al (2004)

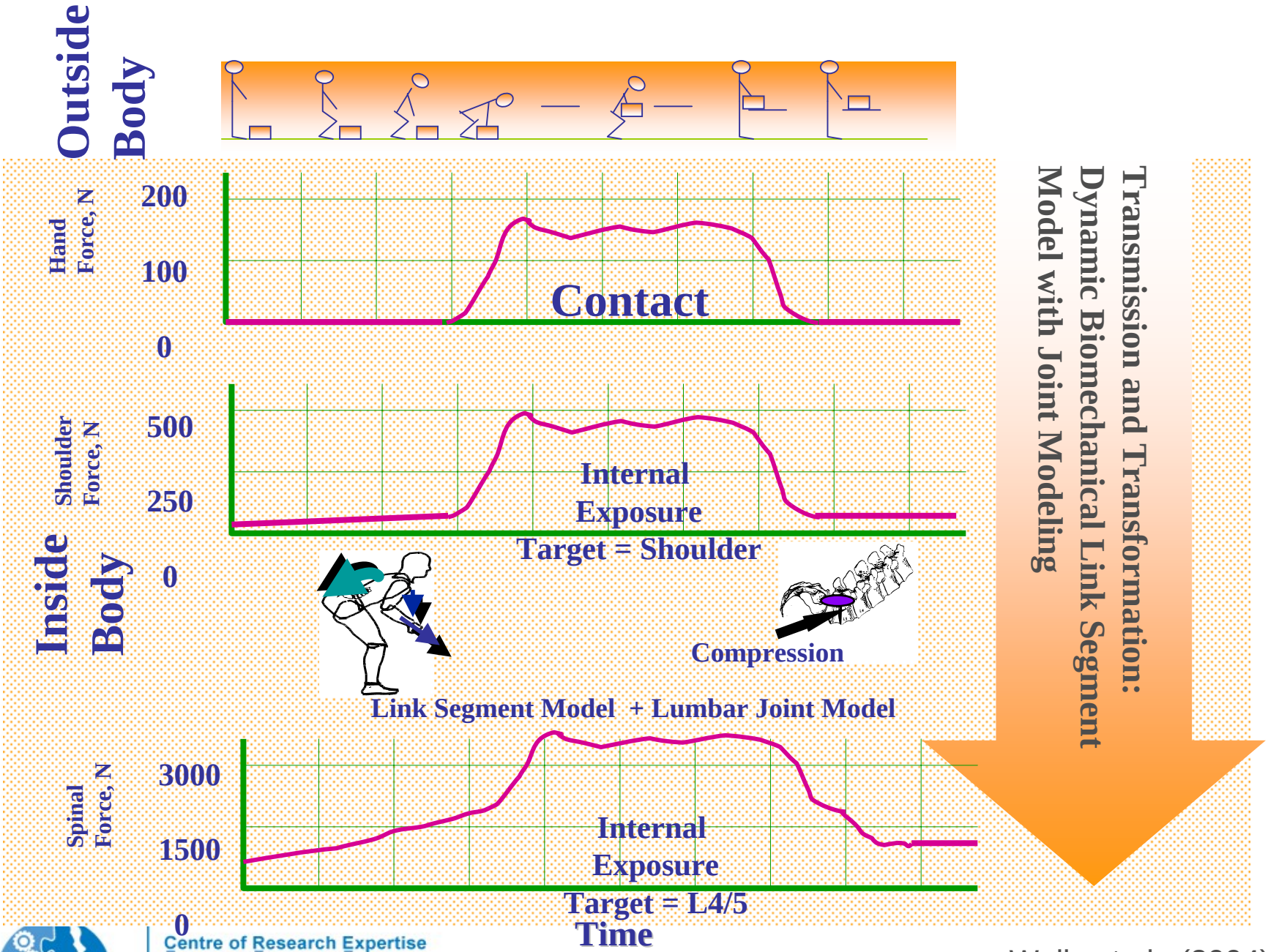


Wells et al., (2004)

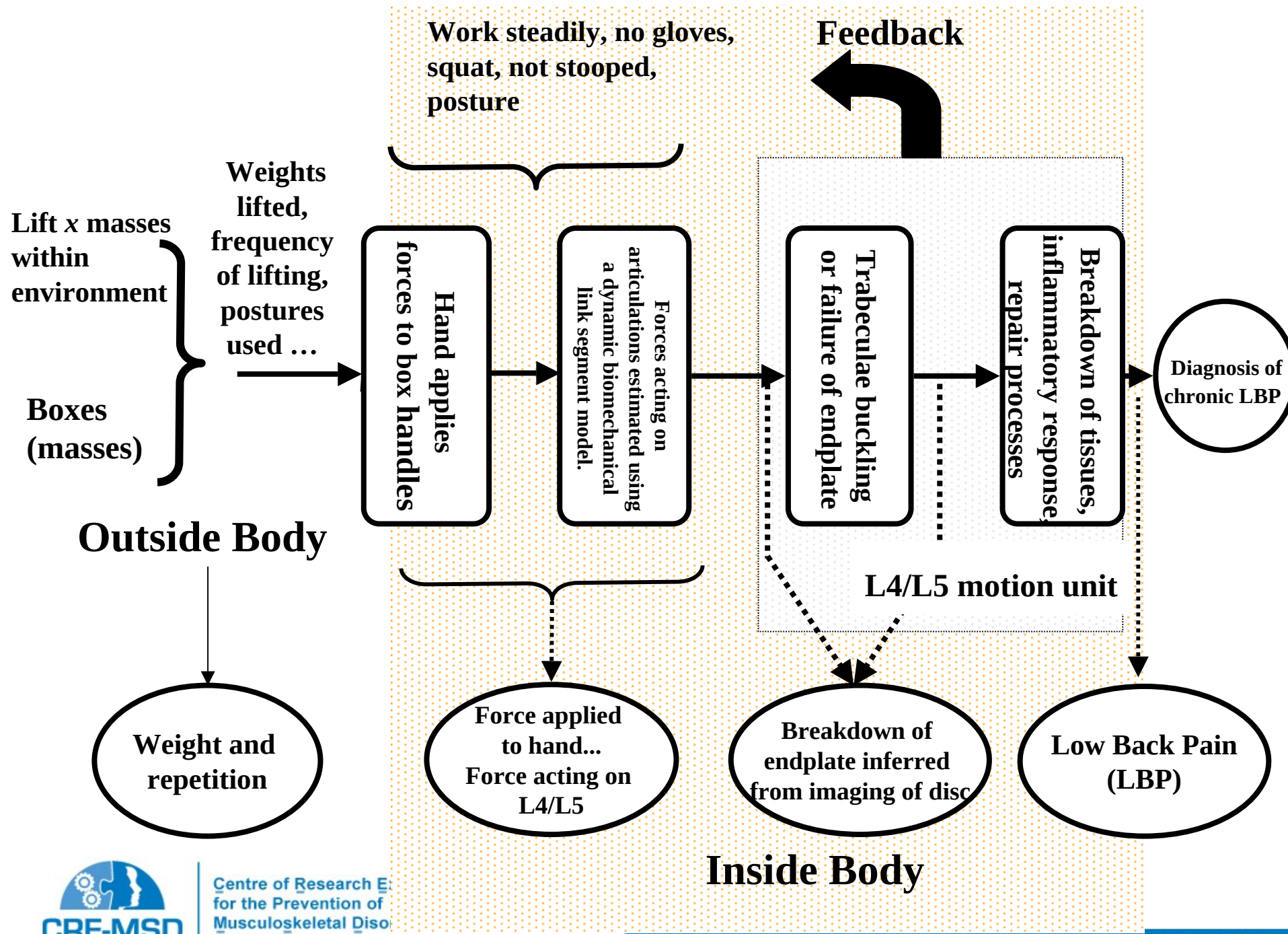
Manual Materials Handling

Manual materials handling still a problem…

Weights have actually increased and handling frequency has also increased

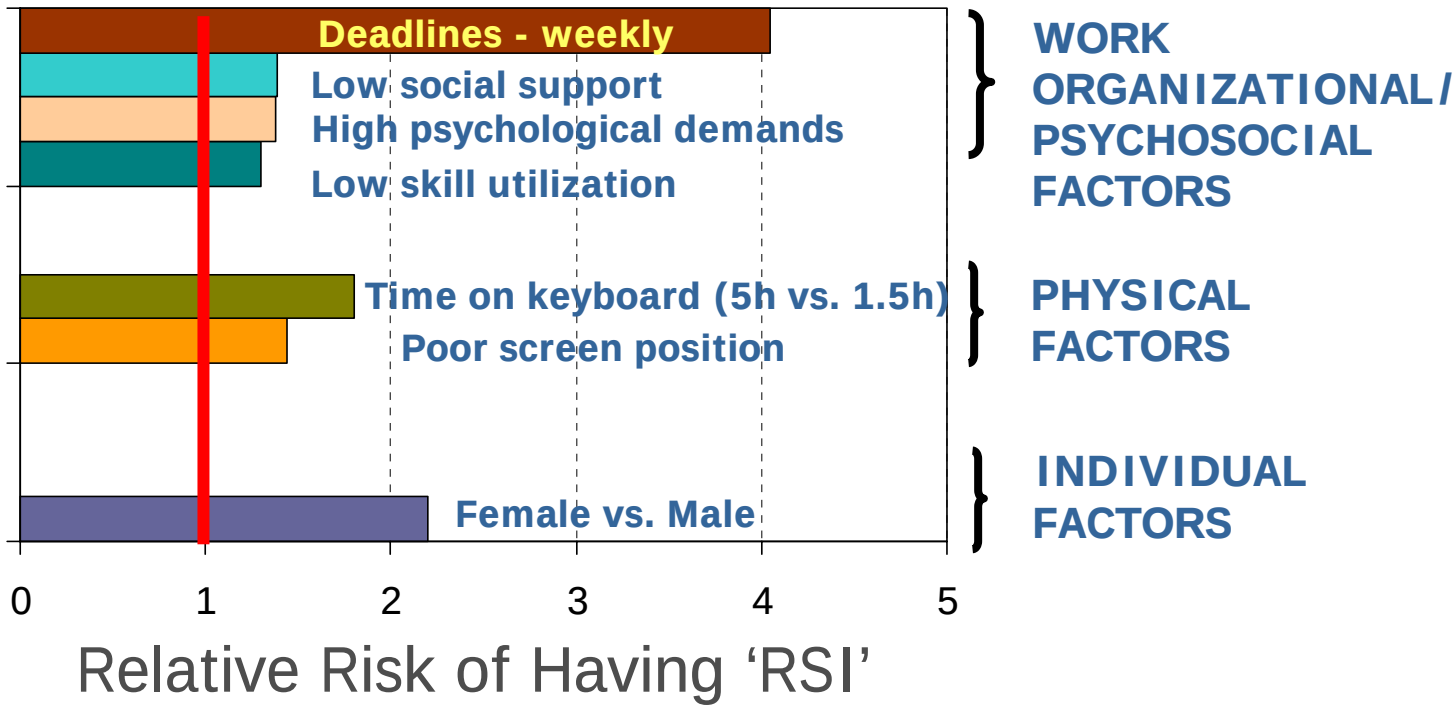


Wells et al., (2004)


Work steadily, no gloves, squat, not stooped, posture
Feedback
Weights lifted, frequency of lifting, postures used …
Lift x masses within environment
Boxes (masses)
Hand applies forces to box handles
Forces acting on articulations estimated using a dynamic biomechanical link segment model.
Trabeculae buckling or failure of endplate
Breakdown of tissues, inflammatory response, repair processes
Diagnosis of chronic LBP
L4/L5 motion unit
Outside Body
Weight and repetition
Force applied to hand... Force acting on L4/L5
Breakdown of endplate inferred from imaging of disc
Low Back Pain (LBP)
Inside Body

MSDs have a large work-related component

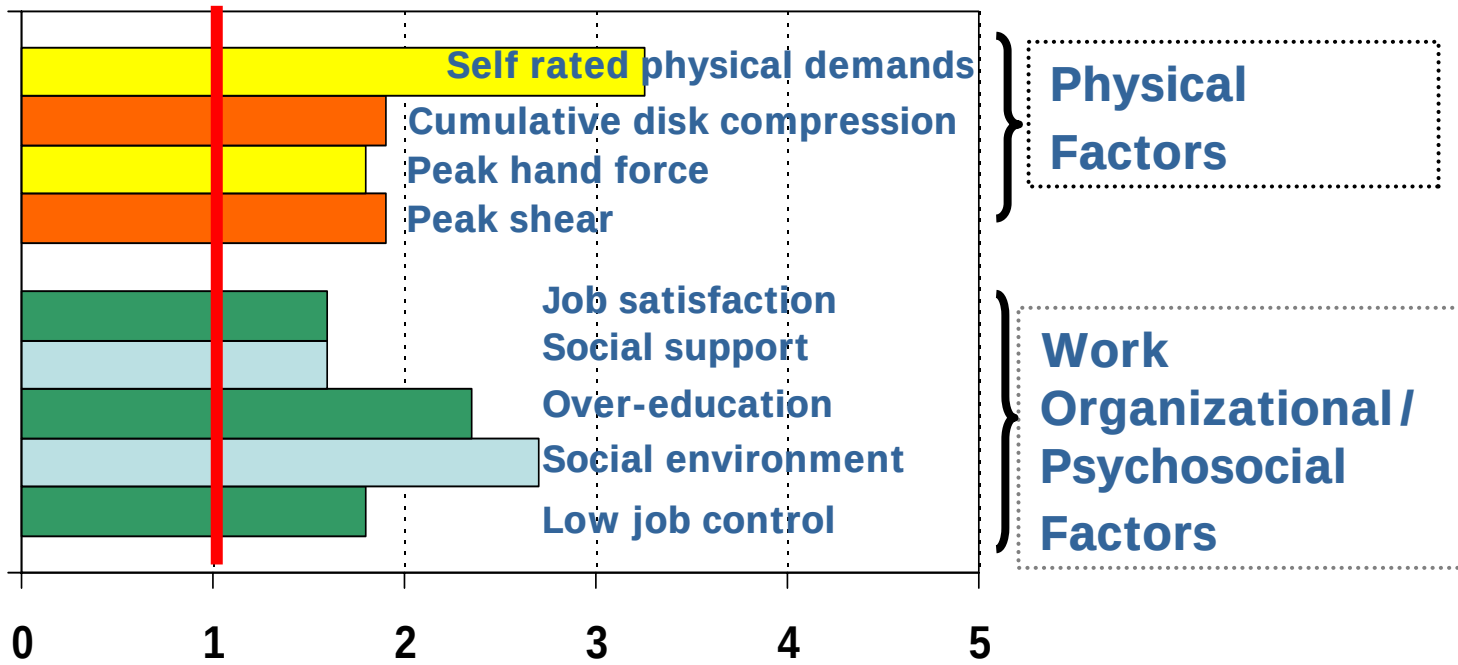
Risk factors for upper limb MSD in a large Canadian office



Polanyi et al., (1998)

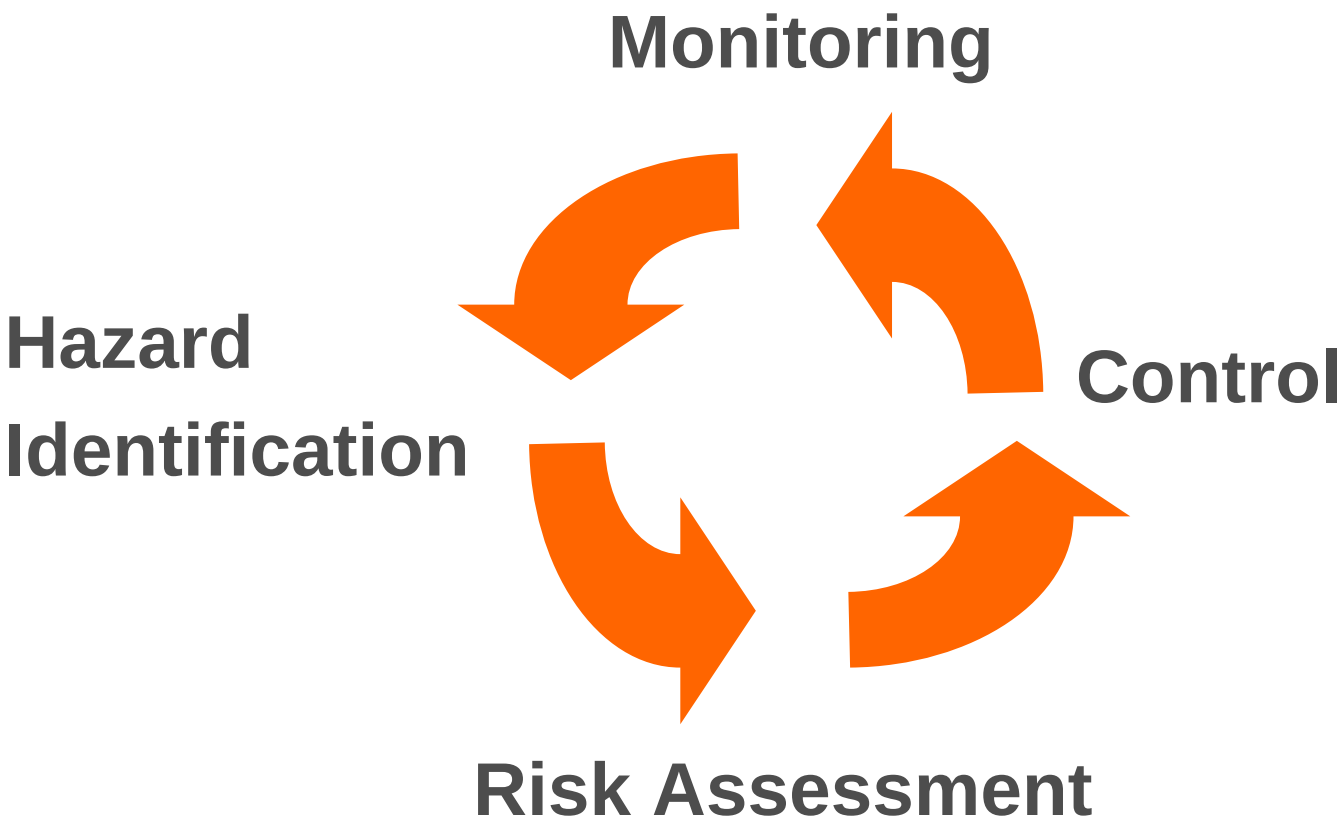
MSDs have a large work-related component

Risk factors for Low Back Pain in a Canadian auto assembly plant



Norman et al., (1998); Kerr et al., (2001)

Prevention process



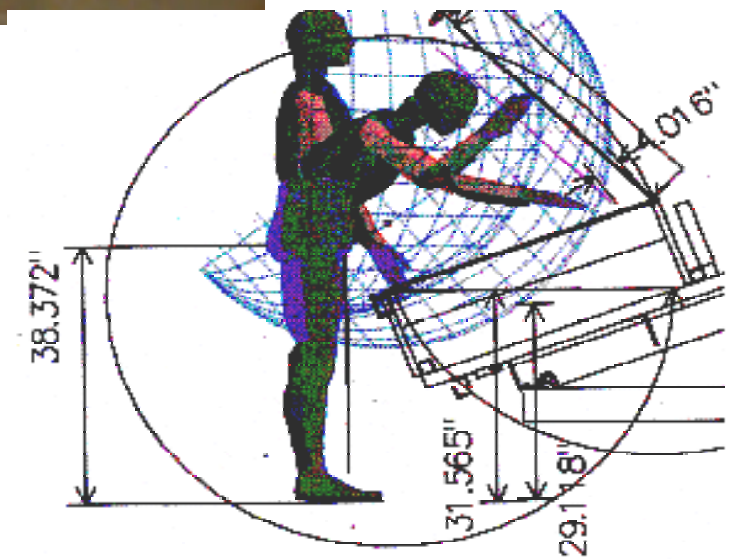
Hazard Identification

Hazards can be identified by the external environment or…

by the interaction of the person with that environment

Hazards

Hazards



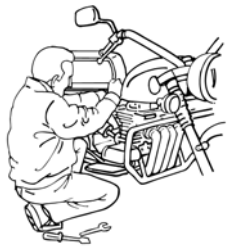
Hazards

Hazard Identification

General Checklists (with scoring)

- RULA; Rapid Upper Limb Assessment
- REBA; Rapid Entire Body Assessment
- QEC; Quick Exposure Check
- **Washington State Caution Zone Checklist**

Washington State Caution Zone Jobs Checklist

Caution Zone Checklist Use one sheet for each position evaluated.			
Movements or postures that are a regular and foreseeable part of the job, occurring more than one day per week, and more frequently than one week per year.	If done in this job position ✓ the box	Job Position evaluated: Date:	No. of employees in these jobs?
Awkward Posture		**Comments/Observations**	
 **1.** Working with the hand(s) above the head, or the elbow(s) above the shoulders more than 2 hours total per day.	☐		
 **2.** Working with the neck or back bent more than 30 degrees (without support and without the ability to vary posture) more than 2 hours total per day.	☐		
 **3.** Squatting more than 2 hours total per day.	☐		
			

Risk Assessment

Some Quantitative Task/ Body Part specific methods

Manual Materials Handling/Back

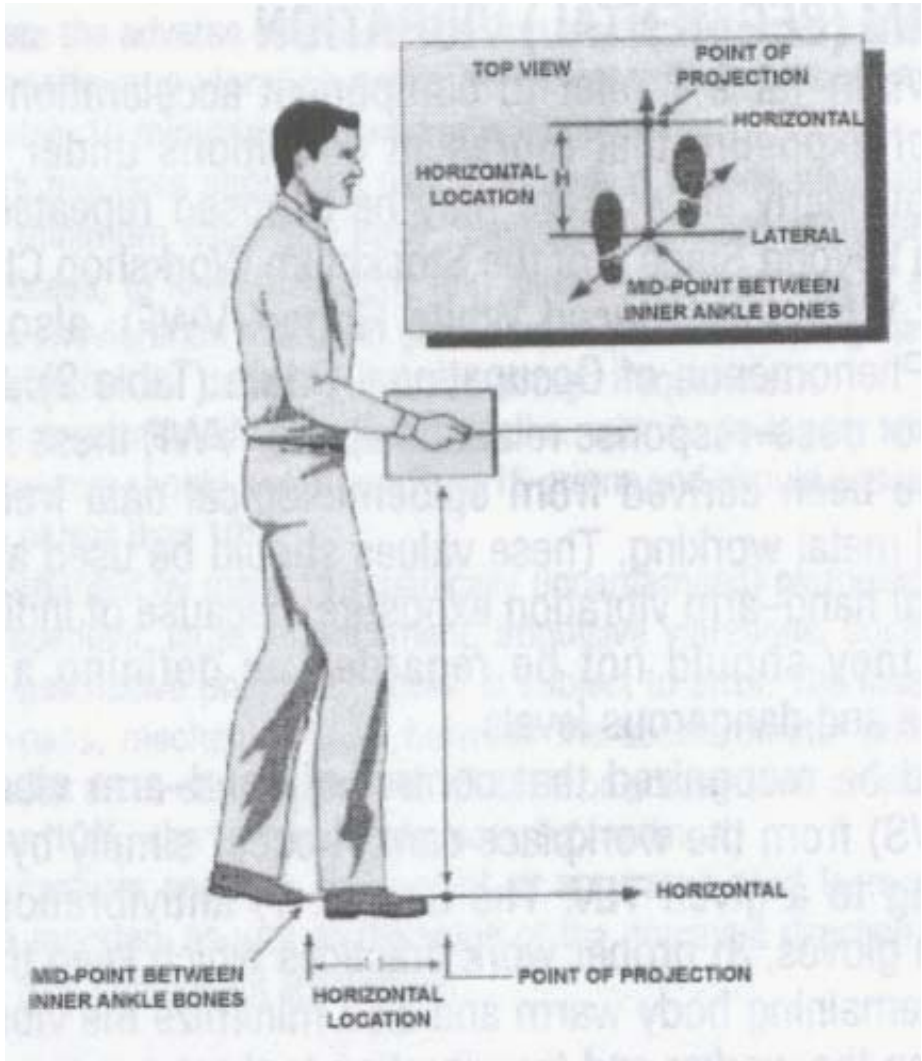
- NIOSH Equation
- SNOOK Tables
- **ACGIH TLV for Lifting**
- …

Upper Limb

- Strain Index
- **ACGIH Hand Activity TLV**
- OCRA
- …

ACGIH Lifting Threshold Limit Values

The TLVs consist of three tables with weight limits, in kilograms, for two-handed, mono-lifting tasks within 30 degrees of the sagittal (neutral) plane.



ACGIH 2001.

Lifting Threshold Limit Values

Lifting Height Zone	Horizontal Location of Lift		
	Close Lifts: Origin < 30 cm from midpoint between inner ankle bones	Intermediate lifts: origin 30 to 60 cm from midpoint between inner ankle bones	Exte 60 to midp inne
Reach limit[B] from 30 cm above to 8 cm below shoulder height	16 kg	7 kg	No for
Knuckle height[D] to below shoulder	32 kg	16 kg	
Middle shin height to knuckle height[D]	18 kg	14 kg	
Floor to middle shin height	14 kg	No known safe limit for repetitive lifting[C]	No for

Notes:

A. Lifting tasks should not be started at a horizontal reach distance more t

ACGIH 2001

ACGIH Hand Activity TLV

Two major factors considered:

- Hand Activity
- Force exerted

Hand Activity Level (HAL) scale; Estimated by observation

0	2	4	6	8	10
Hands idle most of the time; no regular exertions	Consistent conspicuous long pauses; or very slow motions	Slow steady motion/ exertions; frequent brief pauses	Steady motion/ exertion; infrequent pause	Rapid steady motion/ exertions; no regular pauses	Rapid steady motion/ difficulty keeping up or continuous exertion

ACGIH 2001

ACGIH Hand Activity TLV

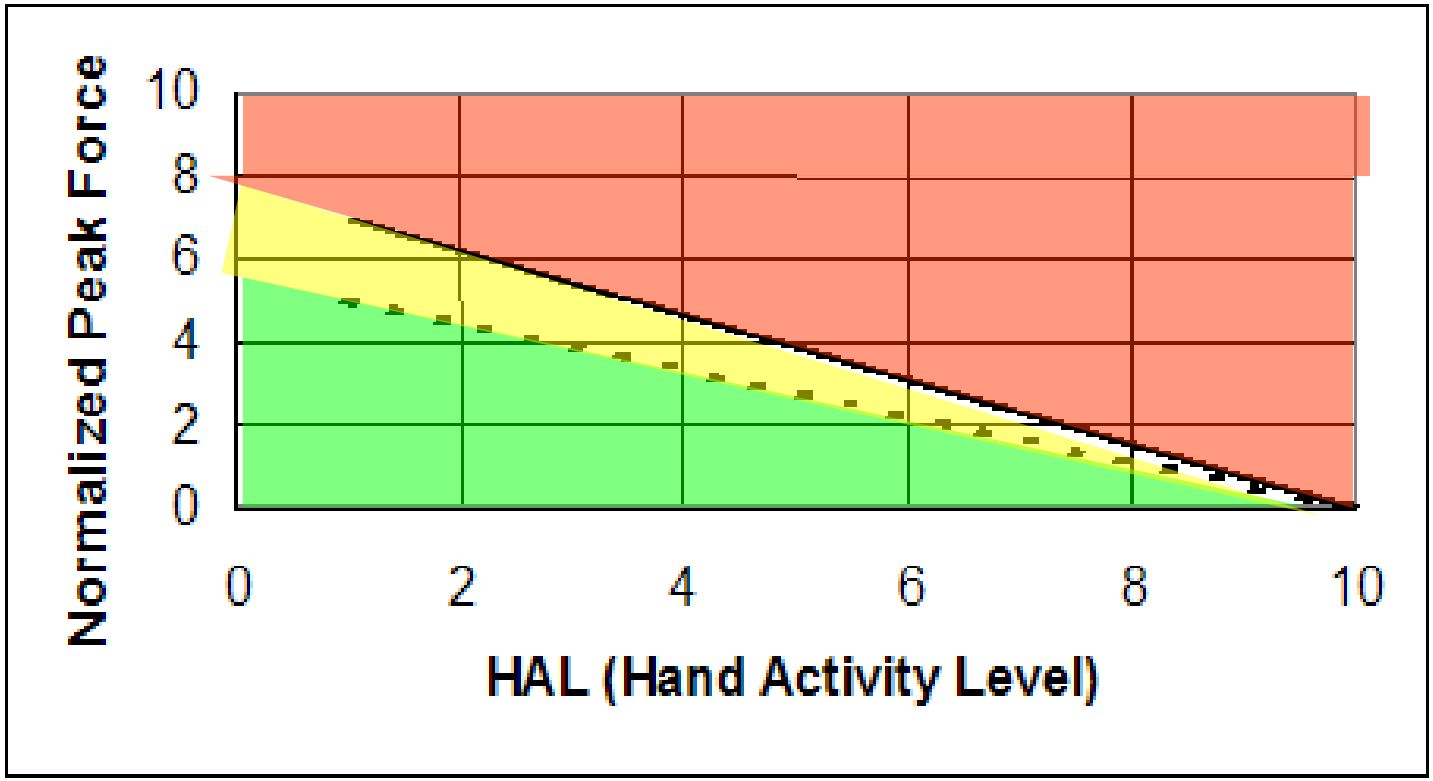
Peak force determined 0-10;

- By Borg scale rating
- Measurement

Score	Verbal Anchor (Borg 1982)
0	Nothing at all
0.5	Extremely weak
1	Very weak
2	Weak (light)
3	Moderately
4	
5	Strong (heavy)
6	
7	Very strong
8	
9	
10	Extremely strong

ACGIH 2001

ACGIH Hand Activity TLV



ACGIH 2001

Control

Interventions should be based on an understanding of the root causes of the problem and tailored to the particular context

"Practical" often means relevant to my situation…(but not to anyone else's situation)… better to concede that there are general principles and approaches

Interventions to prevent low back pain

General Strategy	Example
Eliminate/ Substitute	Redesign (Product)
Engineering Controls	Platforms, Hoists, Rebalancing (Process)
Administrative Controls	Job enlargement, Job rotation, Teams, etc
Personal Protective Equipment	Back belts**, etc
Training	Back school, etc
Increase workers' capacity	Health Promotion, Exercise programs, Stretching programs, etc

**Back belts shown to be ineffective*

How to Intervene to Prevent MSDs?

Example: Understand Root Causes of Low Back Pain at Work

An epidemiological study of low back pain in a large Canadian auto assembly plant revealed these mechanical risk factors:

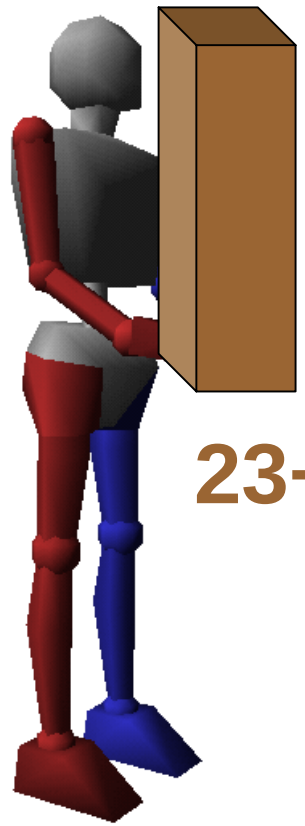
- *High peak loads on the low back*
- *High cumulative loads on the low back*
- *Large degree of trunk motion*

These complement the more common approach of thinking about *force, posture and repetition* but better inform interventions

Root Causes of Low Back Pain at Work #I

High peak loads on the low back

- **Lifting/pushing/pulling large loads***
- Lifting/pushing/pulling loads in disadvantageous postures



23+ kg

****This is the factor most people recognize***

Norman et al., (1998); Kerr et al., (2001)

Interventions for Low Back Pain at Work #l

Problem:

High peak loads on the low back

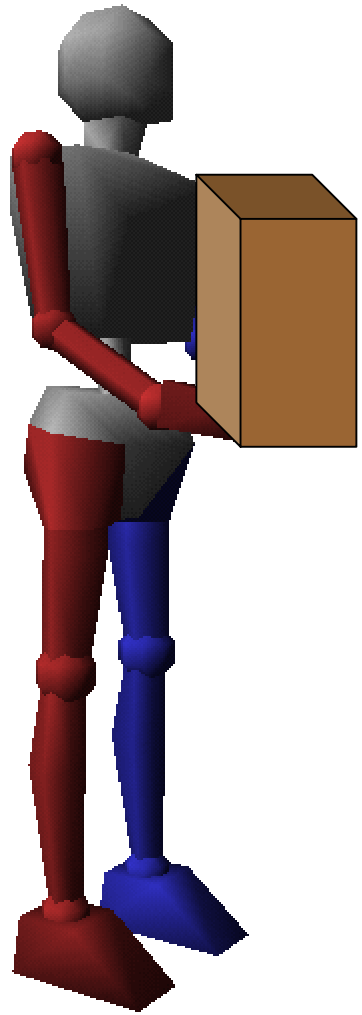
- **Lifting/pushing/pulling large loads**

Interventions (for manufacturing)

- Force/ insertion Limits and Weight Limits e.g. 40lb (~18kg)

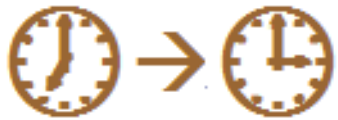
  PRODUCT + PROCESS

- Hoist and lift assists **PROCESS**



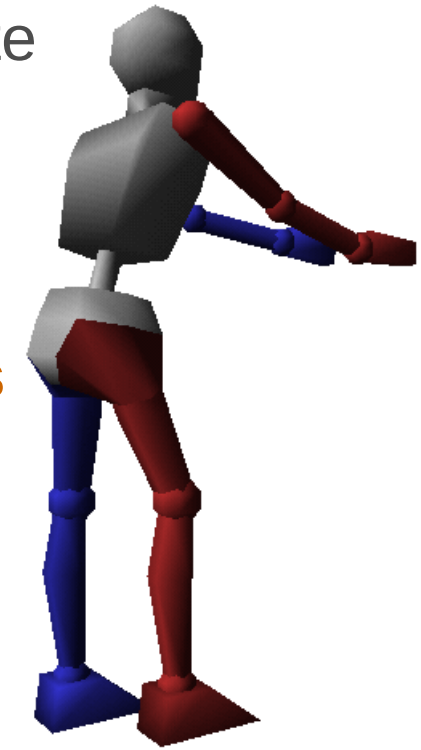
Norman et al., (1998); Kerr et al., (2001)

Root Causes of Low Back Pain at Work #2



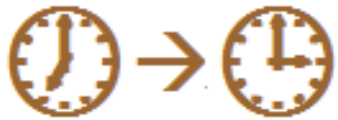
High cumulative loads on the low back

- Lifting/pushing/pulling light to moderate loads for long duration
- Lifting/pushing/pulling of light to moderate loads many times per shift
- **Holding non-upright trunk postures for long duration**
- Long shifts



Norman et al., (1998); Kerr et al., (2001)

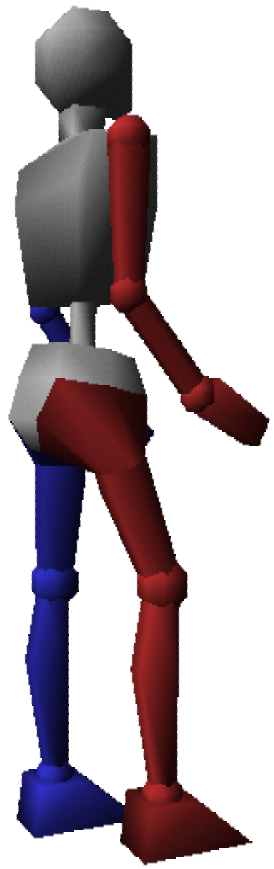
Interventions for Low Back Pain at Work #2



Problem:

High cumulative loads on the low back

- **Holding non-upright trunk postures for long duration**



Interventions (for manufacturing)

- Position of load/force **PRODUCT + PROCESS**
- Reduce force **PRODUCT + PROCESS**
- Reduce time loaded **PRODUCT + PROCESS + ADMIN**

If force small, limited benefit to reducing force as trunk so heav

Norman et al., (1998); Kerr et al., (2001)

Intervention Example

Before

After

Platform

Example of an Upper Limb Intervention

Before:

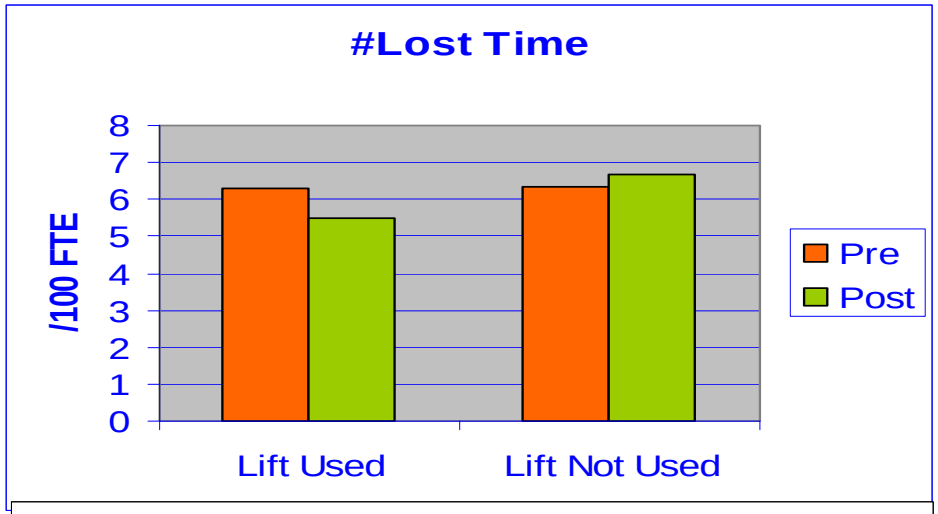
Root Cause: Prolonged pinch grip due to small cutter *leading to* finger and forearm pain

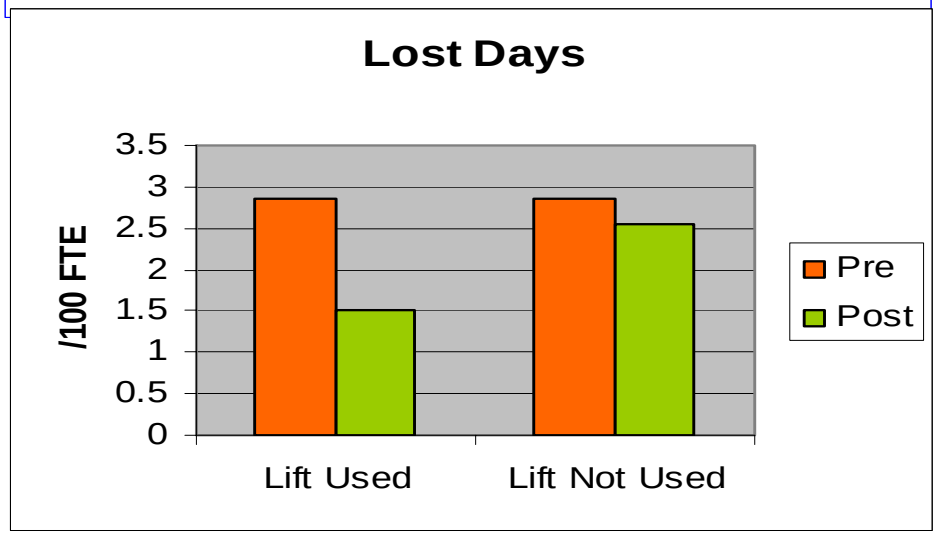
After:

- Power grip
- Preferred by workers, faster
- More rest pauses in forearm muscles

Research Shows That We Can Prevent MSDs ***Now***

- Mechanical lift-assists installed in acute and chronic care facilities
- Earlier return to work when lift assists used
- Newer ceiling lifts likely to produce even larger reductions





Evanoff et al., (2003); Engst et al., (2005)

Canadian Guidelines and Regulations

Canada Labour Code Part II

- Body References Ergonomic Sections
- Ergonomic content under development

British Columbia

- Performance based regulation
- Guidance materials accompany regulation

Saskatchewan

- Although the term ergonomics is not specifically used in *The Occupational Health and Safety Regulations, 1996* , the topic is dealt with in sections 78, 79, 80 and 81 of the regulations.

Ontario

- OSHCO Strategy
- Ministry of Labour Process

Key messages

- MSD have a large monetary and personal burden
- MSDs are often difficult to diagnose, have a variable time course and are underreported
- MSD pathophysiology is under active investigation
- There is a strong work related component

Key messages (continued)

- Prevention of MSDs can be approached in the same way as other occupational health and safety processes
- Guidelines and tools for hazard identification and risk assessment exist
- Interventions to prevent MSD have been shown to work
- Interventions should be based on an understanding of the root causes of the problem in the particular context

Key References for this Presentation

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http://www.labour.gov.on.ca/english/news/2006/06-13b.html

http://www.ahs.uwaterloo.ca/~wells/OccBioHead1.html

http://www.ahs.uwaterloo.ca/~escs/riskwatch.html