THE AGE OF TECHNOLOGY IN MANUAL MATERIAL HANDLING ERGONOMICS

Presented by:
Jim Mecham, MSIE, OTR/L, CPE
Chief Operations Officer – OccuCare Injury Prevention
TODAY'S MANUAL MATERIAL HANDLING OBJECTIVES

- Ergonomic evaluation using technology
- Latest research on manual material handling risk
- Engineering controls and technology
- Administrative controls and technology
- Work Practice controls and technology
- The future of technology in manual material handling
TECHNOLOGY IN ERGONOMICS

• Overexertion associated with manual material handling continues to be the highest risk and highest direct medical cost to employers worldwide.

• Wearable devices, automation, robotics and exoskeletons have infiltrated the ergonomics market

• Just like all technology, it is constantly evolving

• How does this fit into a
  • traditional ergonomic evaluation
  • determining risk factors
  • implementing controls and
  • ultimately making job modification recommendations/implementations changes

• Seasoned ergonomists versus new ergonomists
ERGONOMIC SOFTWARE

- Various pay for service software systems on the market
  - Cority Ergonomic Software (NIOSH Lifting)
  - EgoWeb Software (2D static, NIOSH Lifting, Liberty Mutual)
  - ErgoPlus (NIOSH Lifting, Liberty Mutual, WISHA lifting)

- Various manual material handling calculators
  - NIOSH lifting calculator on the app stores
  - The Ergonomics Center
  - Cornell University Ergonomics Web
MANUAL MATERIAL HANDLING RISK

• One size fits all method for assessing risks of manual materials handling is still nonexistent. Today, the greatest need in preventing manual materials handling injuries is understanding the cumulative effects of work tasks done over days, years, and finally a work career.

WEARABLE ERGONOMIC TECHNOLOGY

- Wearable ergonomic technology can be worn over an extended period of time.
- Track hazardous movements between workers, between jobs and/or between departments.
- Rank jobs within an entire organization based on the jobs with the highest to the least amount of hazardous movements.
- Know exactly overtime when an employee has hazardous movements and where on the job to focus ergonomic improvements.
- Use before and after job modification solutions to see objective empirical improvements.
WEARABLE ERGONOMIC TECHNOLOGY

Notifications to instantly warn worker of high-risk movement

Movement detection algorithms: Quantifies the parameters of every at-risk movement that a worker makes

Intensity prediction model: Estimates the intensity of certain categories of movements (e.g. lifting, striking, push/pull)

Battery life of 2+ months (rechargeable)

Clipped to any shirt or safety vest at orientation of choice (vertically & horizontally)

Program Overview
1. First day: We need to remind our team of our algorithm.
2. Two-day model: The application will model the risk of 45 different movements for 5 working days.
3. Improvement: 2 days to improve your implementation after the whole programme.

Link & Learn
Diagnostic report
We have measured your activity at:

- 665 high-risk movements
- 133 daily average

Bend & Static
Sustained lifting consequences
For a certain time after sustained bending, the spine is not adequately protected for its motions, this potentially makes it unstable and prone to injury.

Reporting to highlight and explain what types of high-risk movements the worker is making

Personalised coaching and exercises to improve body and risk awareness
**WEARABLE ERGONOMIC TECHNOLOGY**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
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<tbody>
<tr>
<td>01</td>
<td>Lifting movements with poor technique (primarily sagittal flexion)</td>
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<tr>
<td>02</td>
<td>Overreaching (sagittal flexion)</td>
</tr>
<tr>
<td>03</td>
<td>Twisting (rotation of the trunk)</td>
</tr>
<tr>
<td>04</td>
<td>Repetitive movements &amp; forces</td>
</tr>
<tr>
<td>05</td>
<td>Sustained awkward static postures (including sagittal flexion, sagittal extension, rotation of the trunk &amp; lateral flexion)</td>
</tr>
<tr>
<td>06</td>
<td>Sustained &amp; high forces</td>
</tr>
<tr>
<td>07</td>
<td>Sudden impact forces</td>
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<tr>
<td>08</td>
<td>Full-body vibrations</td>
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## WEARABLE TECHNOLOGY REPORTING

<table>
<thead>
<tr>
<th>Name</th>
<th>Hazardous movements</th>
<th>Total movements</th>
<th>Average hazardous movements per hour</th>
<th>Hazardous movements ratio</th>
<th>Change</th>
<th>Hazardous movements ratio per day</th>
<th>Hours recorded</th>
<th>Std U/Lifting low intensity</th>
<th>Std U/Lifting high intensity</th>
<th>Std Lifting/lowing</th>
<th>Back twisting</th>
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<tbody>
<tr>
<td>Soutanne Alden</td>
<td>224</td>
<td>768</td>
<td>7.75</td>
<td>29.17%</td>
<td>↓29.63%</td>
<td></td>
<td>28</td>
<td>60</td>
<td>54</td>
<td>47</td>
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<tr>
<td>Parsy Shaw</td>
<td>208</td>
<td>937</td>
<td>4.02</td>
<td>22.2%</td>
<td>↓27.4%</td>
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<td>51</td>
<td>55</td>
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<tr>
<td>Veva Carite</td>
<td>380</td>
<td>1574</td>
<td>6.05</td>
<td>24.14%</td>
<td>↓25.71%</td>
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<td>62</td>
<td>100</td>
<td>93</td>
<td>90</td>
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<tr>
<td>Terach Cass</td>
<td>419</td>
<td>1471</td>
<td>7.93</td>
<td>28.48%</td>
<td>↓20.55%</td>
<td></td>
<td>52</td>
<td>100</td>
<td>104</td>
<td>99</td>
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<tr>
<td>Fraser Keaton</td>
<td>336</td>
<td>1415</td>
<td>5.53</td>
<td>23.75%</td>
<td>↓19.88%</td>
<td></td>
<td>60</td>
<td>83</td>
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<td>David Matasskin</td>
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<td>1329</td>
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<td>24.23%</td>
<td>↓17.32%</td>
<td></td>
<td>60</td>
<td>79</td>
<td>74</td>
<td>84</td>
<td></td>
</tr>
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</table>
EMPLOYEES AND WEARABLE ERGONOMIC TECHNOLOGY

• A product with GPS is hard to convince an employee to wear

• A product with too many sensors is hard to get an employee to wear
  • Needs to be a quick and easy attachment to the body

• Employees struggle with technology that sticks directly to their skin.

• Simple, simple, simple and non obstructing technology tends to be the best

• We have chosen Soter Spine from Soter Analytics [https://www.soteranalytics.com/]
Based on the results obtained, improvement measures were proposed, which can reduce or eliminate the risks associated with the tasks studied, like the implementation of automated or semiautomated loading systems or auxiliary lifting systems.

For selecting appropriate Material Handling Equipment, it is felt that some Multi Criteria Decision Making Methods must be used due to their ability of converting a complex problem to a paired comparison. These methods are based on some relative Criteria and Sub-criteria. Certain methods such as; Analytic Hierarchy Process (AHP), Fuzzy Analytic Hierarchy Process (FAHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) have studied for solving the problem of Material Handling Equipment selection.

ANALYTIC HIERARCHY PROCESS (AHP)

Use this feature to solve multi-criteria decision problems based on a criteria hierarchization. Available in Excel with the XLSTAT software.
• The literature review has shown that researchers have considered the design problems in material flow systems and overcome them with an adequate knowledge base approach, properly design, 3D modeling, analyzing, and using simulation models to validate the system performance for acquiring the MH equipment selection.

The basis of the implanted system was the concept of stock on wheels, practicing materials transport with the aid of a tug internally named “train”. The tug pulls the wagons with more load than forklifts (previous system), maximizing travels and loads through a specific route.

The improvement in material flow caused by the use of the proposed vehicle increased the accuracy of materials delivery time inside the company. Operations became safer.

Exoskeletons

- All passive exoskeletons retrieved were aimed to support the low back. Ten articles suggested forty per cent reductions in back muscle activity during dynamic lifting and static holding have been reported.
- Both lower body, trunk and upper body regions could benefit from active exoskeletons.
- Muscle activity reductions up to 80% have been reported as an effect of active exoskeletons.
- Exoskeletons have the potential to considerably reduce the underlying factors associated with work-related musculoskeletal injury.
- Worldwide, a significant interest in industrial exoskeletons does exist, but a lack of specific safety standards and several technical issues hinder mainstay practical use of exoskeletons in industry.
- Specific issues include discomfort (for passive and active exoskeletons), weight of device, alignment with human anatomy and kinematics, and detection of human intention to enable smooth movement (for active exoskeletons)

EXOVEST
Employee involvement and employee training was mentioned as a key component for achieving an effective and efficient Material Handling System. Organizations already have been realized that without employee involvement the success of any system implementation is almost near to zero.

WORK PRACTICE CONTROLS WITHOUT TECHNOLOGY

“...EDUCATIONAL PROGRAM TO PREVENT WORK ASSOCIATED LOW BACK INJURY FOUND NO LONG-TERM BENEFITS ASSOCIATED WITH TRAINING.”

A CONTROLLED TRIAL OF AN EDUCATIONAL PROGRAM TO PREVENT LOW BACK INJURIES

Lawren H. Daltroy, Dr.P.H., Maura D. Iversen, B.S.P.T., S.D., Martin G. Larson, S.D., Robert Lew, Ph.D., Elizabeth Wright, Ph.D., James Ryan, M.D., M.P.H., Craig Zwerling, M.D., Ph.D., Anne H. Fosse, and Matthew H. Liang, M.D., M.P.H.

ABSTRACT

Background Low back injuries are common and costly, accounting for 15 to 25 percent of injuries covered by workers’ compensation and 30 to 40 percent of the payments made under that program. The high costs of injury, the lack of effective treatment, and the evidence that there are behavioral risk factors have led to widespread use of employee education programs that teach safe lifting and handling. The effectiveness of those programs, however, has received little rigorous evaluation.

Low back pain affects 70 to 80 percent of adults at some time. In the United States and Canada, low back injuries constitute 15 to 25 percent of the injuries covered by workers’ compensation and account for 30 to 40 percent of workers’ compensation payments. Most compensation claims related to back injury (87 percent) are for strains and sprains, most of which (72 percent) are due to overexertion, as in lifting and handling. Back schools are educational programs developed by physical therapists for patients with...
Workers were set up during a short 20-minute briefing session where they were given a device and profiles were created in the App. Team leaders were also present and were trained on how to access and use the online SoterSpine Dashboard to manage progress. Two groups of workers undertook the program, firstly the in-field trainers followed by a group of new starters.

**Trainers**

Breakdown of HRMs, averaged for all Trainers

- Sustained Awkward Static Posture: 19%
- Forward Bending High Intensity: 79%
- Forward Bending Low Intensity: 2%

High-risk movement reduction: **44%**

<table>
<thead>
<tr>
<th></th>
<th>Start</th>
<th>End</th>
</tr>
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<tbody>
<tr>
<td>44% reduction</td>
<td>12.8</td>
<td>7.2</td>
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</tbody>
</table>

**New Starters**

Breakdown of HRMs, averaged for all New Starters

- Sustained Awkward Static Posture: 69%
- Forward Bending High Intensity: 25%
- Forward Bending Low Intensity: 5%

High-risk movements reduction: **45%**

<table>
<thead>
<tr>
<th></th>
<th>Start</th>
<th>End</th>
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<tbody>
<tr>
<td>45% reduction</td>
<td>13.6</td>
<td>7.5</td>
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</table>
WEARABLE DEVICES POWERED BY AI AND THE FUTURE OF DATA DRIVEN INTELLIGENCE HELP A FOOD DISTRIBUTOR IDENTIFY RISK

- Implemented Soter Spine in two different dry good areas of large distribution warehouse.
- Section A had 220 Forward Bending low risk and high risk movements per hour
- Section B had 440 Forward Bending low risk and high risk movements per hour
- Section B had more low back claims
- Wearing the device over 14 days solidified the analytics for management
- It was discovered that the supervisor in Section A taught the workers to place the label on the package at the same time they picked the package. The Supervisor in Section B taught the employees to place the label on the package after they had all the packages loaded on the pallet. This caused twice as many bending repetitions per day in Section B
THE FUTURE OF TECHNOLOGY

• Get used to it.

• I have talked to many ergonomists who say technology can never replace a good solid ergonomic evaluation.

• Just like anything in technology it will continue to get better and better and will become a mainstay in ergonomics.
TECHNOLOGY AND MANUAL MATERIAL HANDLING CONCLUSION

- Good Old Fashion ergonomic evaluation by a trained and certified ergonomist can never be replaced by technology
- Technology can complement and help a trained and certified ergonomist
- Especially gathering data over days, weeks and months
- Everyday there are more and more technologically advanced systems that provide engineering control solutions
- Administrative Controls and good old fashion job rotation and job enlargement require the skill of an ergonomist to design a solution
- Work Practice Controls and teaching a worker to perform an activity in an improved biomechanical fashion is coming back into vogue due to wearable technology.
Questions?

Jim Mecham, MSIE, OTR/L, CPE

Phone: 262-925-2919

Email: jmecham@occucare.net

www.occucare.net