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Title:	Discussions on the Relationship Betweeen Glovebox Worker Safety and Ergonomics
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Discussions on the relationship between glovebox worker safety and ergonomics

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Abstract

Discussions on the Relationship Betweeen Glovebox Worker Safety and Ergonomics

This talk will discuss the results of a glovebox survey. A survey was filled out by every glovebox worker at Los Alamos national laboratory. The results were then reviewed and compiled for further evaluation. Workers were placed in low, medium, and high risk categories.

Outline

- Background
- Survey - Score Sheets - Results
- Risk Categories
- Medical Screens
- Results and Implications

Background – worker/glovebox safety

- **Ergonomics Defined:** The Science relating to man and his work, embodying the anatomic, physiologic, psychologic, and mechanical principles affecting the efficient use of human energy.

- The worker and the work station must enhance the reduction of energy and avoidance of fatigue to insure prevention of injury.

Repetitive Pipetting: Most ergonomic studies performed with similarities to glovebox work

Causes of Pipetting Injuries

- Awkward postures
  - Primary factor in repetitive strain injuries
  - Increase of force results in increased risk
- High repetition of fine motor skills
- Exposure/Duration at work

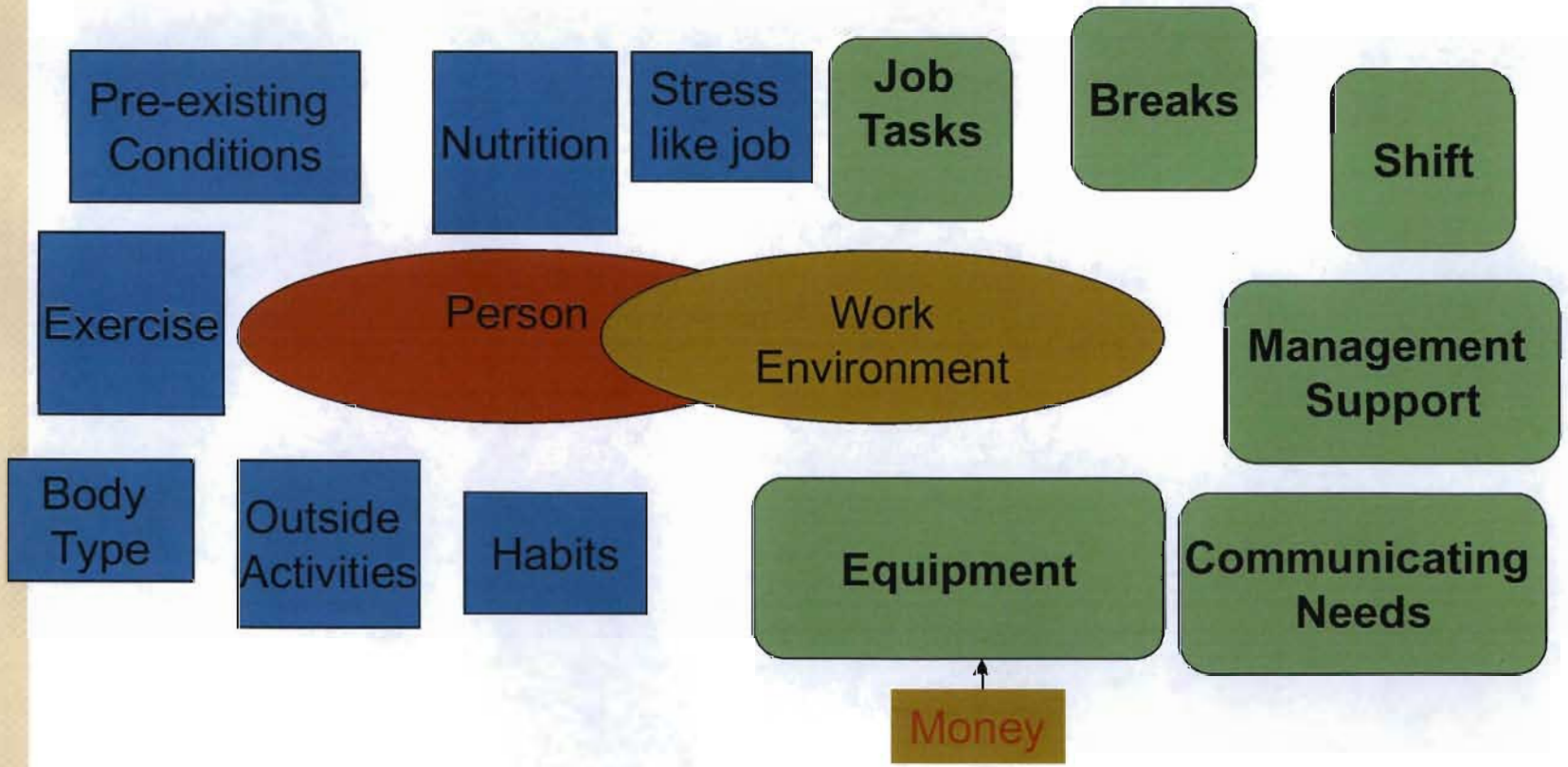
(Burt, Cindy et al., 2005)

Recommendations for Pipetting

- Administrative Controls:
  - Task Rotation/Variation
  - 3-5 minute-break after 20-30 minutes of pipetting
  - No more than 6 hrs/wk, 300 hrs/yr
- Improved ergonomics of pipettes
- Exercises : eye and stretches

(Burt, Cindy et al., 2005)

Who might get hurt?



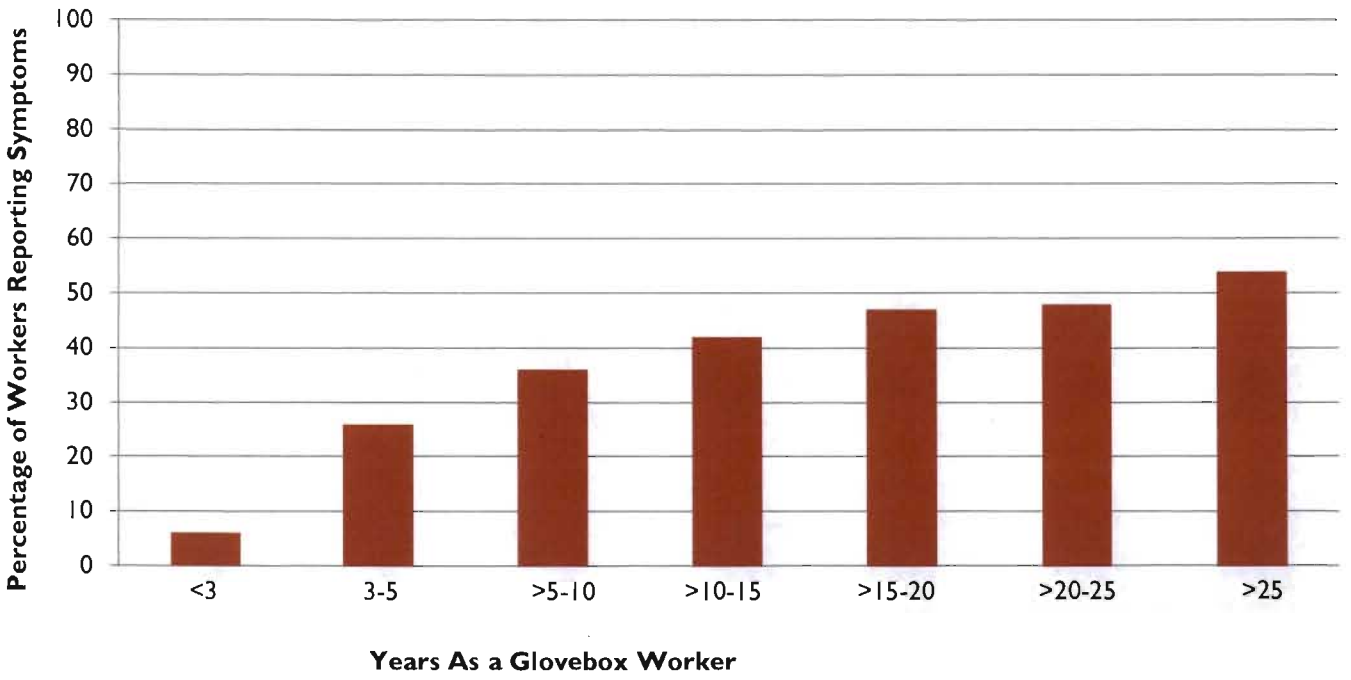
LANL –Glovebox Injury rates

32 people	88% Repetitive	12% Single Occurence			
	2006	2007	2008	2009	2010
First Aide	0	0	2	3	3
Recordable	7	10	8	2	6
Shoulder	Elbow	Wrist	Hand/fingers	Thumb	Spine
17	8	3	5	3	4

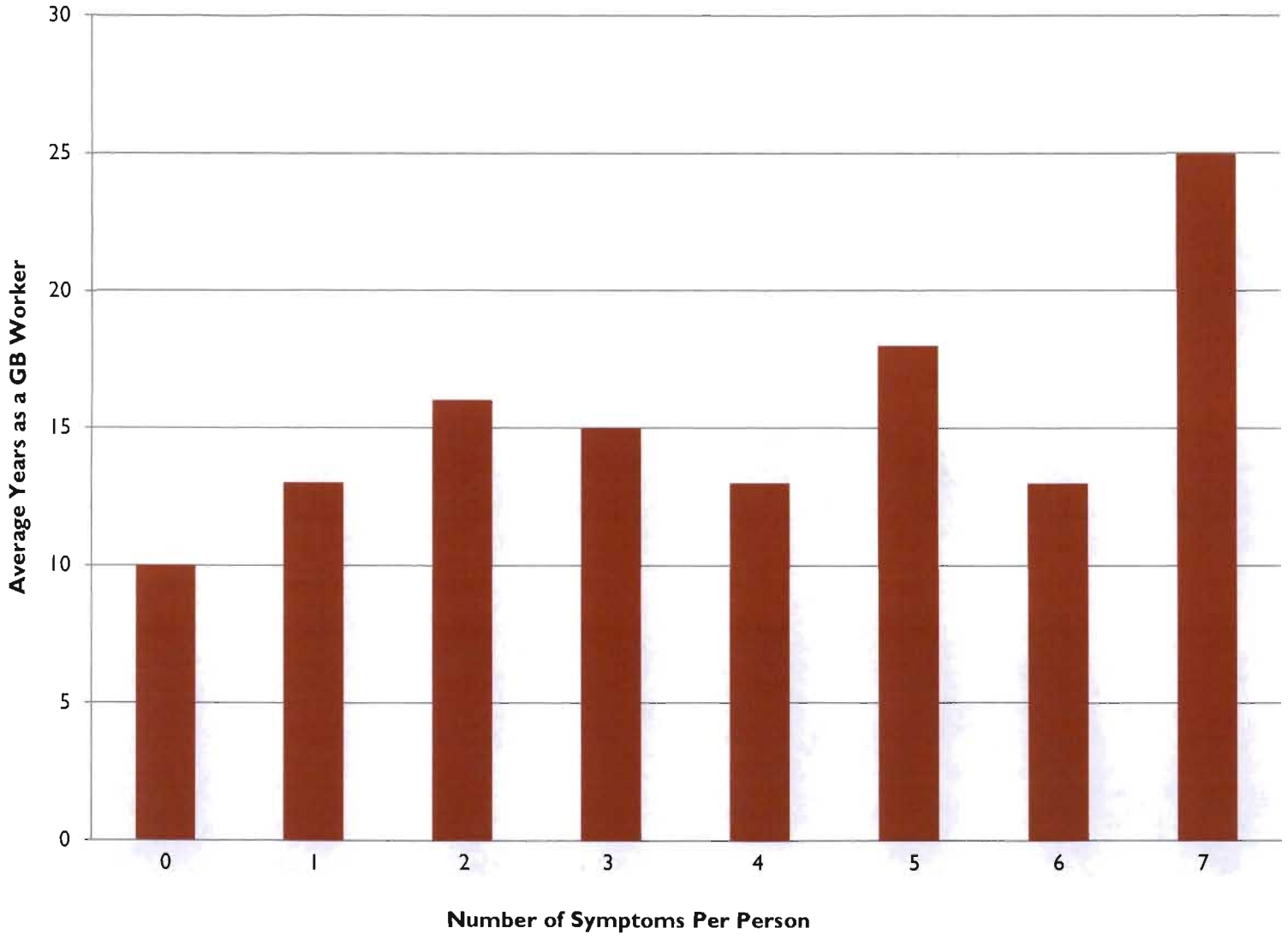
Original Survey

- Ergonomic Assessment Tool (survey) designed to:
  - identify risk factors
  - provide information for establishing work/rest cycles.
- Voluntary then Mandatory
- Distributed to 405 Glovebox Workers

Percentage of Workers Reporting Symptoms vs. Years as a Glovebox Worker



Average Years as a Glovebox Worker vs. Number of Symptoms Per Person



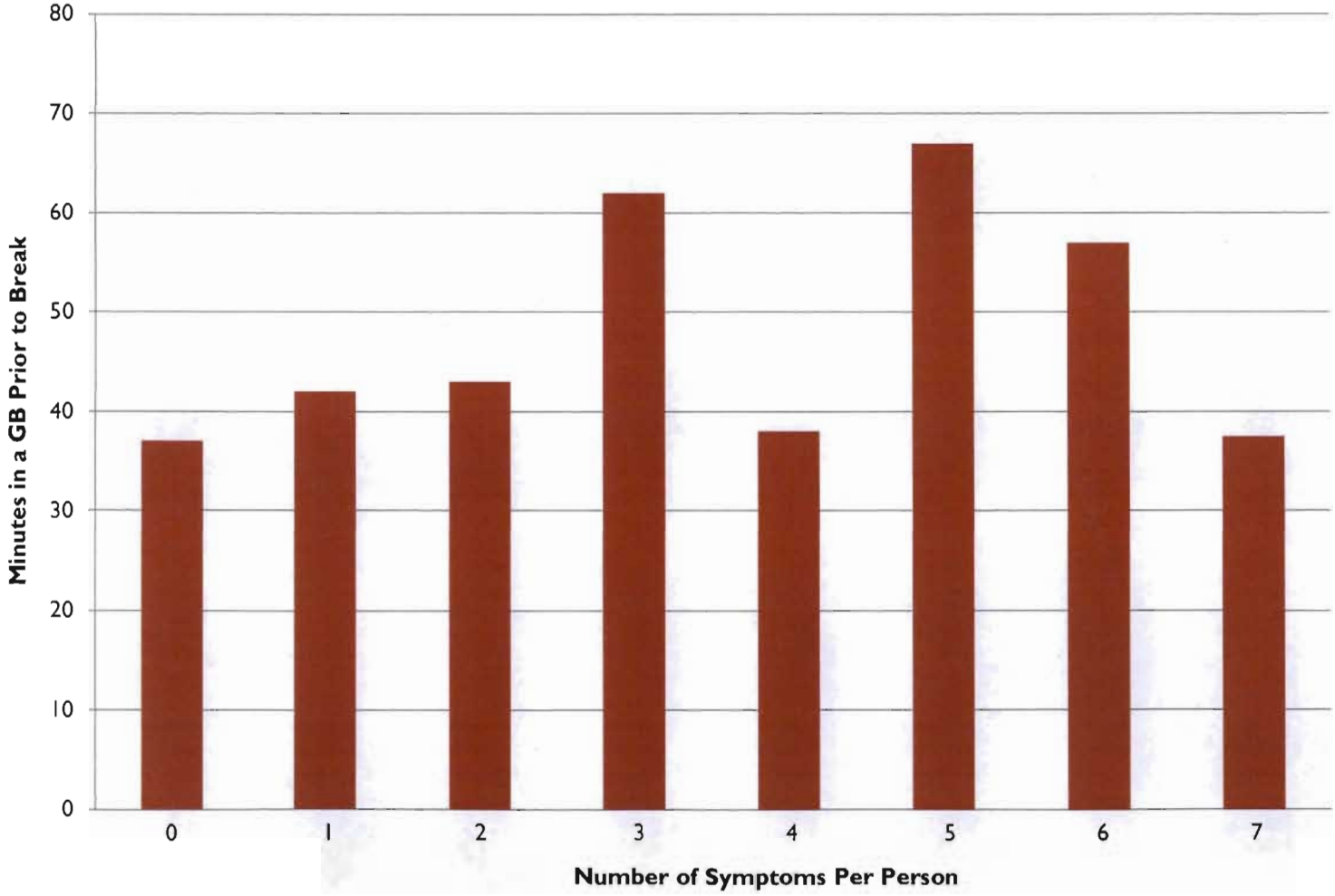
Work Rest Cycles

Number of Workers With Symptoms vs. Amount of Time In the Glovebox Per Day

Number of Workers Reporting Symptoms	Amount of Time in the GB/day
12/116 (10%)	≤ 1 hour
10/46 (22%)	1-2 hours
19/53 (36%)	2-3 hours
13/27 (48%)	3-4 hours
18/36 (50%)	4-5 hours
17/27 (63%)	5-6 hours
27/42 (64%)	>6 hours

- Approximately 50% of workers report symptoms if they work >3 hours/day in a GB.

Average Minutes In the Glovebox Before a Break Is Taken vs. Number of Symptoms Per Person



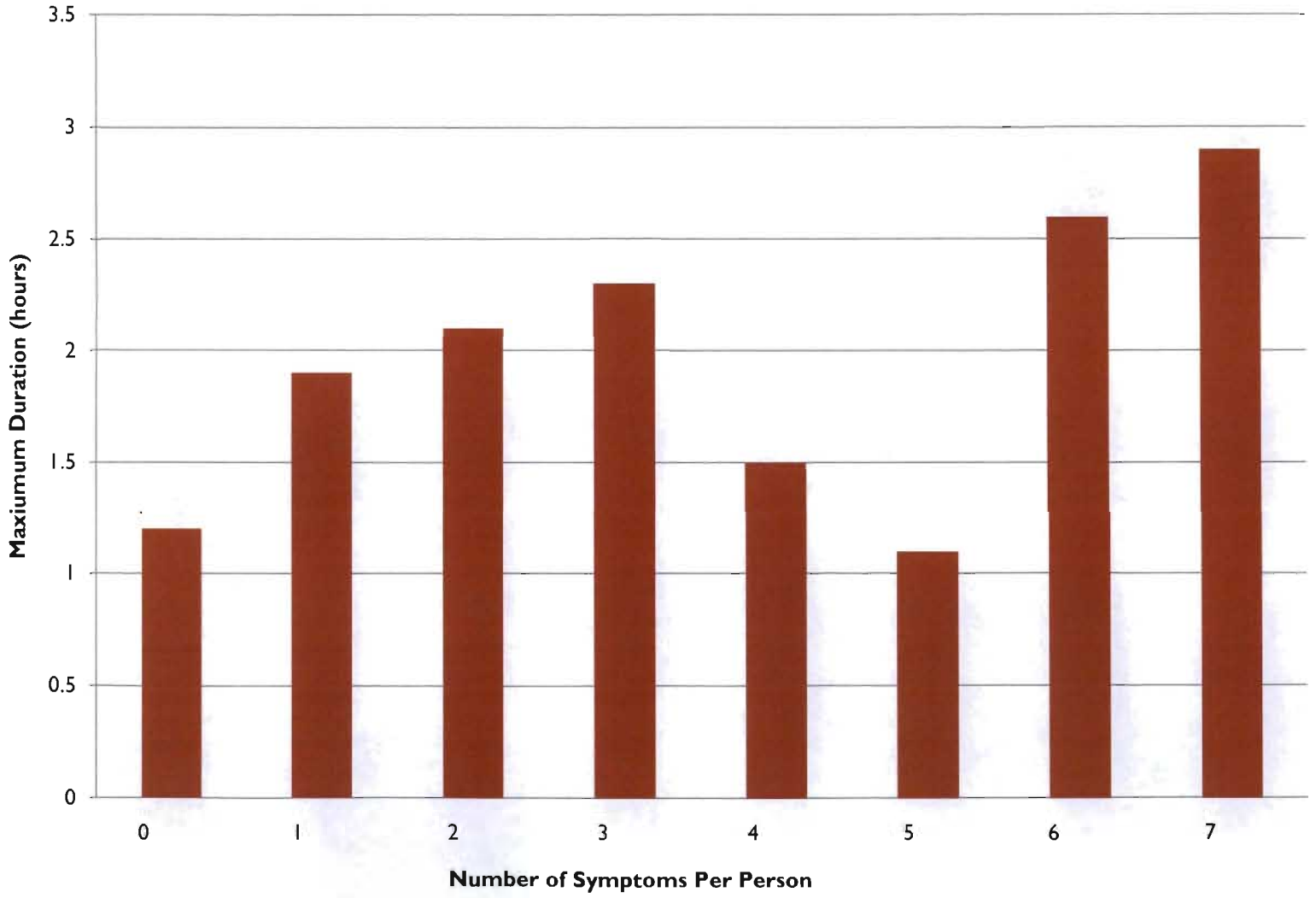
Work/Rest Cycles

Maximum Duration: Longest time in the glovebox without a break

Number of Symptoms Per Person	Average Time in the GB (hours)	Range
0	1.2	0 minutes – 8.5 hours
1	1.9	0 minutes – 5.8 hours
2	2.1	10 minutes – 6 hours
3	2.3	10 minutes – 5 hours
4	1.5	30 minutes – 4 hours
5	1.1	24 minutes – 4 hours
6	2.6	45 minutes – 6 hours
7	2.9	1.8 – 4 hours

Many workers maximum duration is over 2 hours without a break. Fatigue first sign of breakdown of muscles.

Average Maximum Duration In a Glovebox vs. Number of Symptoms Per Person



Work/Rest Cycles

- UNM study showed muscle fatigue after 23 minutes of GB work.
- A 5 minute break is recommended after 30 minutes of work.
- Recommended daily GB worker duration: 3 hours/day.

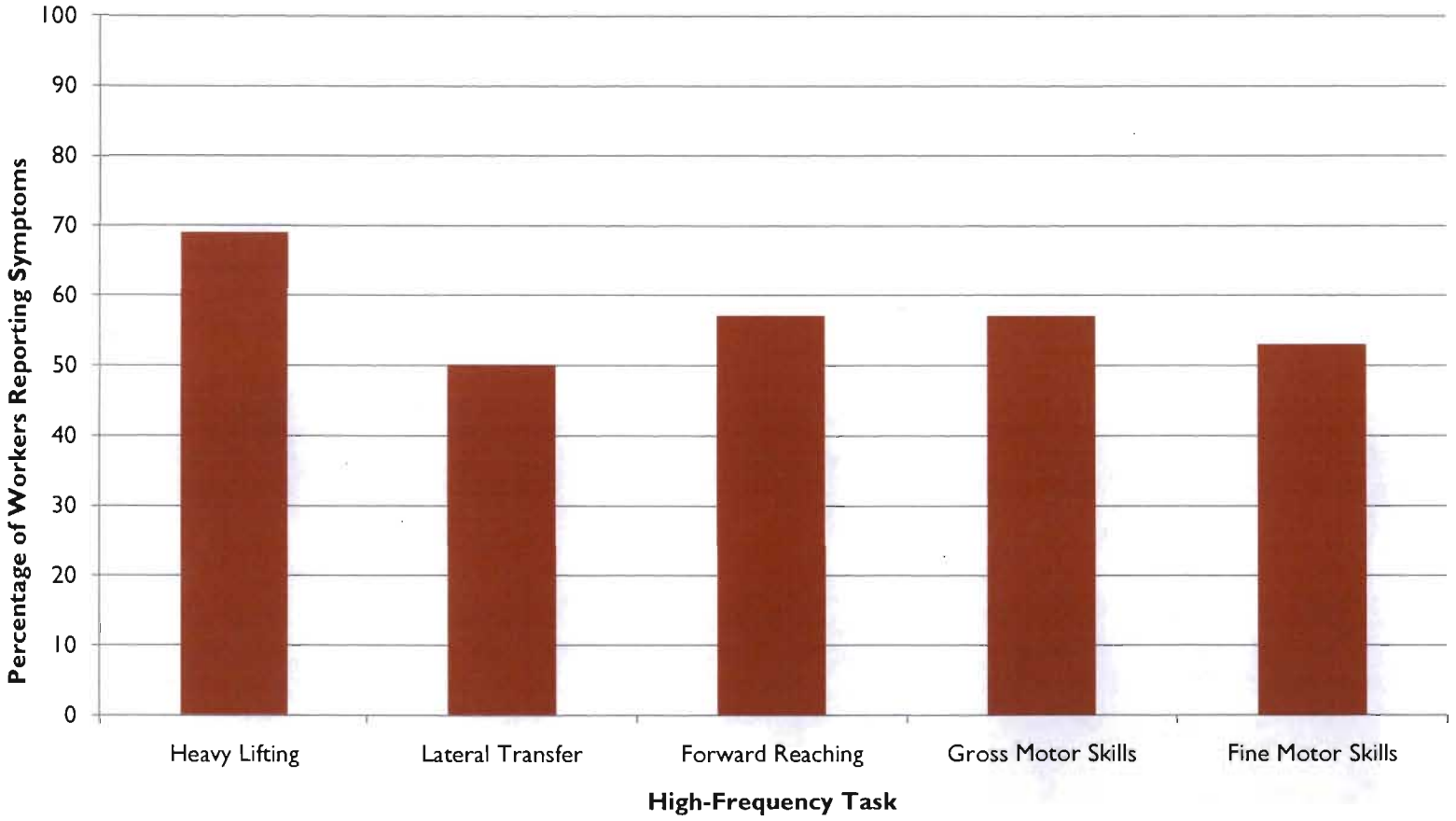
(Swanson, Scott et al., 2009)

Most Frequent Task vs. Symptoms

- Workers who reported symptoms:
  - Heavy Lifting- 11/16 (69%)
  - Lateral Transfer- 35/70 (50%)
  - Forward Reaching- 33/58 (57%)
  - Gross Motor Skills- 32/56 (57%)
  - Fine Motor Skills- 29/52 (53%)

- All tasks with high repetition cause ~ 57% of workers to have symptoms
- No task was associated with a specific type of symptom
  - (thumb, hand, wrist, elbow/forearm, shoulder, neck/upper back, lower back)

Percentage of Workers Reporting Symptoms for Various High- Frequency Tasks



Occupational Medicine

Rating of Physical Discomfort & Mental Stress:

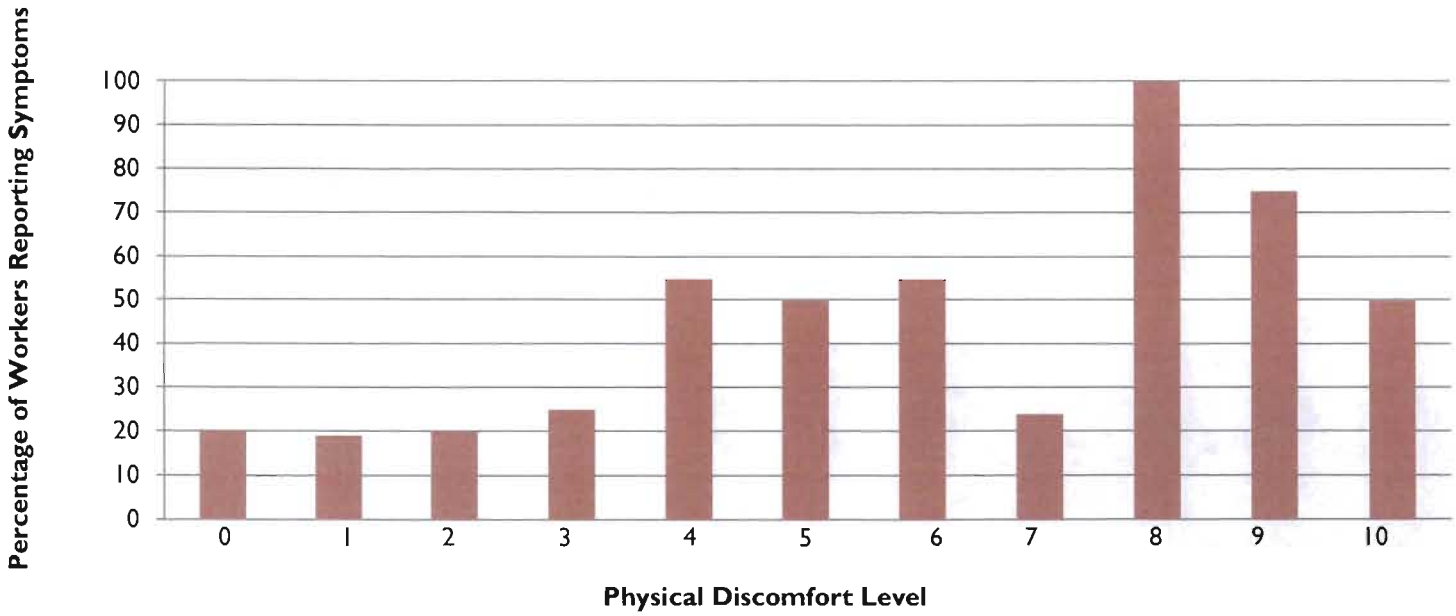
Scale 0-10: 0 being None.

- Physical Discomfort: Avg. 3.4/10
  Range 0-10

- Mental Stress: Avg. 3.5/10
  Range 0-10

Most workers have underlying pain. When this is combined with stress a worker becomes more susceptible to fatigue and the risk of injury increases.

Perception of a Physical Problem



Occ Med Use by Workers with Discomfort Levels ≥4 (146 Workers)

- 95/146 (65%) workers do NOT feel that they have present symptoms.

- 51/146 (35%) workers reported having present symptoms. Of these:
  - 19/51 (37%) have seen OccMed
  - 32/51 (63%) have not seen OccMed

- Of those without present symptoms (95 workers):
  - 34/95 (36%) had past symptoms
    - 7 of these were treated by OccMed
  - 61/95 (64%) did not have past symptoms

Occupational Medicine

Occ Med Use Among Symptomatic Workers

OccMed	Past Symptoms Still Present
Yes	16/56 (29%)
No	40/56 (71%)

OccMed	Past Symptoms No Longer Present
Yes	13/55 (24%)
No	42/55 (76%)

- Most workers do not seek treatment through OccMed
- OccMed treatment is successful approximately 50% of the time

Risk Category

- Voluntary Survey Results were used to develop the score sheet
- All Glovebox workers placed in a risk Category

Risk Category

The Survey Identified:

58 High-Risk Workers

94 Moderate-Risk Workers

195 Low-Risk Workers

* 125 workers asked to be removed from the roster as they are no longer actively involved in GB work

Present Symptom	Automatic High
Past Symptom	Automatic Moderate

- A symptom was defined as any physical pain, discomfort, tingling, or numbness that one can attribute to his/her glovebox work.

Areas of concern:

- Shoulder
- Elbow/forearm
- Thumb
- Wrist
- Hand
- Neck/Upper back

Results → Action

High Risk: Obtain Medical Screen and Glovebox Ergonomic Evaluation

Moderate Risk: Obtain Glovebox Ergonomic Evaluation

All workers were asked to read the Glovebox Ergonomic Guideline

Medical Screen for High Risk Glovebox Workers

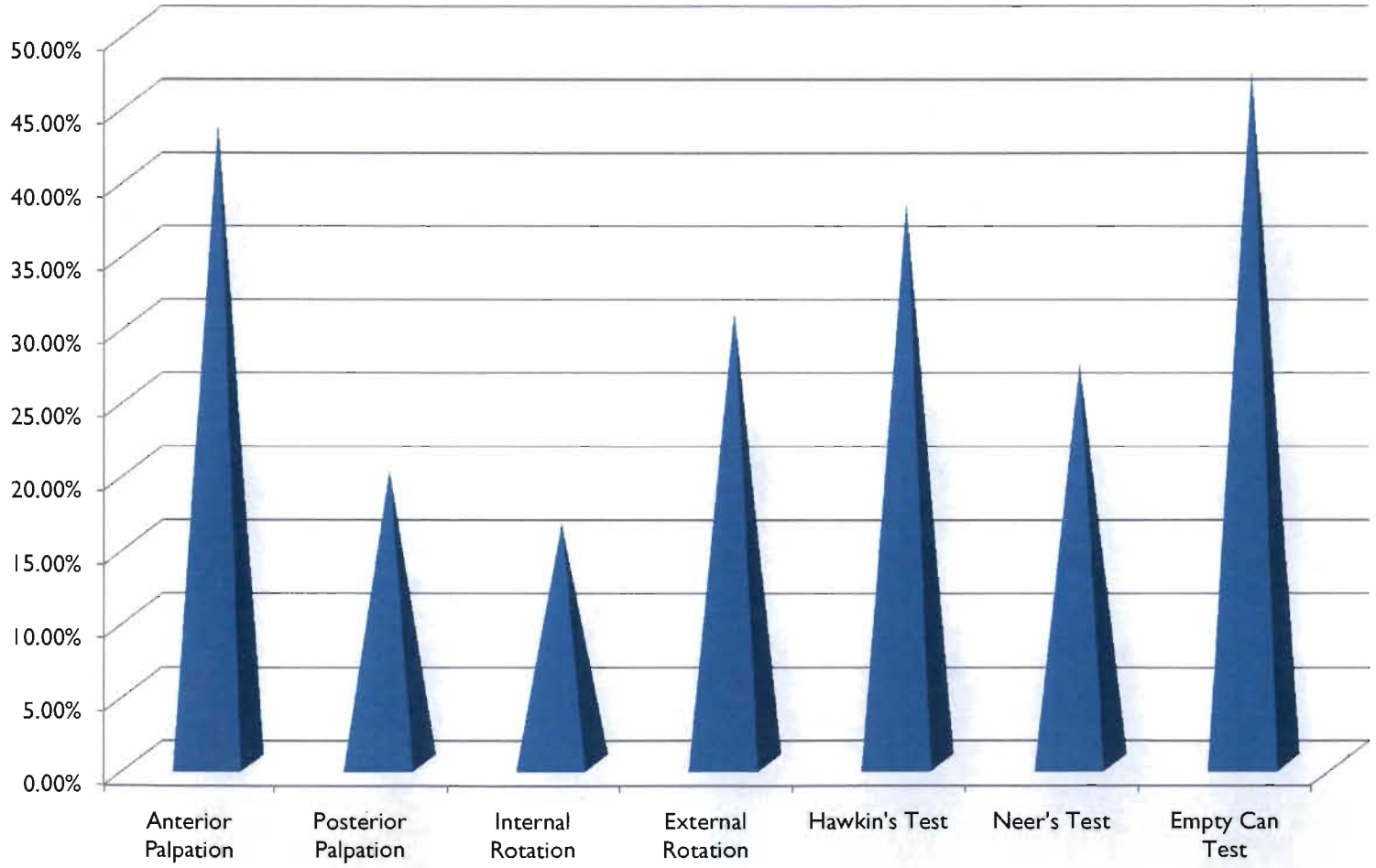
- 55 screens performed (20 minutes each)
- 50 present symptoms and 11 high risk
  - 7 of these scored above 30 and were symptomatic
- The average score for the high risk glovebox workers was 23

Rotator Cuff Screen

- Empty Can Test
- Neer's Test
- Hawkin's Test
- Internal Rotation
- External Rotation
- Anterior Shoulder Palpation
- Posterior Shoulder Palpation

*3 or more positive tests indicate a damaged rotator cuff

Percentage of Workers That Tested Positive for Rotator Cuff Tests



Rotator Cuff Results

22 workers had three or more positive tests; indicating a damaged or torn rotator cuff

One worker showed signs of bilateral compromise

Elbow Screen

- Wrist Flexion
- Wrist Extension
- Medial Epicondyle Palpation
- Lateral Epicondyle Palpation

Elbow Results

Test	Location	Prevalence
Wrist Flexion	Right Only	1/55 (1.8%)
	Left Only	0/55 (0%)
	Bilateral	0/55 (0%)
Wrist Extension	Right Only	2/55 (3.6%)
	Left Only	1/55 (1.8%)
	Bilateral	1/55 (1.8%)
Medial Epicondyle	Right Only	4/55 (7.3%)
	Left Only	5/55 (9.1%)
	Bilateral	3/55 (5.5%)
Lateral Epicondyle	Right Only	11/55 (20%)
	Left Only	2/55 (3.6%)
	Bilateral	14/55 (25.5%)

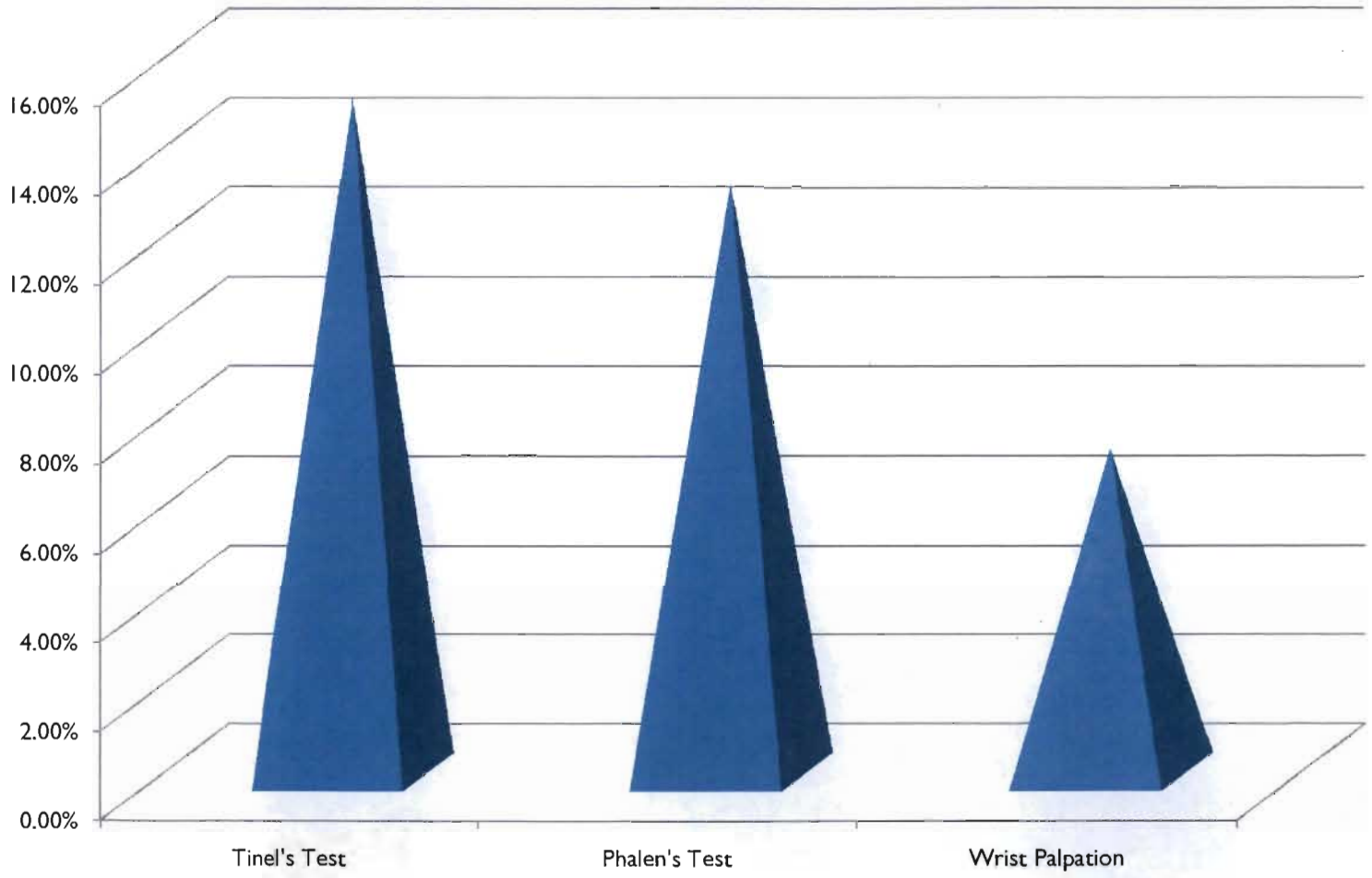
Elbow Results

- 1 worker had medial epicondylitis
- 4 workers had lateral epicondylitis

Carpal Tunnel Syndrome Screen

- Tinel's
- Phalen's
- Wrist Palpation

Percentage of Workers That Had Positive Carpal Tunnel Tests



Carpal Tunnel Results

- 3 workers were sent to OccMed for Carpal Tunnel Syndrome

Reasons Sent to Occ Med

- 12 workers immediately sent to OccMed:
  - 5 - Rotator Cuff Impairment
  - 2 - Carpal Tunnel Syndrome
  - 1 - Thumb Pain
  - 1 - Elbow Pain
  - 1 - Neck
  - 1 - Rotator Cuff and Carpal Tunnel Syndrome
  - 1 - Thumb and Elbow

Symptoms but previously to Occ Med

- 12 were not sent because they already were being treated through Occ Med
- 1 person was sent to their personal doctor

Corrective Actions

- Rotator Cuff Strengthening (21)
- Limiting Time in the Glovebox
- Increasing Number of Breaks
- Increasing Break Duration
- All Receive Glovebox Ergonomic Evaluations
- Forearm Stretches (22)
- New Ergonomic Equipment

Considerations

A High Risk was given for a score above 30.

The average score of our high risk glovebox workers was only 23.

Should the scoring system be reconsidered?

Considerations for glovebox safety

- Schedule a 5 minute break for every 30 minutes spent in the glove box
- Track time/day and time/year in the GB
  - 3 hrs/day
- Improve the availability and efficiency of rehabilitation (primarily through Occ Med)
- Vary tasks when possible

New Tooling

- Allen Wrenches
- Longer tweezers – ALARA (2 hrs to 20 minutes)
- Mirrors – improve visibility
- Glovebox Ergonomic Evaluations (10-15 changes per evaluation)

Questions?

References

- Burt, Cindy. (2005). *Selection and Use of Pipettes*. UCLA Ergonomics. NECE, Las Vegas, NV.

- Swanson, Scott. (2009). *The Glove Study*. Department of Orthopedics. UNM Medical, Albuquerque, NM.

Glovebox Safety Program
Worker Assessment Survey Scoring

1	**Years performing GB work**	**enter score**	
	<1 year	2	
	1 – 5 years	0	
	>5 – 15 years	1	
	>15 years	2	
2	**Weeks/year performing GB work**	**enter score**	
	1 - 10 weeks	0	
	11 - 20 weeks	1	
	21 - 30 weeks	2	
	31 - 40 weeks	3	
	41 - 50 weeks	5	
3	**Hours/day performing GB work**	**enter score**	
	< 2 hours	0	
	2 – 4 hours	3	
	>4 hours	6	
4	**Employee work breaks**	**enter (a + b + c)**	
	a) GB work duration before a break		
	0 – 30 minutes	0	
	31 – 60 minutes	2	
	61 – 120 minutes	4	
	>120 minutes	6	
	b) How long is each break?		
	<5 minutes	1	
	c) Longest duration w/o break		
	>240 minutes	1	
5	**Glovebox Glove Type**	**enter score**	
	hypalon 15 mil	0	
	hypalon/poly or viton 25 mil	1	
	hypalon 30 mil	2	
	hypalon 30 mil (lead loaded)	4	
	Other	contact ergonomic specialist for appropriate scoring	
6	**Overgloves**		
	more than 25% of the time	2	
7	**Most Frequent Task**	**enter score**	

If a task ranked 5 on the assessment tool enter the corresponding score. If more than one task ranked 5, use the higher score. If no task ranked 5, enter zero for none.

None	0
Heavy Lifting (≥ 15 lbs)	5
Fine Motor (eg tweezers, allen wrench)	2
Lateral Transfer (in/out of airlocks)	3
Gross Motor (moving canisters)	2
Forward Reaching (arms extended)	1

Glovebox Safety Program
Worker Assessment Survey Scoring

8	**Mental Stress**	**enter score**	
	0 = no stress 10 = extreme stress		
		0 - 3	0
		4 - 6	2
		7 -10	3
9	**Physical Stress**	**enter score**	
	0 = no discomfort, 10 = extreme discomfort		
		0 - 3	0
		4 - 6	2
		7 - 8	4
		9 - 10	5
10	**Pain, tingling or numbness**	**No numerical score for this question.**	
	Present Symptoms		**Automatic High Risk**
	Past Symptoms		**Automatic Moderate Risk, Unless Score is High Risk**
	Total Score	**auto filled if completed in Excel**	**0**

Circle the appropriate category		Actions	FLM and Worker initials acknowledging appropriate action
High Risk	31 - 40, or "Yes" for present symptoms in question 10	FLM Notify Occ Medicine if present symptoms; worker must read P101-28 and Glovebox Ergonomics Guideline	
Moderate Risk	16 - 30 or "Yes" for past symptoms in question 10	Worker must read P101-28 and Glovebox Ergonomics Guideline	
Low Risk	0-15	Worker must read P101-28 and Glovebox Ergonomics Guideline	

Name:	Z#:	Signature:	Date:
Worker:			
FLM:			

Glovebox Worker Ergonomic Assessment Tool

Your answers to these questions will be kept confidential; the answers will be used to determine the ergonomic risk category. Please return this completed form to your first line manager (FLM). FLMs: Please score using the GB Survey Score spreadsheet, and forward the spreadsheet, and this form to Occupational Medicine: medical_request@lanl.gov, or by interoffice mail to Terese Ford, OM-OMO, MS D421.

Worker Name: _____ **Initials and date**_____

Z #: _____

TA, Building, Room #'s where you perform the majority of your GB work: _____

1. Approximately how long have you been a glovebox worker? _____years

2. How many weeks out of the year do you perform GB work? _____weeks

3. How much time do you spend working in a GB in a typical workday? _____hours per day

4. After how many minutes of GB work do you take a break? _____minutes

How long is each break? _____minutes

What is the longest duration you have worked in a GB without a break? _____minutes

5. What type of gloves do you use most frequently?

[ ] Hypalon 15 mil

[ ] Hypalon 30 mil

[ ] Hypalon/Polyurethane 22mil (blue & white)

[ ] Hypalon 30 mil (lead loaded)

[ ] Viton 25 mil

[ ] Other – please specify: _____

6. Approximately what percent of your GB work requires over gloves? _____ %

7. How frequently do you perform the following GB tasks? (enter a number between 0 and 5, 5= most frequent, 1=infrequently, 0= never perform the task) (Example photos are included on back page)

[ ] Heavy lifting (≥15lbs)

[ ] Fine motor activities (e.g. using tweezers or allen wrenches)

[ ] Lateral transfer of items (e.g. in/out of airlock, passing items down the length of a glovebox)

[ ] Gross motor activities (e.g. moving canisters)

[ ] Significant forward reaching (arms completely straight)

8. Please indicate your average daily mental stress level:

0 ------- 1 ------- 2 ------- 3 ------- 4 ------- 5 ------- 6 ------- 7 ------- 8 ------- 9 ------- 10

(no stress) (extreme stress)

9. Please indicate your average physical comfort level while working in a GB:

0 ------- 1 ------- 2 ------- 3 ------- 4 ------- 5 ------- 6 ------- 7 ------- 8 ------- 9 ------- 10

(no discomfort) (extreme discomfort)

10. Have you experienced any physical pain, tingling, or numbness, either in the past or the present that you attribute to your GB work? ____YES ____ NO

If YES, please mark an X in the corresponding cells below for past and present symptoms. Mark all that apply.

Have you reported a glovebox related injury to Occupational Medicine? ____ YES ____ NO

Body Part	Thumb	Hand	Wrist	Elbow/Forearm	Shoulder	Neck/Upper Back	Other (Please Specify)
Past							
Present							

Glovebox Worker Ergonomic Assessment Tool

Comments (Please include the following. Describe any glovebox related injury, or glovebox design feature that causes pain or discomfort. Describe any suggestions that would improve efficiency, safety, or ergonomic conditions in your glovebox work.):

Gross Motor Activities
(e.g. moving canisters)

Fine Motor Activities-Pinch Gripping
(e.g. using tweezers/allen wrench)

Significant Forward Reaching
(arms completely straight)

Lateral Transfer of Items
(e.g. in/out of airlock)