MANUFACTURING

03.23.21

1PM-2PM CST

STRAINS, SPRAINS & *REPETITIVE MOTION*

Presented by: ***Safety Management Services Company***

TODAY'S PRESENTER

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TRAINING OBJECTIVES

- Statistics and Costs of Strain, Sprain and Repetitive Motion Injuries
- Types of Strains, Sprains Repetitive Motion Injuries
- Risk Factors that contribute to Strain, Sprain and Repetitive Motion Injuries
- Understand basic Ergonomic Assessment Tools
- How to Develop an Implementation Plan to Prevent Strain, Sprain and Repetitive Motion Injuries

POLL QUESTION #1

What is your most common loss leader/cause of loss at your company?

a) Cuts and Punctures

b) Strains and Sprains

c) Slips and Falls

d) Repetitive Motion Injuries

STRAIN, SPRAIN, REPETITIVE MOTIONS STATISTICS & COSTS

- Muscular Skeletal Disorders (MSDs – 33% of all work-related injuries (BLS 2019)
  - 266,530 Loss Workday cases (total industry)
  - Sprains: 30,480 Loss Workday cases
  - Strains: 124,020 Loss Workday cases
  - Median 13 days away from work
- Average MSD cost (National Safety Council 2017):
  - Strain/Sprain injury: $12,800
  - Cumulative Trauma Injury: $14,000
  - Back injury: $25,800

	Profit Margin($)			
Workers Compensation Costs ($)	2%	6%	10%	20%
10,000	500,000	166,667	100,000	50,000
25,000	1,250,000	416,667	250,000	125,000
20,000	2,500,000	833,333	500,000	100,000
125,000	6,250,000	2,083,333	1,125,000	625,000
250,000	12,500,000	4,166,667	2,500,000	1,250,000

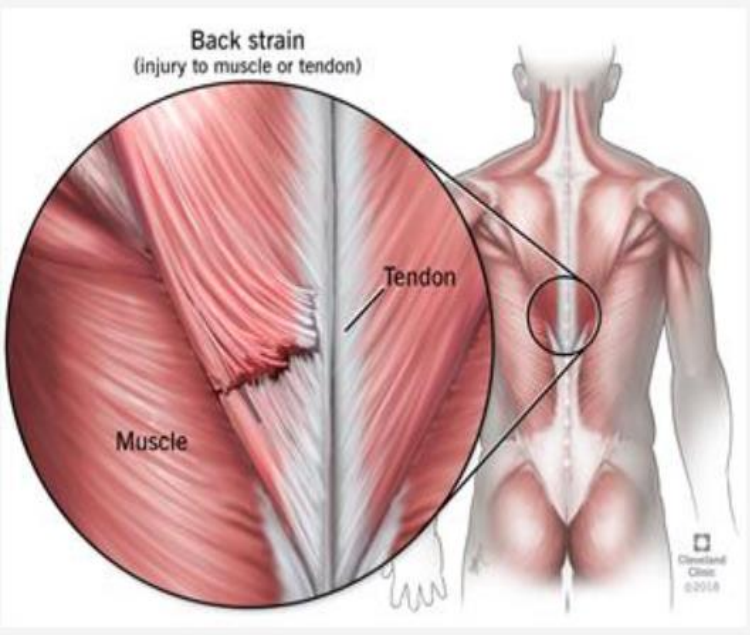
BENEFITS OF ERGONOMICS-IMPORTANCE

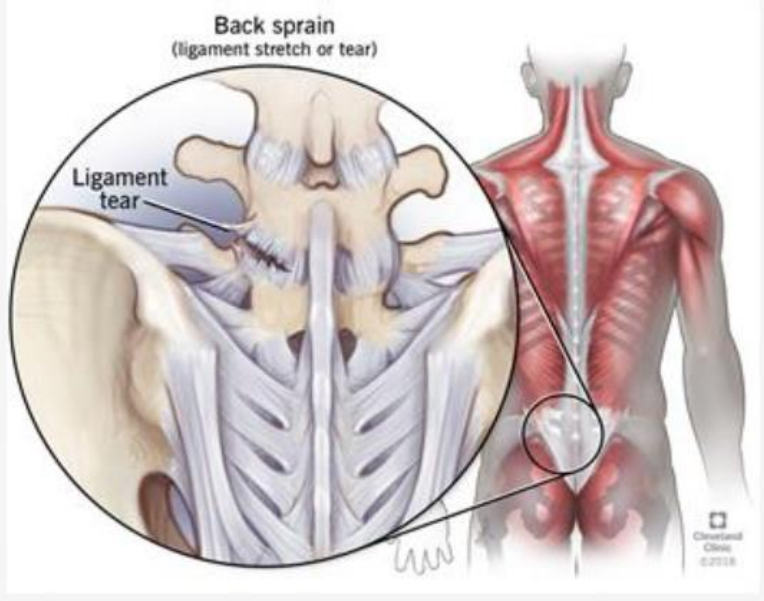
By fitting the work tasks to the capabilities of most employees, employers can:

- Reduce or eliminate the risk factors that lead to musculoskeletal disorders (MSDs)
- Decrease injuries, illnesses, and workers' compensation costs
- Decrease absenteeism and turnover
- Improve employees health outcomes
- Increase employee morale and productivity
- Make it easier for employees to do high-quality work

WHAT ARE STRAINS AND SPRAINS

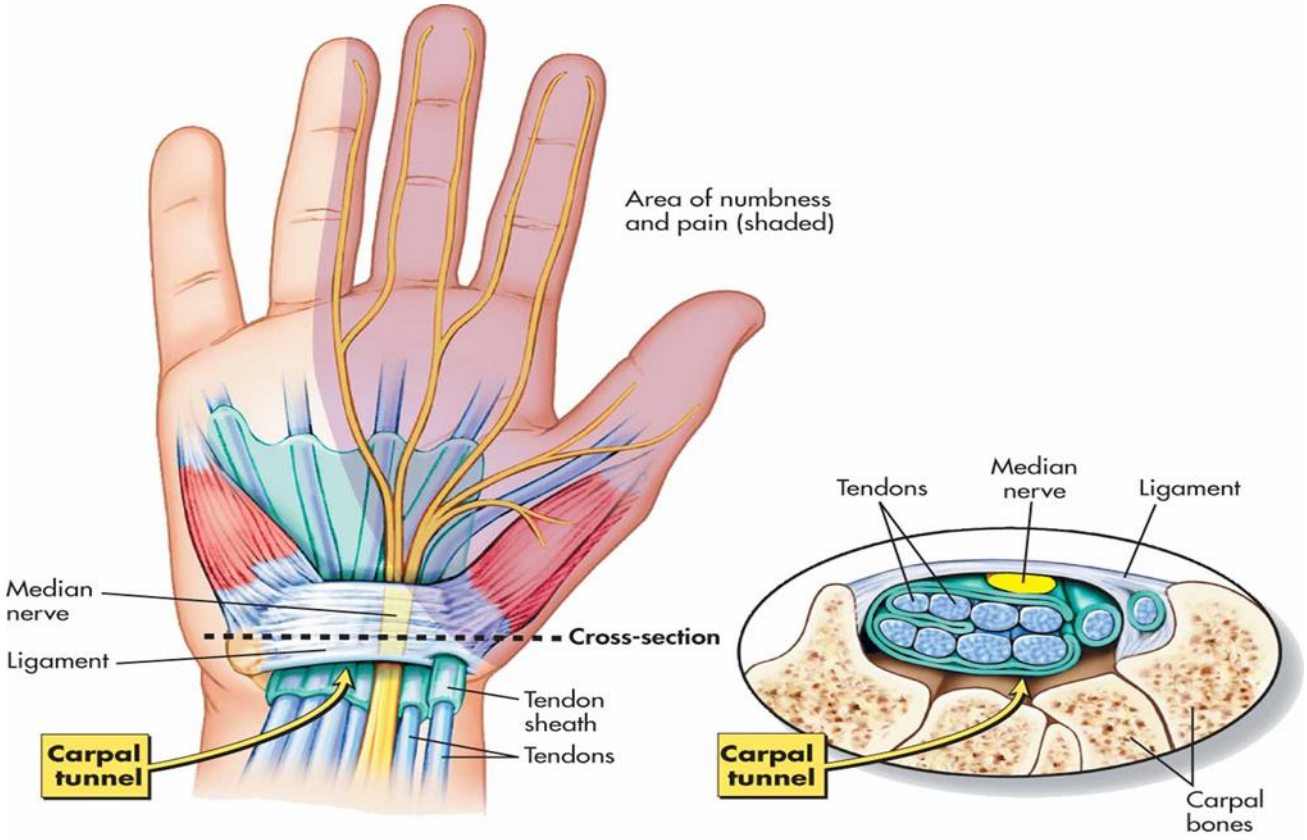
- **STRAIN** = is an injury to a muscle or a tendon (tissue that connects muscle to bone). In a strain a muscle or tendon is stretched or torn
- **SPRAIN** = is an injury to a ligament (tissue that connects two or more bones at a joint. In a sprain, one or more ligaments is stretched or torn





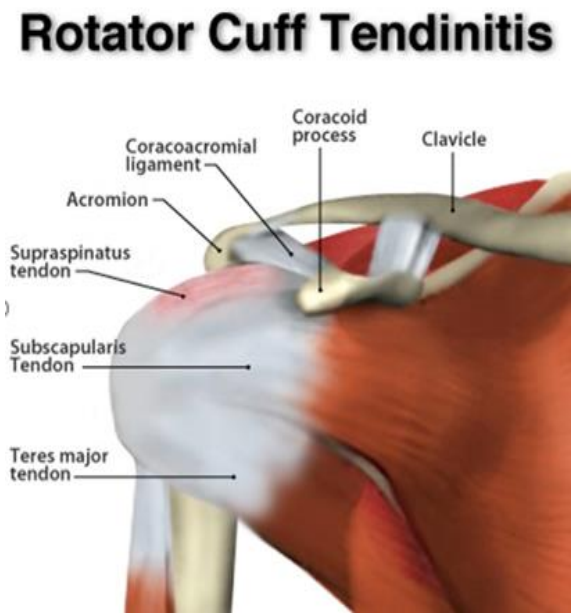
INJURIES-NERVES

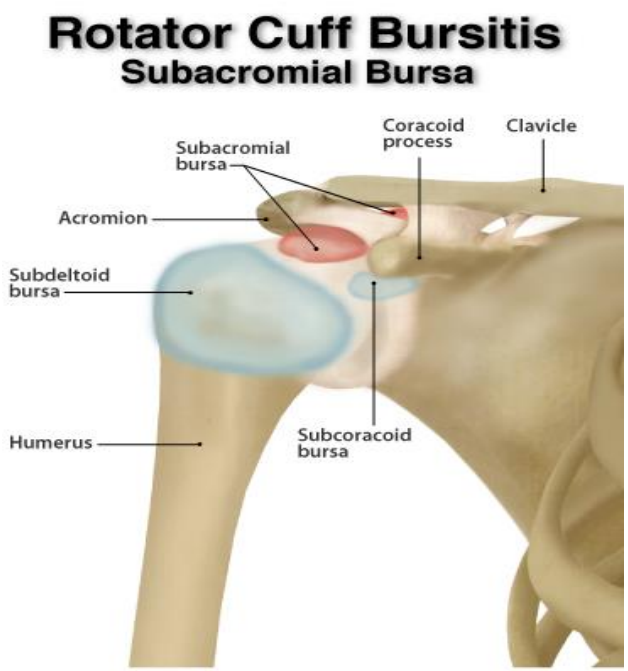
- Carpal Tunnel Syndrome
- Causes: Repetitive motion, repeated vibration, extension of wrist



INJURIES-SHOULDER

- Rotator Cuff Tendonitis/Bursitis
- Causes: Repetitive overhead lifting, forceful pulling motions

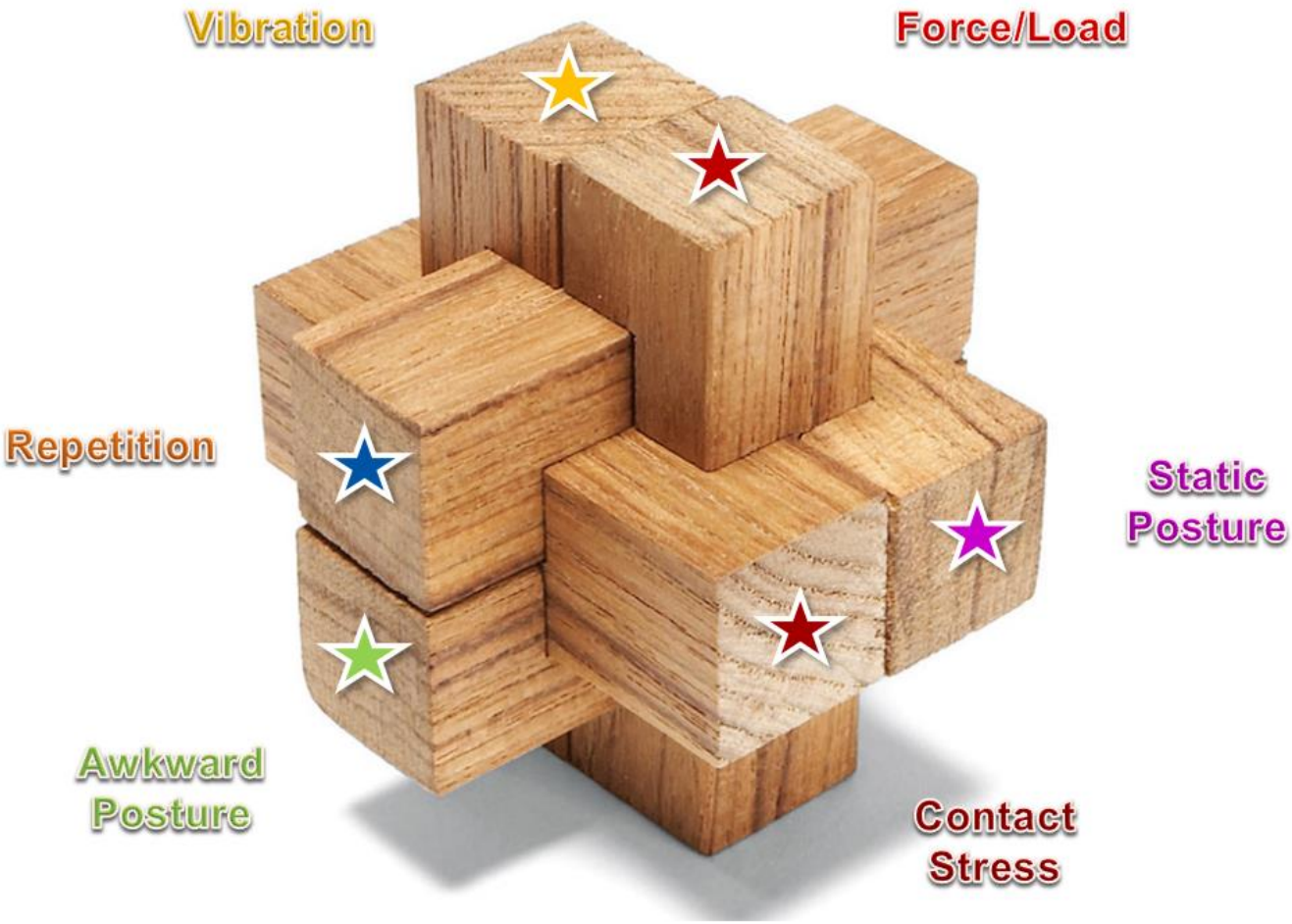




INJURIES-TRAUMA

- How much trauma one body part can take
- How fast a body part can heal
- Trauma Bucket

RISK FACTORS CONTRIBUTING TO STRAINS, SPRAINS, REPETITIVE MOTION INJURIES



RISK FACTORS

- Ergonomics “Fire Triangle”
  - Posture – Non-neutral positions
  - Force – Excessive weight, grip or pressure
  - Frequency – Lack of frequency or too high of frequency

RISK FACTORS-POSTURE

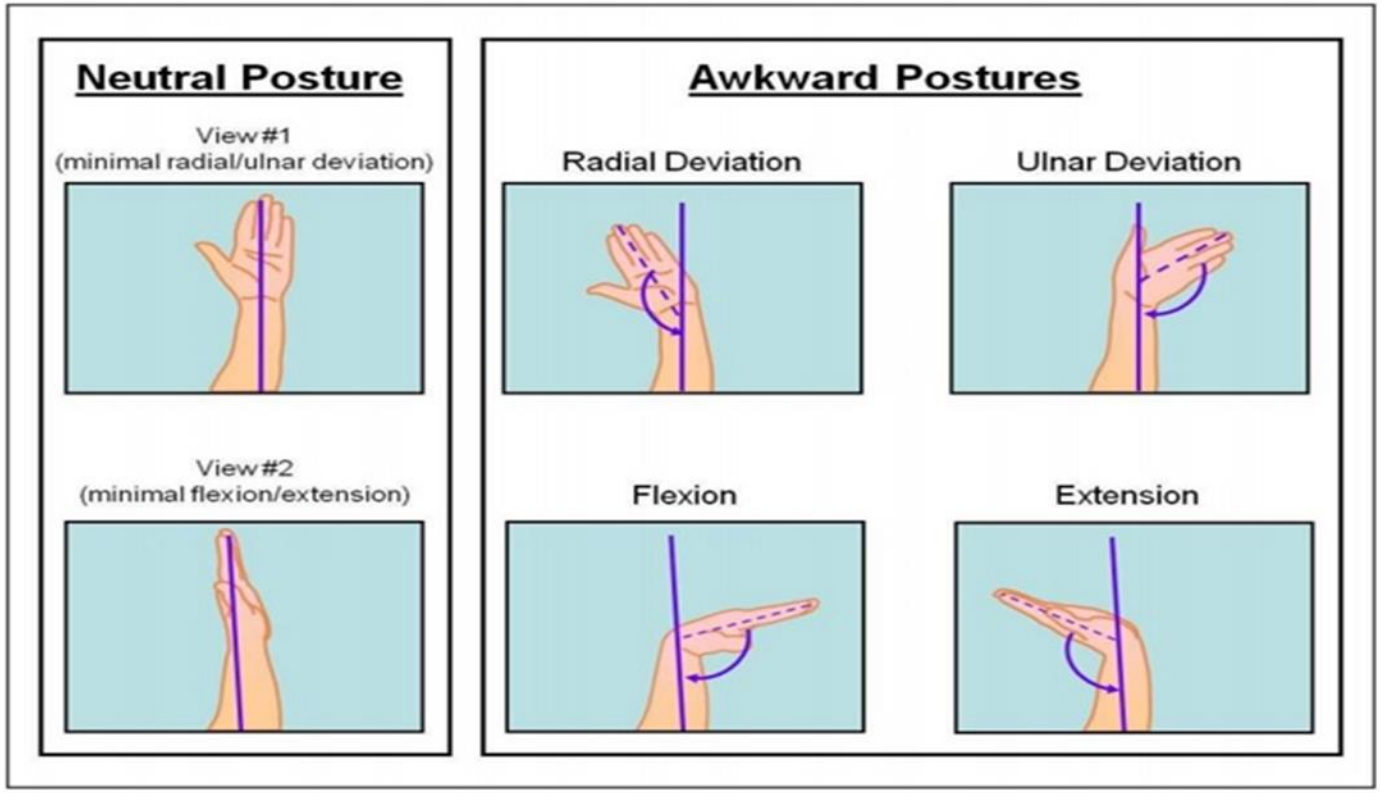
- Positions of the body while performing work activities that deviate significantly from the neutral position
  - Wrist
  - Elbow/Lower Arm
  - Shoulder/Upper Arm
  - Neck
  - Back/Trunk

Example of an engineering control: mechanical devices that lift and tilt to adjust materials for easier handling

Source: Solutions for the Prevention of Musculoskeletal Injuries in Foundries, OSHA Publication 3465, (2012)

RISK FACTORS-POSTURE WRIST

- Neutral wrist provides greatest grasping power



RISK FACTORS-POSTURE WRIST

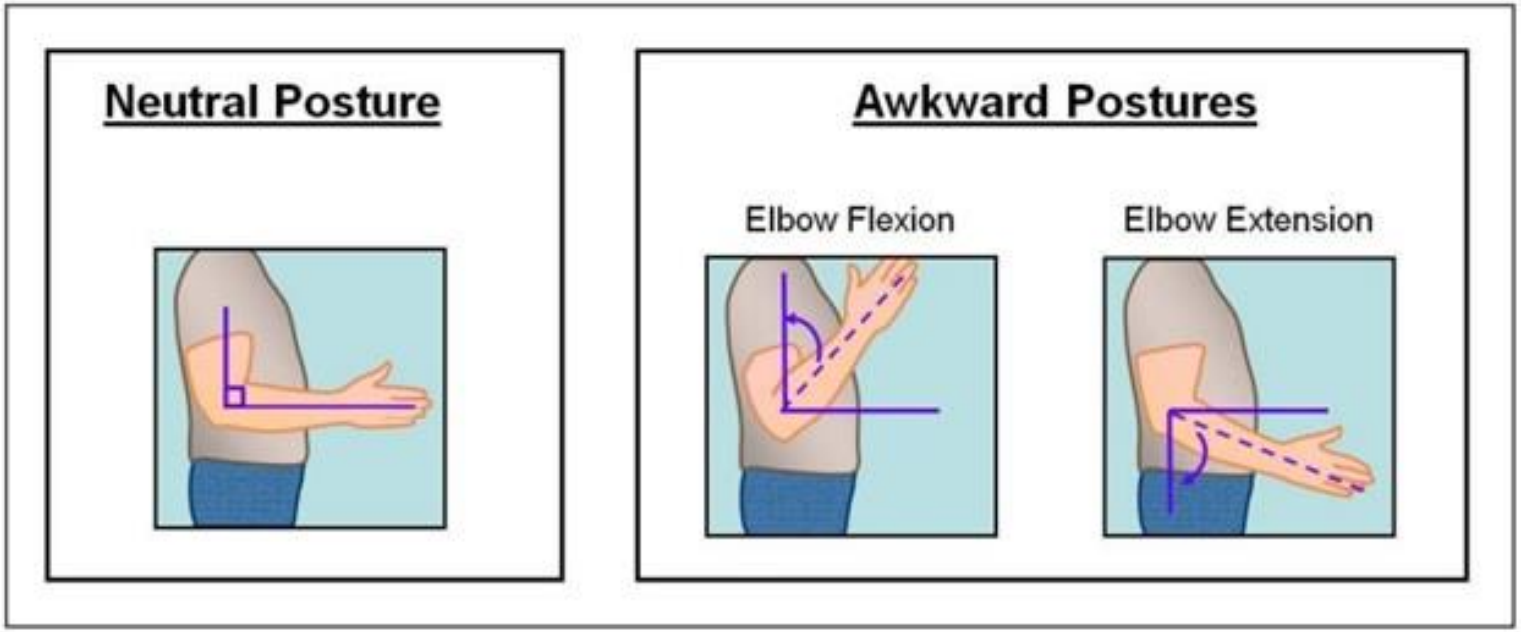
- Pen Grip Test Demonstration

Neutral Position

Awkward Position

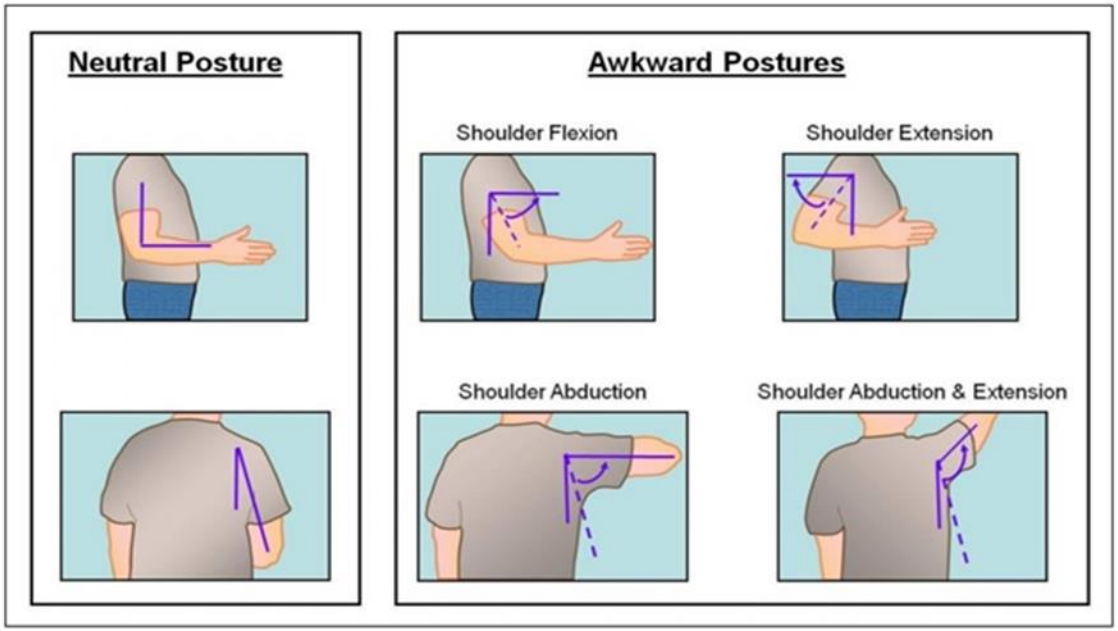
RISK FACTORS-POSTURE ELBOW LOWER ARM

- Elbows at 90 degrees and near body



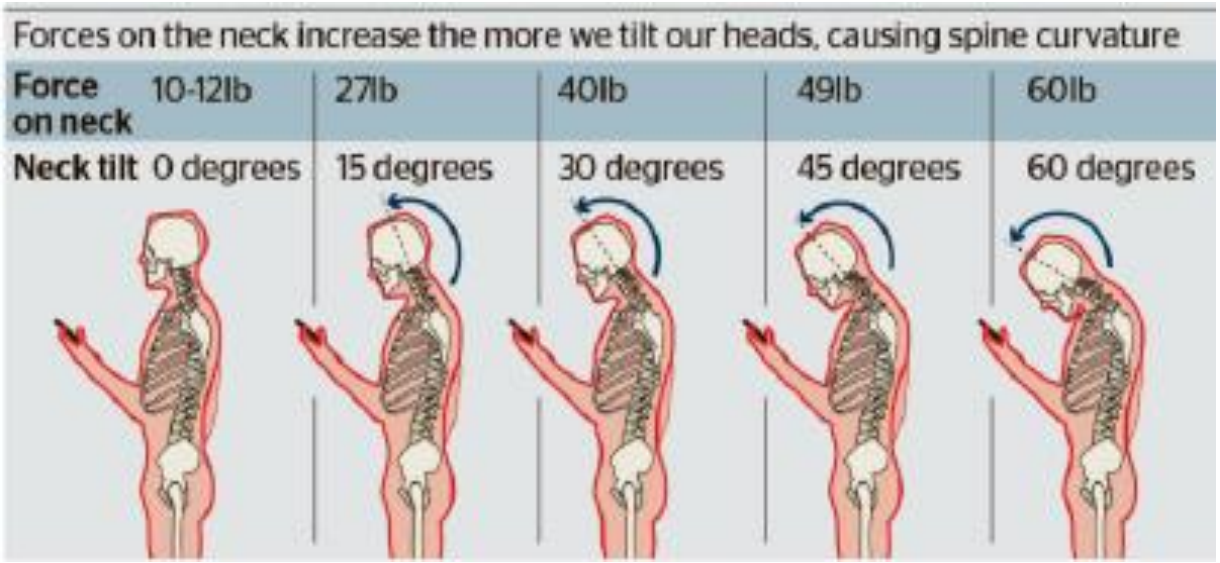
RISK FACTORS-POSTURE SHOULDER/UPPER ARM

- Shoulders naturally level
- Avoid hands behind and above shoulder
- Avoid elbow behind back
- Avoid hands crossing body midline



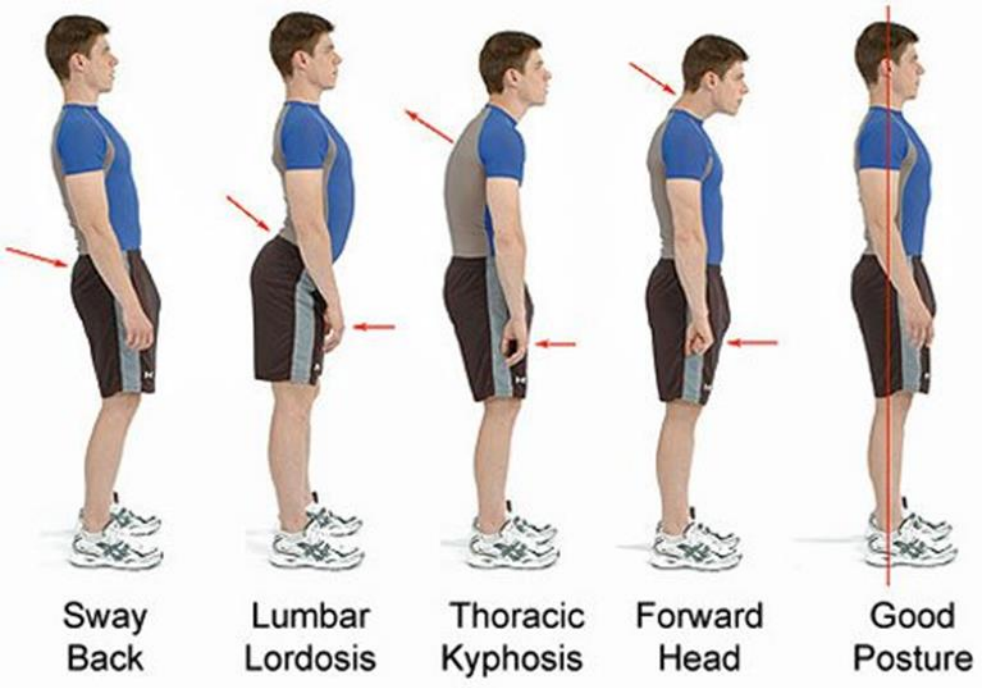
RISK FACTORS-POSTURE NECK

- Head straight
- Avoid leaning
- Monitor neck angle



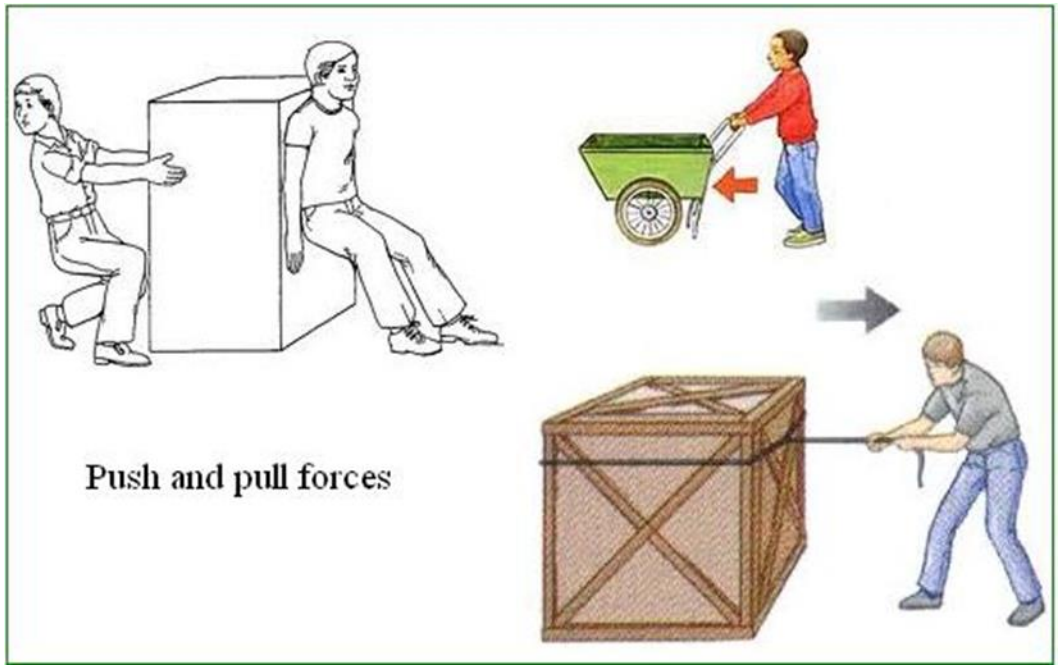
RISK FACTORS-POSTURE BACK/TRUNK

- Avoid torso bending backwards or laterally
- Avoid twisting



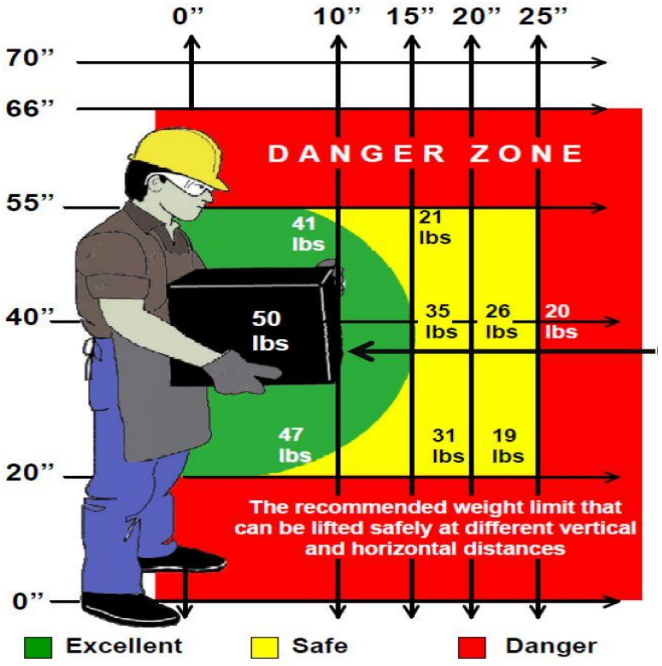
ERGONOMIC RISK FACTORS-FORCE

- Weight of Object
- Size/Shape of object
- Location
- Grip



RISK FACTORS-FORCE LIFTING ABILITY AND LOCATION

- Consider how much object weighs
- Consider distance away from body
- Consider the capability of each worker
- Items located at opposite end of workstation may require more force

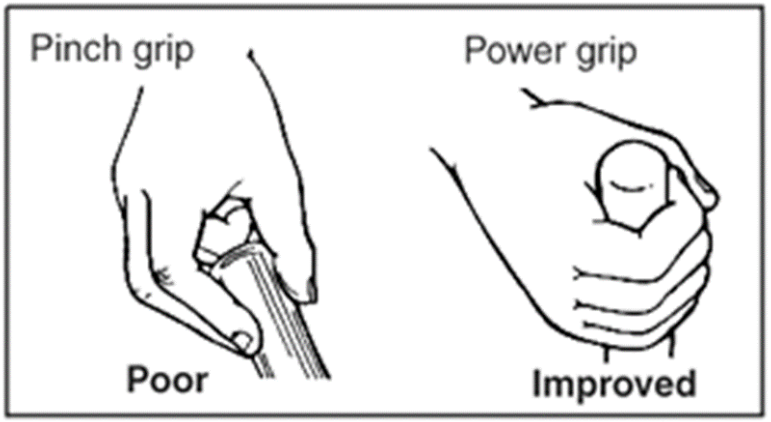


RISK FACTORS-SHAPE/SIZE OF OBJECT

- Odd shaped objects will take more force to lift, carry, or move
- Use custom material handling tools

RISK FACTORS-GRIP

- Pinch Grip vs. Power Grip

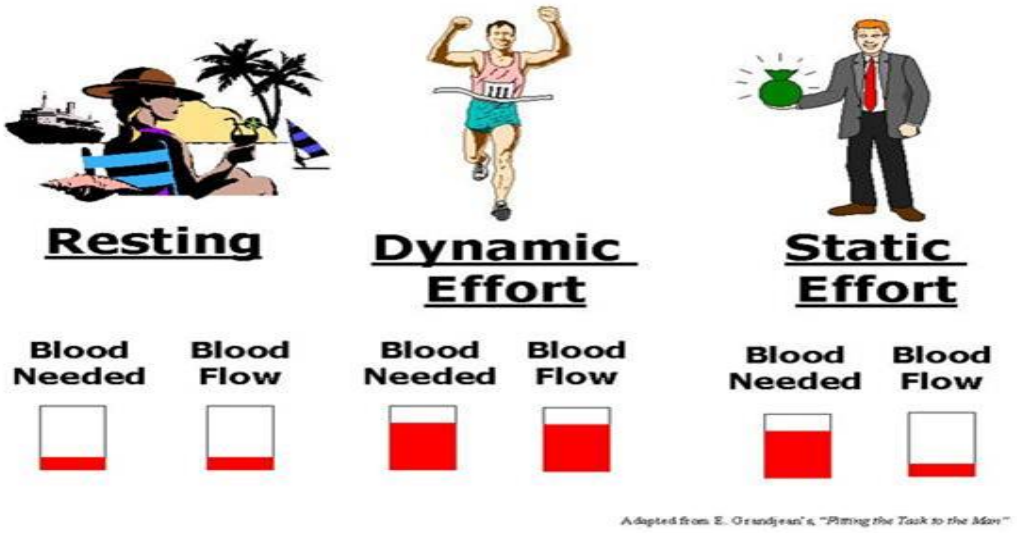


RISK FACTORS-REPETITION/FREQUENCY

- Posture held for more than one minute
- Repeated action happens four times per minute
- Two body postures per minute

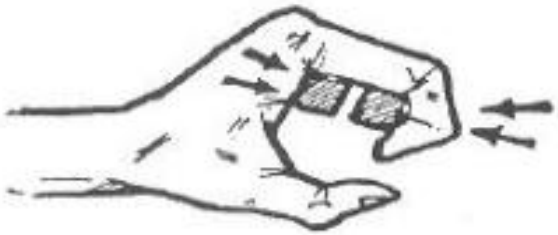
RISK FACTORS-STATIC POSTURE

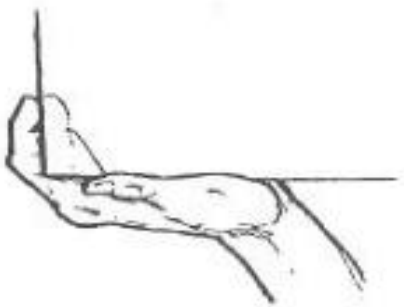
- These types of exertions put increased loads or forces on the muscles and tendons, which contributes to fatigue

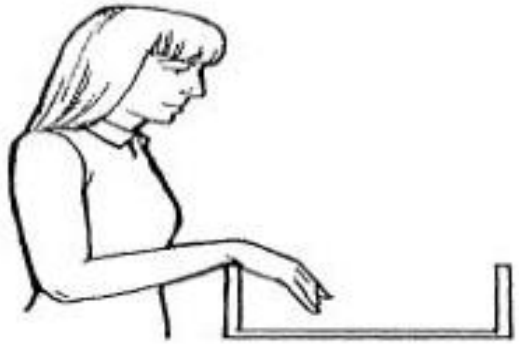


RISK FACTORS-CONTACT STRESSORS

- Sharp edges
- Ends of table
- Edge of box or machine
- Tool handles







RISK FACTORS-ENVIRONMENTAL

- Temperature
  - Hot - blood flows to skin to get rid of accumulated heat - this results in less blood to muscles and a reduction in work capacity
  - Cold - reduces circulation, skin temperature
- Lighting: Adverse levels can contribute to postural and eye strain, low levels and glare

Activity	Illumination *(lux, lumen/m^2)*
Public areas with dark surroundings	20 - 50
Simple orientation for short visits	50 - 100
Working areas where visual tasks are only occasionally performed	100 - 150
Warehouses, Homes, Theaters, Archives	150
Easy Office Work, Classes	250
Normal Office Work, PC Work, Study Library, Groceries, Show Rooms, Laboratories	500
Supermarkets, Mechanical Workshops, Office Landscapes	750
Normal Drawing Work, Detailed Mechanical Workshops, Operation Theatres	1,000
Detailed Drawing Work, Very Detailed Mechanical Works	1500 - 2000
Performance of visual tasks of low contrast and very small size for prolonged periods of time	2000 - 5000
Performance of very prolonged and exacting visual tasks	5000 - 10000
Performance of very special visual tasks of extremely low contrast and small size	10000 - 20000

WHERE DO YOU BEGIN

- Workplace behavior
- Records
- Surveys

WHERE DO YOU BEGIN-WORKPLACE BEHAVIOR

- Shaking and wringing hands
- Constant shrugging shoulders
- Craning of neck
- Pads on tables, chairs, tools

WHERE DO YOU BEGIN-SURVEYS

- Give surveys
- Talk to floor workers
- Talk to managers

WHERE DO YOU BEGIN-RECORDS

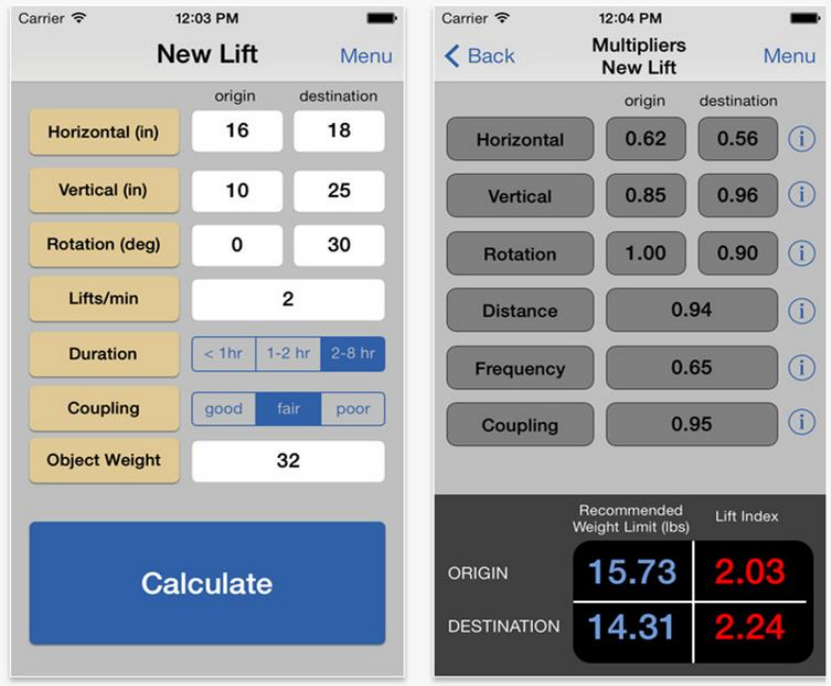
- OSHA 300 Log
- Near miss reports
- Injury reports
- First aid reports

HOW DO I EVALUATE

- LiftRight App
- BC Calculator
- REBA/RULA assessments

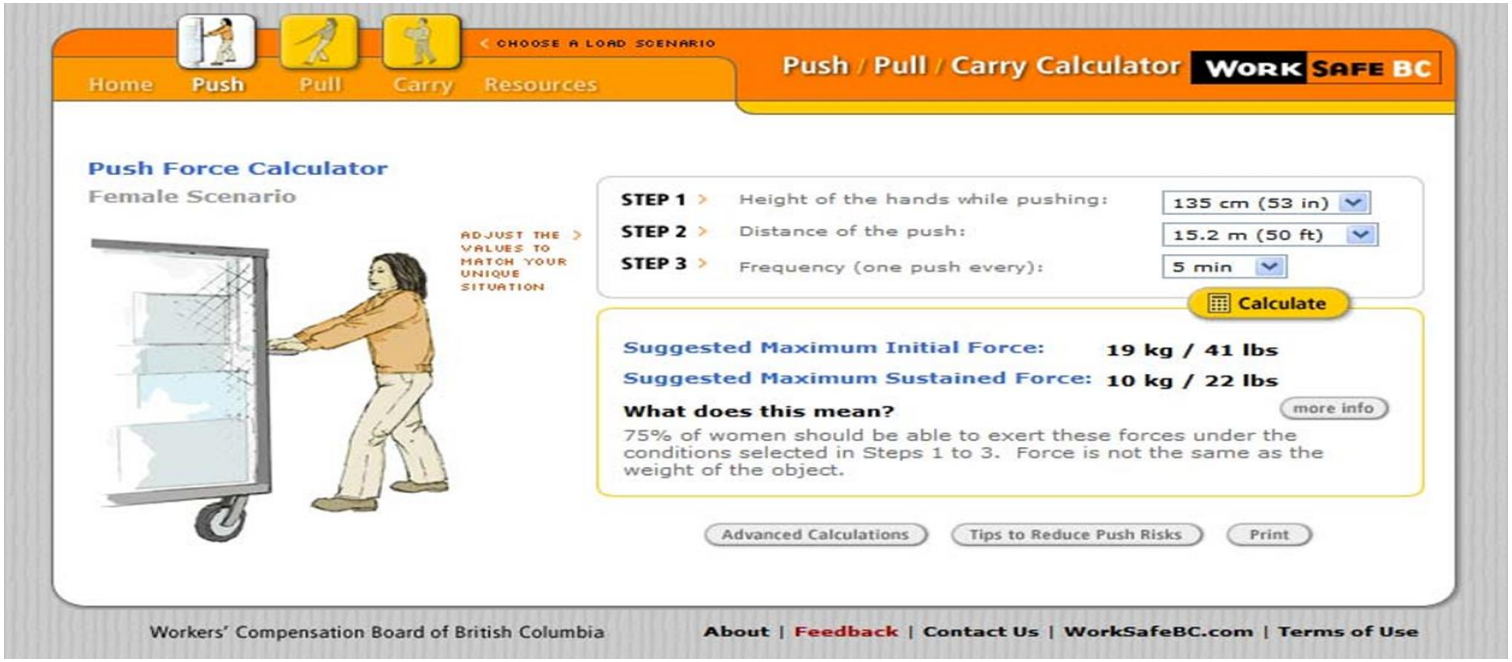
HOW DO I EVALUATE-LIFTRIGHT APP

- Lifting equation that take into account various variables to determine how much one can lift
- Google LiftRight App



HOW DO I EVALUATE-BC CALCULATOR

- This calculator can be used to estimate the suggested maximum force that can be used during pushing and pulling, and the weight that can be carried
- https://www.worksafebc.com/en/resources/health-safety/interactive-tools/push-pull-carry-calculator?lang=en



HOW DO I EVALUATE-REBA/RULA ASSESSMENT

- Rapid Entire Body Assessment (REBA) for full body activities
  - Loading a pallet
  - Moving/picking up product

- Rapid Upper Limb Assessment (RULA) when it is mainly upper body work
  - Assembly Line
  - Cutting Meat

HOW DO I EVALUATE-REBA ASSESSMENT

- Evaluates and assigns a score for each of the following body regions: wrists, forearms, elbows, shoulders, neck, trunk, back, legs and knees
- After the data is collected and scored, each area is given a score from 1-7 on severity and MSD risk.

Score	Level of MSD Risk
1	negligible risk, no action required
2-3	low risk, change may be needed
4-7	medium risk, further investigation, change soon
8-10	high risk, investigate and implement change
11+	very high risk, implement change

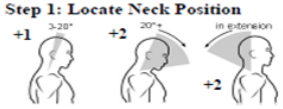
HOW DO I EVALUATE-REBA ASSESSMENT

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

Step 1: Locate Neck Position



Step 1a: Adjust…
If neck is twisted: +1
If neck is side bending: +1

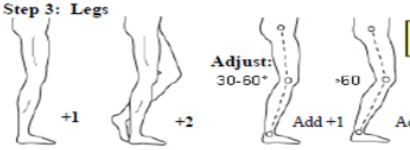
Neck Score

Step 2: Locate Trunk Position

Step 2a: Adjust…
If trunk is twisted: +1
If trunk is side bending: +1

Trunk Score

Step 3: Legs



Leg Score

Step 4: Look-up Posture Score in Table A
Using values from steps 1-3 above, locate score in Table A

Posture Score A

Step 5: Add Force/Load Score
If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

Force/Load Score

Step 6: Score A, Find Row in Table C
Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

Score A

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

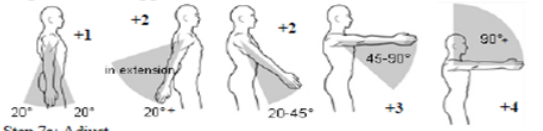
Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

Score A (score from table A +load/force score)	Table C: Score B, (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

Table C Score + Activity Score → Final REBA Score

B. Arm and Wrist Analysis

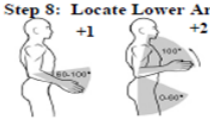
Step 7: Locate Upper Arm Position:



Step 7a: Adjust…
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

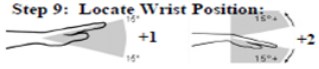
Upper Arm Score

Step 8: Locate Lower Arm Position:



Lower Arm Score

Step 9: Locate Wrist Position:



Wrist Score

Step 9a: Adjust…
If wrist is bent from midline or twisted : Add +1

Step 10: Look-up Posture Score in Table B
Using values from steps 7-9 above, locate score in Table B

Posture Score B

Step 11: Add Coupling Score
Well fitting Handle and mid rang power grip, *good: +0*
Acceptable but not ideal hand hold or coupling acceptable with another body part, *fair: +1*
Hand hold not acceptable but possible, *poor: +2*
No handles, awkward, unsafe with any body part, *Unacceptable: +3*

Coupling Score

Step 12: Score B, Find Column in Table C
Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

Score B

Step 13: Activity Score
+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: _____ Reviewer:_____ Date: _____/_____/_____

This tool is provided without warranty. The author has provided this tool as a simple means for applying the concepts provided in REBA .

HOW DO I EVALUATE-RULA ASSESSMENT

- Survey method to assess postures of neck and upper limb loading
- Final risk assessment score combines arm/wrist risk with neck, trunk, leg risk
- Final score magnitude (between 1 and 7) overall injury risk due to musculoskeletal loading

Score	Level of MSD Risk
1-2	negligible risk, no action required
3-4	low risk, change may be needed
5-6	medium risk, further investigation, change soon
6+	very high risk, implement change now

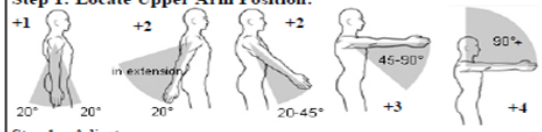
HOW DO I EVALUATE-RULA ASSESSMENT

RULA Employee Assessment Worksheet

based on RULA: a survey method for the investigation of work-related upper limb disorders, McAtamney & Corlett, Applied Ergonomics 1993, 24(2), 91-99

A. Arm and Wrist Analysis

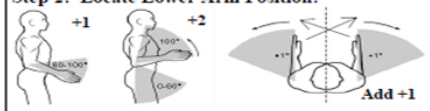
Step 1: Locate Upper Arm Position:



Step 1a: Adjust…
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

Upper Arm Score

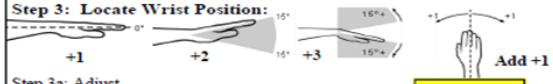
Step 2: Locate Lower Arm Position:



Lower Arm Score

Step 2a: Adjust…
If either arm is working across midline or out to side of body: Add +1

Step 3: Locate Wrist Position:



Step 3a: Adjust…
If wrist is bent from midline: Add +1

Wrist Score

Step 4: Wrist Twist:
If wrist is twisted in mid-range: +1
If wrist is at or near end of range: +2

Wrist Twist Score

Step 5: Look-up Posture Score in Table A:
Using values from steps 1-4 above, locate score in Table A

Posture Score A

+

Step 6: Add Muscle Use Score
If posture mainly static (i.e. held>1 minute),
Or if action repeated occurs 4X per minute: +1

Muscle Use Score

+

Step 7: Add Force/Load Score
If load < .4.4 lbs (intermittent): +0
If load 4.4 to 22 lbs (intermittent): +1
If load 4.4 to 22 lbs (static or repeated): +2
If more than 22 lbs or repeated or shocks: +3

Force/Load Score

=

Step 8: Find Row in Table C
Add values from steps 5-7 to obtain
Wrist and Arm Score. Find row in **Table C**.

Wrist & Arm Score

SCORES

Table A: Wrist Posture Score

Upper Arm	Lower Arm	1 Wrist Twist 1	1 Wrist Twist 2	2 Wrist Twist 1	2 Wrist Twist 2	3 Wrist Twist 1	3 Wrist Twist 2	4 Wrist Twist 1	4 Wrist Twist 2
1	1	1	2	2	2	2	3	3	3
	2	2	2	2	2	3	3	3	3
	3	2	3	3	3	3	3	4	4
2	1	2	3	3	3	3	4	4	4
	2	3	3	3	3	3	4	4	4
	3	3	4	4	4	4	4	5	5
3	1	3	3	4	4	4	4	5	5
	2	3	4	4	4	4	4	5	5
	3	4	4	4	4	4	5	5	5
4	1	4	4	4	4	4	5	5	5
	2	4	4	4	4	4	5	5	5
	3	4	4	4	5	5	5	6	6
5	1	5	5	5	5	5	6	6	7
	2	5	6	6	6	6	7	7	7
	3	6	6	6	7	7	7	7	8
6	1	7	7	7	7	7	8	8	9
	2	8	8	8	8	8	9	9	9
	3	9	9	9	9	9	9	9	9

Table C: Neck, trunk and leg score

Wrist and Arm Score	1	2	3	4	5	6	7+
1	1	2	3	3	4	5	5
2	2	2	3	4	4	5	5
3	3	3	3	4	4	5	6
4	3	3	3	4	5	6	6
5	4	4	4	5	6	7	7
6	4	4	5	6	6	7	7
7	5	5	6	6	7	7	7
8+	5	5	6	7	7	7	7

Scoring: (final score from Table C)
1 or 2 = acceptable posture
3 or 4 = further investigation, change may be needed
5 or 6 = further investigation, change soon
7 = investigate and implement change

Final Score

B. Neck, Trunk and Leg Analysis

Step 9: Locate Neck Position:

Step 9a: Adjust…
If neck is twisted: +1
If neck is side bending: +1

Neck Score

Step 10: Locate Trunk Position:

Step 10a: Adjust…
If trunk is twisted: +1
If trunk is side bending: +1

Trunk Score

Step 11: Legs:
If legs and feet are supported: +1
If not: +2

Leg Score

Table B: Trunk Posture Score

Neck Posture Score	1 Legs 1	1 Legs 2	2 Legs 1	2 Legs 2	3 Legs 1	3 Legs 2	4 Legs 1	4 Legs 2	5 Legs 1	5 Legs 2	6 Legs 1	6 Legs 2
1	1	3	2	3	3	4	5	5	6	6	7	7
2	2	3	2	3	4	5	5	6	6	7	7	7
3	3	3	3	4	4	5	5	6	6	7	7	7
4	5	5	5	6	6	7	7	7	7	7	8	8
5	7	7	7	7	7	8	8	8	8	8	8	8
6	8	8	8	8	8	8	8	9	9	9	9	9

Step 12: Look-up Posture Score in Table B:
Using values from steps 9-11 above,
locate score in Table B

Posture Score B

+

Step 13: Add Muscle Use Score
If posture mainly static (i.e. held>1 minute),
Or if action repeated occurs 4X per minute: +1

Muscle Use Score

+

Step 14: Add Force/Load Score
If load < .4.4 lbs (intermittent): +0
If load 4.4 to 22 lbs (intermittent): +1
If load 4.4 to 22 lbs (static or repeated): +2
If more than 22 lbs or repeated or shocks: +3

Force/Load Score

=

Step 15: Find Column in Table C
Add values from steps 12-14 to obtain
Neck, Trunk and Leg Score. Find Column in **Table C**.

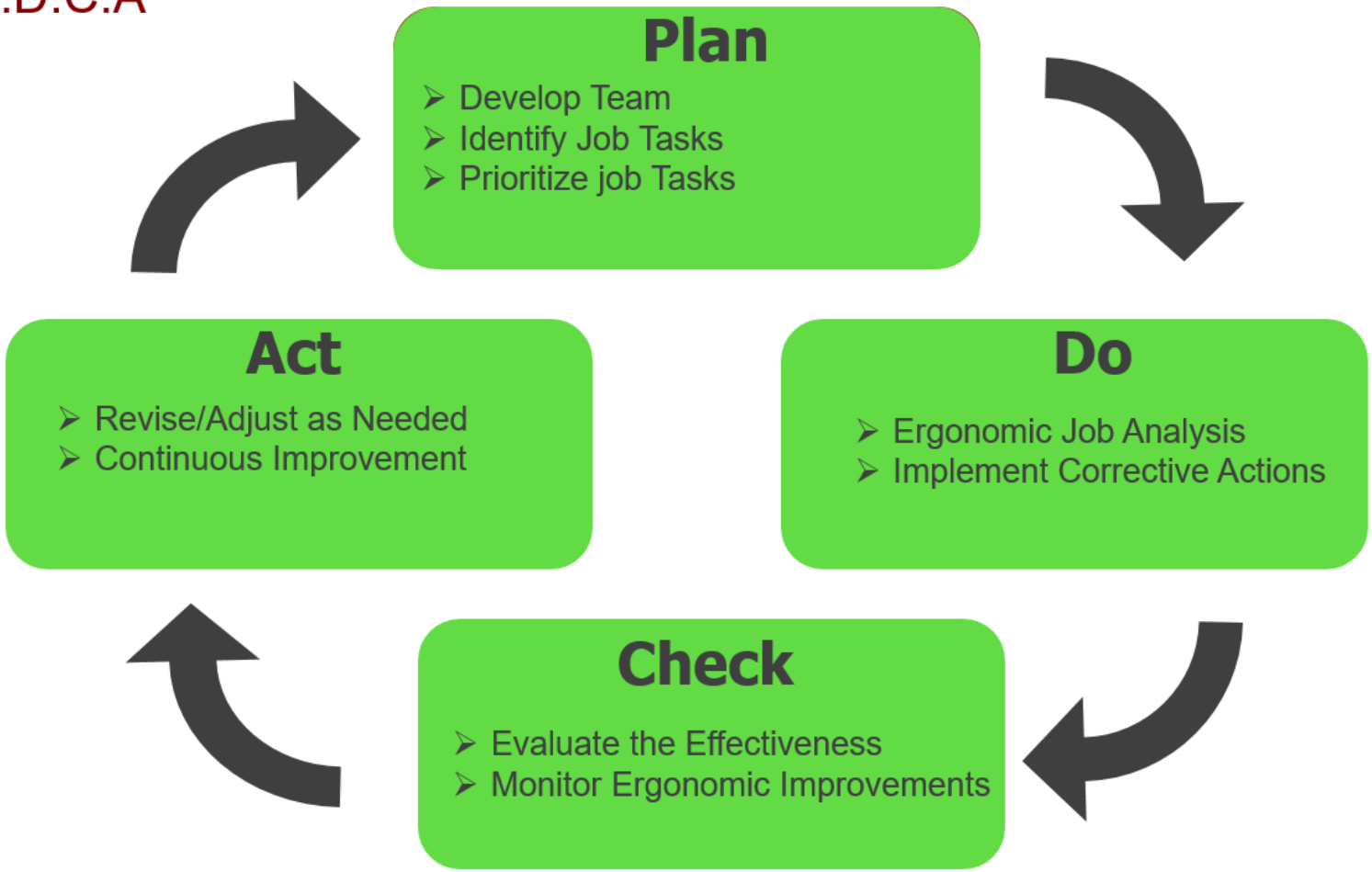
Neck, Trunk & Leg Score

Task name: _____ Reviewer:_____ Date: _____/_____/_____

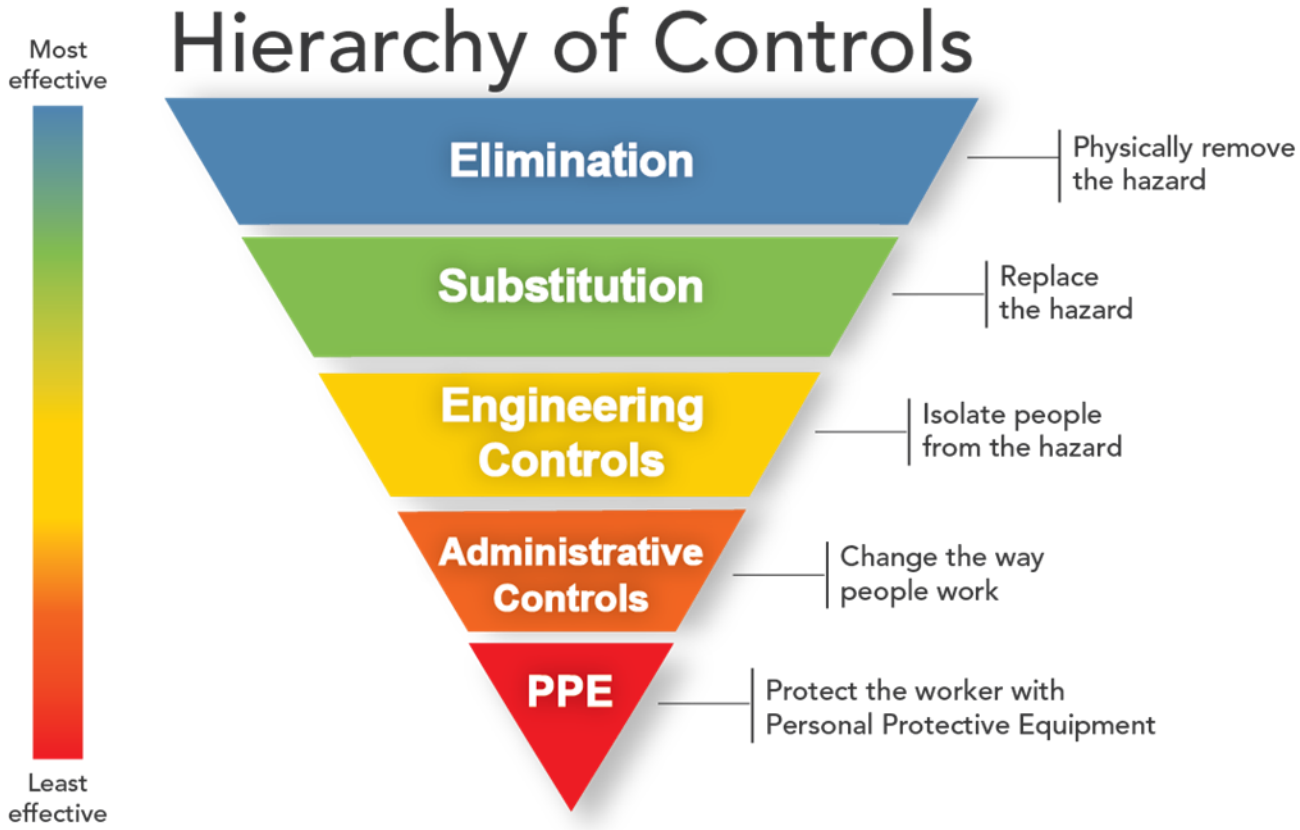
This tool is provided without warranty. The author has provided this tool as a simple means for applying the concepts provided in RULA .

DEVELOPING AN IMPROVEMENT PLAN

P.D.C.A



CORRECTIVE ACTIONS



IMPLEMENTING CHANGE

- Don’t design for the average
- Design for adjustability
- If design for the average, exclude 67% population
- Design for the extreme (i.e. door height)
- 5th for reaching
- 95th for clearance

IMPLEMENTING CHANGE

- Employee involvement
- Take any offered feedback
- Inform employees of changes that are coming
- Follow up 4-6 weeks later

SUMMARY

- Statistics and Costs of Strain, Sprain and Repetitive Motion Injuries
- What are Strains, Sprains Repetitive Motion Injuries
- Risk Factors that contribute to Strain, Sprain and Repetitive Motion Injuries
- Understand basic Ergonomic Assessment Tools
- How to Develop an Implementation Plan to Prevent Strain, Sprain and Repetitive Motion Injuries

QUESTIONS?