Firefighter and Emergency Medical Services Ergonomics Curriculum

University of Oregon
Labor Education and Research Center

This material has been made possible by a grant from the Oregon Occupational Safety and Health Division, Department of Consumer and Business Services

We are interested in receiving feedback from those who use or read this curriculum. Comments about the accuracy or appropriateness of the material, clarity, format, examples, ease of use and suggestions for additions or revisions are welcome. Comments and requests for additional copies of the manual can be sent to:

Laurel Kincl or Jennifer Hess
Labor Education and Research Center
1289 University of Oregon
Eugene, OR 97403-1289
Telephone: (541) 346-3073
Fax: (541) 346-2790
E-Mail: lkincl@uoregon.edu or
jhess@uoregon.edu

Acknowledgments

This curriculum is the product of efforts by many individuals and organizations. It was prepared by the University of Oregon Labor Education and Research Center. We owe a great deal to the International Association of Fire Fighters (IAFF) locals 851 and 1395, the City of Eugene Fire and EMS Department and the City of Springfield Fire and Life Safety for helping us develop and test the curriculum, for assistance in producing the ergonomics review video and for spending many hours educating us about their jobs. Funding was provided by the Oregon Occupational Safety and Health Division, Department of Consumer and Business Services, under its Occupational Safety and Health Training Grants Program. Additional funding was provided by the Oregon Labor Safety and Health Education Program (OLSHEP).

Writers/Editors

Labor Education and Research Center:

Laurel Kincl
Jennifer Hess
Steven Hecker

Thanks to the following individuals helped in the development, pilot, testing and revision of the curriculum

Karen Anderson, EMS Training Coordinator, City of Eugene Fire and EMS

Barry Burleson, Video Technician, City of Eugene Fire and EMS

Matt Ennis, Captain, City of Eugene Fire and EMS

Kevin Gray, Training Captain, City of Springfield Fire and Life Safety

Dale Knight, SAIF Corporation

Fred Lundgren, EMS Officer, City of Springfield Fire and Life Safety

Mike Mitchell, Technical Section, Oregon OSHA

Thomas Price, Lane County N0. 1 Fire District

Mike Pungercar, Safety/Loss Control and Environmental Programs Manager, City of Eugene

Terry Riley, Regional Training Coordinator, Fire Service Training, Department of Public Safety Standards and Training

Brian Smith, Training Captain, City of Eugene Fire and EMS

Mark Walker, Battalion Chief-Training, City of Springfield Fire and Life Safety

References

Biering-Sørensen F. Physical measurements as risk indicators for low-back trouble over a one-year period. *Spine*, 1984; 9(2): 106-19.

Conrad KM, Balch GI, Reichelt PA, Muran S, Kyoung O. Musculoskeletal injuries in the fire service. *American Association of Occupational Health Nurses Journal*, 1994; 42(12): 572-581.

Federal Emergency Management Agency (FEMA) "Fire and Emergency Medical Services Ergonomics: A guide for understanding and implementing an ergonomics program in your department." March 1996. www.fema.gov.

Hess J, Hecker S. Stretching at work for injury prevention: issues, evidence, and recommendations. *Applied occupational and environmental hygiene*, 2003 May; 18(5): 331-8.

Karter and Molis. United States *Firefighter Injuries of 2002*, National Fire Protection Association, 2003.

Karter. *Patterns of Firefighter Fireground Injuries*, National Fire Protection Association, 2003.

Lavender SA, Conrad KM, Reichelt PA, Johnson PW, Meyer FT. Biomechanical analysis of paramedics simulating frequently performed strenuous work tasks. *Applied Ergonomics*, 2000; 31: 167-177.

Lavender SA, Conrad KM, Reichelt PA, Meyer FT, Johnson PW. Postural analysis of paramedics simulating frequently performed strenuous work tasks. *Applied Ergonomics*, 2000; 31: 45-57.

Luoto S, Heliovaara M, Hurri H, et al. Static back endurance and the risk of low back pain. *Clinical Biomechanics*, 1995; 10: 323-324.

Lusa, S, Louhevaara V, Smolander J, Kinnunen K, Korhonen O, Soukainen J. Biomechanical evaluation of heavy tool-handling in two age groups of firemen. *Ergonomics*, 1991; 34(12): 1429-1432.

McGill S. Low back disorders: evidence-based prevention and rehabilitation. Human Kinetics. United States. 2002.

Reichelt RA and Conrad KM, Musculoskeletal Injury: Ergonomics and Physical Fitness in Firefighters, *Occupational Medicine*, 1995; 10(4): 735-746.

Thacker SB, Gilchrist J, Stroup DF, et al. The impact of stretching on sports injury risk: a systematic review of the literature. *Medicine and Science in Sports and Exercise*, 2004; 36(3): 371-8.

Walton, SM, Conrad KM, Furner SE, Samo DG. Cause, Type and Workers' Compensation Costs of Injury to Firefighters. *American Journal of Industrial Medicine, 2003*; 43: 454-458.

Table of Contents

Introduction 1

Training Philosophy 1

Organization of the Curriculum 2

Using the Curriculum..... 4

Background Information for the Instructor 5

Module 1: Introduction to Ergonomics and Cumulative Trauma 1-1

Risk Factor Handout 1-15

Module 2: Ergonomic Hazard Analysis 2-1

'What and Why' Handout with example..... 2-15

'What and Why' Handout blank..... 2-17

Module 3: Developing and Implementing Ergonomic Solutions 3-1

Solution Analysis Handout for instructor..... 3-13

Solution Analysis Handout blank..... 3-15

Module 4: Body Mechanics and Back Health 4-1

Body Mechanics Handout..... 4-19

Trunk Endurance Exercises Handout..... 4-21

Module 5: Command Staff Ergonomics 5-1

Appendix 1: Glossary of terms A1-1

Appendix 2: Resources A2-1

Appendix 3: Evaluation Form A3-1

Introduction

This guide accompanies "Firefighter and Emergency Medical Services Ergonomics Curriculum". The curriculum was developed by ergonomists at the University of Oregon Labor Education and Research Center. The project was funded by a grant from the Oregon Occupational Safety and Health Division. The curriculum is for both fire and emergency medical services (EMS) personnel. While it contains information for both of these occupations, it is appropriate for departments or organizations that provide solely firefighting duties such as volunteer fire departments or solely EMS duties such as private ambulance companies.

The purpose of the instructor's guide is to provide a road map for using the curriculum effectively. We use the term "instructor" broadly here. While teaching skills and experience are helpful, a person who is familiar with firefighting and/or EMS work and spends sufficient time becoming familiar with the materials should be able to make good use of the curriculum. This guide offers general information concerning the training philosophy behind the curriculum and specific guidance on how to use the modules.

Training Philosophy

In our health and safety training we are committed to methods that involve participants to the greatest degree possible. This derives from our understanding of principles of adult learning and from our own experience in education and training. Adults learn most effectively when they are actively engaged in the learning process, they can integrate new knowledge with their own experience, and there is give and take between learner and teacher and among learners. With this curriculum a participatory learning process is especially important. Firefighters (FFs) and EMS personnel have unique work situations that place them at high risk for sprains, strains and other musculoskeletal injuries. We rely on the input of the participants themselves to help devise control measures which are practical and which firefighters and EMS workers would actually follow in practice. Trainee involvement is also important to achieving recognition by as many participants as possible that 1) there is a problem, even if everyone does not experience it firsthand, and 2) there are positive steps that can be taken to solve parts of the problem.

We have included a number of small activities in the modules to promote participatory learning. Frequently in training and education programs a conflict develops between participation and time constraints. The more material an instructor has to cover, the more likely that instructor will resort to a lecture to squeeze it in. We ask you to remember a basic principle of education: *what's important is not how much information the teacher puts out, but how much the student takes in, integrates, and puts into practice*. If you are faced with time constraints and are tempted to talk fast to cover more of the material in a module, we encourage you to think about this principle. You are likely to be more effective as an instructor if you spend the time letting the small groups discuss and discover

answers among themselves. This is active learning that they will retain better than by simply telling them or having them read the information themselves.

Organization of the Curriculum

This binder contains the following materials:

- an introduction for the instructor guide
- an instructor guide for each module including handouts and copies of the slides that could be made into transparencies if needed
- appendices containing:
  - a glossary of terms
  - a list of resources
  - an example evaluation form
- a CD with all the PowerPoint presentations and other materials in electronic form. The PowerPoint files have all the notes from the instructor guide with each slide. The electronic materials are in PowerPoint and pdf format (pdf format can be read with Adobe Reader, this is a free download at www.adobe.com). There is also a file called "information.txt" on the CD that has details about the materials on the CD.
- a DVD with a 15 minute ergonomics review video. A VHS video is available upon request

The instructor guide begins with this introduction that is intended for instructors. Following this introductory section are tabs for each module that explain the specifics for the instructor for each module. A brief description of the modules is presented below, organized by topic. The modules are arranged in the preferred order of presentation, although there is some flexibility once the first module is taught. We have tried to limit the modules to a time frame that will fit into most training schedules. A brief discussion of the rationale for the order of the modules follows.

Module 1: **Introduction to Ergonomics and Cumulative Trauma**. This module provides on introduction to the concept of ergonomics and cumulative trauma. Ergonomics is defined and firefighter injury data are presented. Musculoskeletal risk factors are presented providing workers with tools to understand how these risks are present in their jobs. It is important to begin the ergonomics series with this module in order to lay the groundwork for the other modules. This is a 1.5-hour module.

Module 2: **Ergonomic Hazard Analysis.** This module introduces how to conduct a hazard analysis. Basic principles of ergonomics are reviewed, providing a forum for discussion about why and how a musculoskeletal hazard analysis can be completed. This module follows the introduction module nicely since it teaches the audience how to recognize the musculoskeletal risk factors associated with their various work tasks. This is a 1.5-hour module.

Module 3: **Developing and Implementing Ergonomic Solutions.** This module presents information on how to develop and implement ergonomic solutions. Once the group understands how to critically think about the tasks/jobs they do at work, the next step is to learn how to develop solutions. This module explains a way of considering many possible solutions and going further to exploring how these solutions could be implemented. It also covers how to decide which solution is best for a given situation. This is a 1.5-hour module.

Module 4: Body Mechanics and Back Health. In this module basic body mechanics principles and back health are presented. This is the most flexible of the modules in that it could be taught at any point in the ergonomics training. An overview of spinal anatomy and physiology is presented, which is then applied to ways of protecting the back. This is a 2-hour module.

For line personnel, it is strongly recommend that module 1 be presented first. Modules 2 and 3 are a good follow up, with 4 being taught last, but these are somewhat flexible.

Module 5: **Ergonomics for Command Staff**. This module contains the same basic principles of ergonomics (definition of ergonomics, musculoskeletal risk factors, and elements of an ergonomics program) as the first four modules, but it is intended for management and the board of directors. This module specifically addresses the elements of an ergonomics program that need to be addressed by management. The best situation is to have the command staff module presented to management before the other modules are taught to line personnel so that decisions about starting and implementing an ergonomics program can be shared with line personnel at the time of their training and with management support. This is a 1-hour module.

Following each tab for the modules, you will find some basic information about the module. This will be in the following format:

Instructor Guide for [title of slide]

Title: [title]

Date Developed: [date the module was developed]

Time Required: [estimate of the time required to teach the module- you may decide a different amount of time is required]

Number of Slides: [the number of slides in the PowerPoint presentation]

Materials/Resources Needed: [list of materials to have copied or ready for the class – handouts and each slide will found at the end of the instructor's guide for each module that can be copied or transparencies made]

Objective: [overall objective with a list of main concepts to be covered]

Motivation: [reason why this module was included to give a sense of purpose to it]

Overview: [overview of what is contained in the module]

Following the basic information, each slide is shown with the purpose, emphasis and action point for that information accompanying it. After all the slides are covered, there are the handouts for the module as well as each slide printed separately. These can be copied or you can have transparencies made, if necessary, for the class.

Using the Curriculum

Needs Assessment

Prior to implementing any of the modules, you should conduct a needs assessment of your audience. This can be done formally or informally through questionnaires, discussions, and review of records. The information you will want to know includes:

- The incidence of musculoskeletal disorders (MSDs) at your work site among the target audience
- Perceptions of how big a problem musculoskeletal disorders are
- How much is already known about ergonomics and MSD problems among firefighters and EMS workers
- What people in your department want most to learn about these issues.

You might also use the needs assessment to identify key individuals in the workplace who can help "sell" the training to others.

Scheduling the Training

Ideally all of the modules should be scheduled in order to achieve the full benefit of an ergonomics program. Scheduling depends on the types of time slots you have available for delivering the modules. The command staff module is designed to take one hour. Command staff is encouraged to attend the other modules along with line personnel for additional training. The full curriculum for the line personnel requires about 6.5 hours. Considerations in scheduling include:

- Try not to spread the sessions out over too long a period so that people don't remember the information from the earlier sessions.
- Set up the schedule to make use of available training resources, for example, use a physical or occupational therapist in module 4, if available.
- Use periods between sessions to your advantage by having attendees try out things they've learned, e.g. a hazard analysis or solution analysis.

- Do your best to maximize consistency in attendance so that everyone is exposed to the same information.
- Schedule the training in the morning when people are fresher and more receptive to learning.

Preparing to Teach

- Review the general material in this Instructor's Guide on teaching philosophy, how the modules fit together, etc.
- Read in advance the module you will be presenting and the accompanying overhead transparencies. If you have questions about the subject matter consult people within the organization with appropriate expertise who might be able to help you. You can also use the Resource Agencies and Materials guide in the appendix.
- Make an outline or notes of the module for yourself. This will help you get organized and also will help you become more familiar with the material.
- Prepare materials for the session. Make enough copies of materials in the module(s) you will be using for the number of people anticipated for the training. You may choose to hand out only those modules you are covering that day, or you may want to hand out the entire manual at the first session.

Assessing Impact

We have not prepared "tests" to evaluate specific knowledge learned from these modules. We do include an evaluation form that could be used to get feedback. If instructors are interested in evaluating assimilation of specific information, they may develop such tests themselves based on the module text and objectives.

Background information for the instructor

The following information is meant to provide instructors with background information on the following topics:

- Basic principles of ergonomics
- Musculoskeletal disorders
- An ergonomics approach to illness and injury prevention
- Review of basic anatomy and physiology
- Basic biomechanics.

Basic Principles of Ergonomics

Ergonomics in its broadest definition is the study of the relationship between the worker and his/her work. The term comes from the Greek words, *nomos* (rule, law), and *ergon* (work); thus it is the study of the laws of work. Ergonomics looks at how tools and equipment are designed, how workplaces are laid out, and how work is organized in relationship to people doing the work.

This type of evaluation is usually undertaken after problems occur, such as:

- High worker injury, disability absence, and workers' compensation costs
- Errors, problems of quality
- Employee absenteeism, turnover, low morale and job dissatisfaction.

Ergonomics, which is sometimes referred to as *human factors*, encompasses a number of different fields of study including, engineering, physiology, psychology, and medicine. It looks at factors as diverse as:

- the way humans process information
- human measurements i.e. population distributions of height, weight, hand size, torso length, etc. (the field which studies these measurements is called *anthropometry*)
- temperature extremes
- human energy expenditure
- lighting.

Musculoskeletal Disorders

In recent years ergonomic problems have become widely recognized due to the fact that musculoskeletal injuries and illnesses account for the majority of time lost from the job, nationally and in Oregon. The U.S Department of Labor defines a musculoskeletal disorder (MSD) as an injury or disorder of the muscles, nerves, tendons, joints, cartilage, or spinal discs. MSDs do not include disorders caused by slips, trips, falls motor vehicle accidents or similar accidents. In 2003 according to the Bureau of Labor Statistics in 2003 MSDs accounted for 33% of all work-related injuries and illnesses that resulted in days away from work in the United States.

One goal of ergonomics is to reduce musculoskeletal disorders by adapting the work to fit the person, instead of forcing the person to adapt to the work. Other terms for musculoskeletal disorders are:

- **Cumulative trauma disorders (CTDs)**
- **Repetitive strain injuries (RSI)**
- **Work-related musculoskeletal disorders (WRMD)**

Cumulative trauma disorders largely affect the soft tissues (muscles, tendons, ligaments, nerves, vessels) and can be caused, aggravated, or precipitated by forceful or repetitive work, particularly in combination with awkward postures. Many cases of low back pain are the result of cumulative trauma, rather than of a single incident. Other common locations of CTDs are the hand, wrist, elbows and shoulders. Carpal

tunnel syndrome (CTS), which has received much attention in recent years, is a CTD affecting the median nerve, a key nerve that runs through the wrist into the hand.

An Ergonomic Approach to Injury/Illness Prevention

Ergonomics examines:

- how people do their work
- what body movements and positions they use
- what tools and equipment are used
- how the work is organized.

This is in order to systematically analyze:

- energy required to perform job tasks (fatigue)
- forces required to perform job tasks (biomechanics)
- postures required (musculoskeletal problems)
- work environment conditions (heat, cold, light, noise)
- work schedules: shift work, length of shift (fatigue)
- worker/machine interaction: control design, information control
- social interaction at work, work organization, monitoring and management style (stress)
- workload, decision-making, latitude over job.

The ultimate purpose is to identify what effect all of these factors have on employee's health. A key to the ergonomic approach to prevention is that it is **systematic**. This means looking at all elements, not only independently but as a whole system, of the worker/work environment interaction to identify problems and solutions. This approach helps to get at the root causes of injury and illness in order to develop viable solutions.

Review of Basic Anatomy and Physiology

Anatomy and physiology help us to understand ways that the body is susceptible to musculoskeletal injuries from firefighting and emergency medical services and other work tasks. While all EMTs and paramedics have training in anatomy and physiology, we are presenting this information as a review and relating it specifically to the stresses that fire and EMS tasks place on the spine.

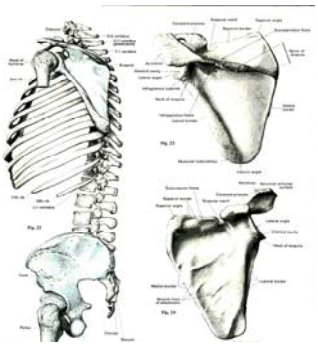
Anatomy studies the basic structure of the body and its organ systems. Physiology looks at the function of the body, its organ systems, and the relationship of these systems. The primary systems of interest to a physiologist are the cardiovascular, nervous, and musculoskeletal systems. This section focuses on the

anatomy and physiology of the musculoskeletal system with the goal of helping you better understand its component parts and what can go wrong.

The Musculoskeletal System

The skeletal system is made up of bones, muscles, tendons, ligaments and skin. The skeletal system provides support and leverage for the body, protection for the organs, and movement. We describe those parts of the musculoskeletal system of greatest concern in disorders of the hand, wrist, arms, shoulders, and back.

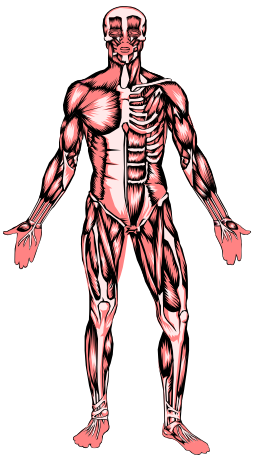
Bones



Bone is material that continually renews itself through a process of breaking down and rebuilding. Bone can also respond to stresses placed upon it (such as fractures and excessive use) by thickening and reshaping. There are four main types of bone in the body:

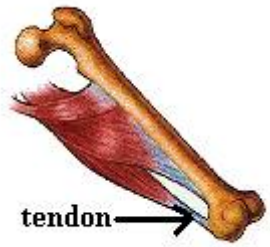
- Long (femur, tibia, humerus in the arms and legs)
- Short (carpals and tarsals in the hands and feet)
- Flat (ribs, scapulae, frontal)
- Irregular (vertebrae, sacrum, coccyx)

Muscles



Muscles are responsible for the movement of the body. Each muscle consists of thousands of fibers, each of which can contract to cause movement. As muscles alternatively relax and contract, they help to move blood and the oxygen and nutrients it carries through the muscle. If a static posture is held for a long time, the blood can't flow through the muscle. This causes the oxygen to be used up and the carbon dioxide and waste products, such as lactic acid, to build up in the blood trapped in the muscle. This causes muscle fatigue. Overexertion, overuse, or overstretching a muscle can lead to a strain. Important aspects of muscle health are strength, endurance, symmetry and tone. Many times the focus of muscle health is only enhancement of strength. Ignoring these other aspects of muscle health can lead to decreases in muscle coordination, efficiency and eventually, injury.

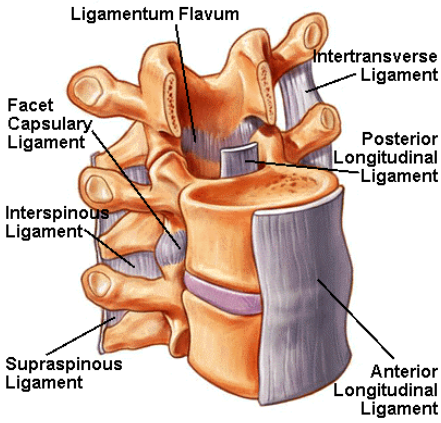
Tendons



The tendons are made up of connective tissue, and they connect muscles to bones. Overuse of tendons causes wear and tear, which results in irritation, edema and accompanying pain and tenderness. Continual overuse of tendons can lead to an acute injury, cumulative trauma injury, and eventual disability. Injury to tendons is known as

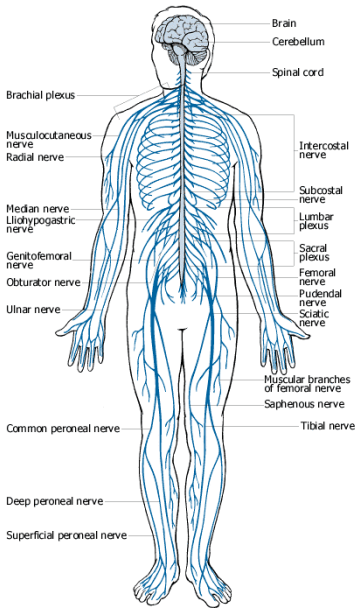
tendonitis. Lateral epicondylitis of the elbow is an example of a common cumulative trauma injury to a tendon.

Ligaments



Ligaments connect bone to bone and are important joint stabilizers. A sprain results when ligaments are stressed, torn or otherwise damaged. These types of injuries are usually the result of ballistic loading such as slips, and falls or a traumatic sports activity (a torn anterior cruciate ligament for example). Sprains may take weeks or months to heal because ligaments have a poor blood supply. This may result in joint instability and risk of re-injury or a worse injury, such as a ligament tear.

Nerves



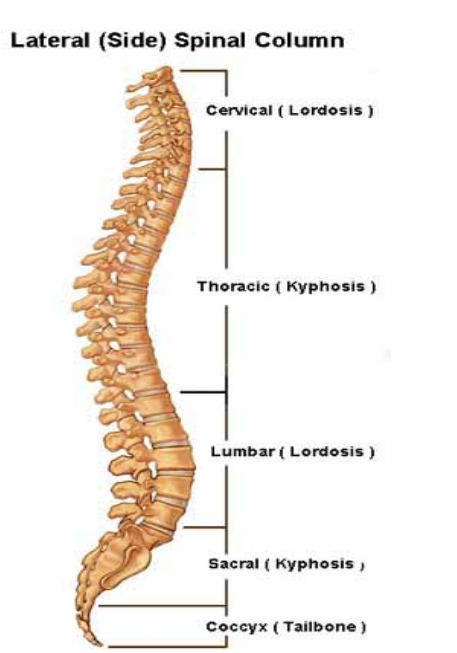
The nerves carry electrical impulses from the brain and spinal cord throughout the body. The nerves themselves are made up of:

- Cell bodies (found in the spinal column or immediately adjacent) covered with dendrites (connections to other cell bodies);
- A long axon (nerve fiber enclosed in a sheathe) which is connected to the muscle or organ the nerve is responsible for; and
- Nerve endings throughout the body.

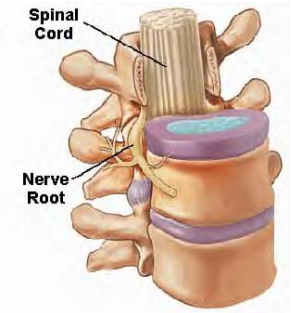
Spinal nerve compression can be caused by a variety of factors such as edema of the posterior longitudinal ligament, narrowing (stenosis) of the spinal canal or foreman, or impingement by a bulging disc.

Anatomy and Function of the Spine

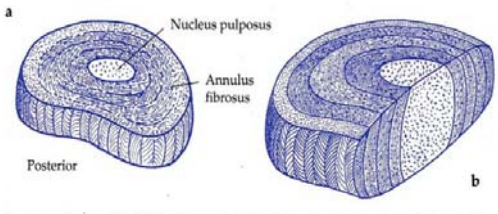
Spine



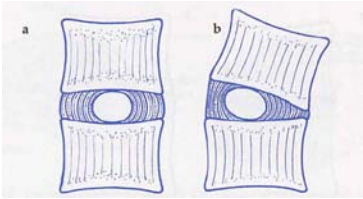
The spinal column is made up of vertebrae and depends for its stability on supporting ligaments and muscles. It can be divided into three sections: cervical (neck), thoracic (upper back), and lumbar (lower back). The spine offers protection for the spinal cord and it is unique in that it not only provides support but it allows free movement of the torso. The most common site of injury in the lower back is at the level of the vertebrae just above the pelvis (L5-S1) which is the site substantial stress and strain during activities such as twisting, bending or lifting. The three curves of the spine, the cervical and lumbar lordosis, and thoracic kyphosis, are also an important source of spinal stability. The spine is in *neutral posture* when these curves are intact, and in this position it is most stable and strong.



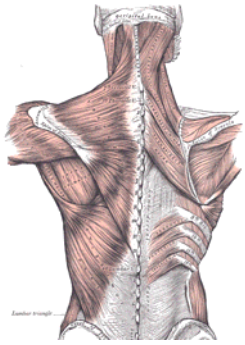
A motion unit in the spine is made up of an intervertebral disc sandwiched between two adjacent vertebrae. The spinal cord runs from the brain down the spine posterior to the vertebral bodies but anterior to the posterior elements (spinous processes, transverse processes). Spinal nerves exit the spine at each vertebral level from openings called 'foramen'.



The discs act as spacers and shock absorbers, cushioning loads and allowing free movement. They are made up of two parts—an outer hard fibrous ring (annulus fibrosus) surrounding an inner soft gel-like center (nucleus pulposus). When the spine is flexed, as when lifting or sitting, a wedge is created between the two bones anteriorly. This causes the nucleus to be pushed posterior. If the outer annular fibers are weak or torn, the nucleus can be pushed or squeezed outward. This is called a 'disc bulge' or 'herniation' (incorrectly referred to as a "slipped disc"). The stress on the disc increases when a load is applied (such as when lifting heavy equipment or a patient), or when the spine is also rotated or laterally flexed. These stresses become a major risk when the disc degenerates, which is part of the normal aging process.



Muscles of the Back



The muscles of the back and abdominal wall are of supreme importance. They control spinal movements and protect and stabilize the vertebral column against motions beyond the physiological range. For stability of the trunk, certain muscles, such as the abdominal rectus abdominis and obliques anteriorly, and the erector spinae and quadratus lumborum posteriorly, should be maintained for strength, tone, symmetry and endurance.

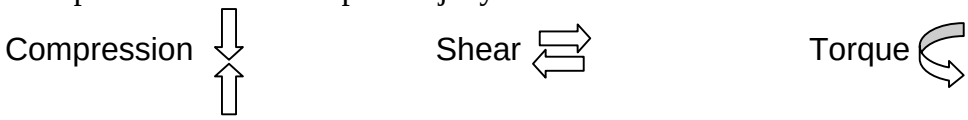
Why is the back injured so often? The spine supports the weight of the head, torso and arms, which equals about 65% of the body weight. When we hold loads or weights, the effort of holding this weight is transferred to the spinal and trunk muscles, creating a burden on these structures. Further, the ability to have a large degree of spinal flexibility comes at the cost of strength and stability.

When standing upright in neutral posture for example, the load on the spine arises mainly from the effects of gravity transmitted directly down the vertebral column. Once one leans forward, the tension in the muscles of the back and hips increases. In order to reduce the stress on the spinal column resulting from lifting, twisting, or bending motions, it is important to minimize the forces and loads present during each movement. This concept is discussed further in the following biomechanics section.

Basic Biomechanics

Biomechanics is the study of engineering principles such as force, velocity and acceleration and how they affect the human body. This study is important to understanding how the body is injured and how to develop injury prevention strategies.

Three important forces for spine injury are:



Compression: This is a force on the spine in the vertical direction. You can imagine if you took a marshmallow (representing your disc) and placing it between two cookies (representing your vertebrae). When you squeeze the two cookies together in the center, it makes the marshmallow bulge on all sides. This is an example of compressive force and what it does to your disc. The disc is anatomically designed to withstand more force in this direction since the weight of your upper body constantly compresses your spine when you are upright. However, if this force is excessive, the endplates of your vertebrae can be fractured over time.

Shear: This is a force that is horizontal or across a surface. These forces are important when you are bending forward (flexing). Bending forward creates a shear

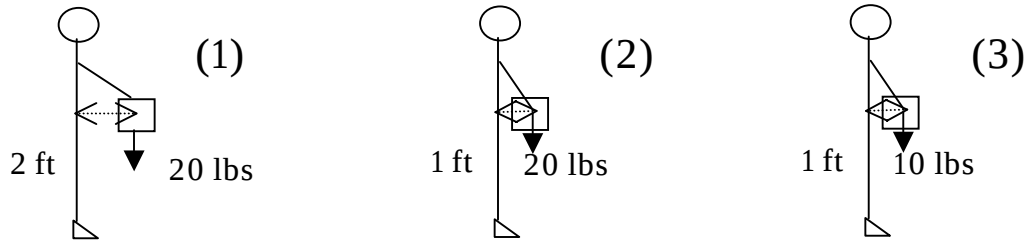
force in the disc pressing it backwards. You can again imagine two cookies with a marshmallow between them. When you press the cookies together towards one edge of the cookies, you can see how the marshmallow begins to squeeze out the opposite side. This is an example of the shear force created when the disc is pushed in the posterior direction when you flex forward.

Torque: This is the rotational or twisting force. It is important when you are bending forward as you are creating a rotation about the point where you are bending, which is usually your lower back. This torque must be handled by the soft tissue in the low back, i.e. the muscles, ligaments and discs. A very important concept is that torque is increased when distance is increased. This is explained by the equation for torque.

TORQUE = FORCE x DISTANCE

Where: **force** is essentially the weight that you are lifting and **distance** is measured from your low back to the position of the weight that you are lifting.

Therefore, two ways to decrease the torque on your low back are to decrease the weight you are lifting and to shorten the distance away from your body that you are lifting. In the following basic example, if you are standing upright and holding a 20-lb box 24 inches or 2 feet away from your low back, you will have 40-ft lbs of torque on your low back (1). If you decrease the distance to 1 ft by holding the box closer to you, you decrease the torque by half on your low back (2). In the final example you can see if you decrease the distance to 1 ft and decrease the weight to 10 lbs then you can reduce the torque down to 10 ft-lbs (3).



Torque = 2 ft x 20 lbs = 40 ft-lbs

Torque = 1 ft x 20 lbs = 20 ft-lbs

Torque = 1 ft x 10 lbs = 10 ft-lbs

In the example that you will teach in module 4 of this curriculum, we show a firefighter bending at the waist to lift. When a person is flexed, you have to add the weight of the torso into the torque calculation since the person is not only lifting the box in the example, but also the weight of his own upper body. This, of course, increases the torque on the low back.

With all this background information you should be prepared to look through each module you plan to teach. As you look through, you can prepare your own notes or outline so that you can feel more comfortable with the material you plan to cover. Good luck!

Instructor Guide for Introduction Module

Title: Introduction to Ergonomics and Cumulative Trauma

Date Developed: 4/2005

Time Required: 90 minutes

Number of Slides: 32

Materials/Resources Needed:
Introduction to Ergonomics and Cumulative Trauma PowerPoint presentation-electronic form or transparencies
Computer system with PowerPoint software installed and projection system (if using electronic form)
Hard copies of PowerPoint slides for handouts
Hard copies of risk factor handouts

Objective: To provide information on the concept of ergonomics including:

1) Injuries
2) Cumulative trauma
3) Risk factors for musculoskeletal disorders
4) Elements of an ergonomics program
5) Information and resources for developing an ergonomics program for the fire department

Motivation: To provide background and basic principles of ergonomics to firefighters and/or emergency service workers.

Overview: This module contains the basic principles of ergonomics such as defining cumulative trauma, soft tissue injury and ergonomics. This module also spends time explaining musculoskeletal risk factors. It includes the elements of an ergonomics program and introduces hazard assessments and methods for developing ergonomic solutions, which are further discussed in another module. We strongly recommend that this should be taught to line personnel prior to the delivering the other modules so that they can have a good introduction into the topic of ergonomics.

Ergonomics for Fire and EMS Departments

Introduction to Ergonomics & Cumulative Trauma

University of Oregon
Labor Education and Research Center

This material has been made possible by a grant from the Oregon Occupational Safety and Health Division, Department of Consumer and Business Services

LABOREGON
LERC

Purpose: Introduce yourself and the title of the topic: Introduction to Ergonomics.
Emphasis: Acknowledge the sponsors listed on the slide. If you plan on teaching the other modules, you should comment that this is the first part of several classes. Other modules available in the "Ergonomics for Fire and

EMS Departments" include: Ergonomic Hazard Analysis, Developing and Implementing Ergonomic Solutions, Body Mechanics and Back Health, and Command Staff Ergonomics. This module is intended to be a 90-minute course, but you can adjust the time as you feel appropriate.

Action Point: Ask for a show of hands of those who have had an ergonomics class before and who knows what ergonomics means. This will help you gauge the level of knowledge.

Today's Workshop

Will provide information on:

- Injuries
- Cumulative Trauma
- Risk factors for musculoskeletal injury
- Elements of an ergonomics program
- Resources for developing an ergonomics program

Purpose: To introduce today's module.

Emphasis: The focus of the class will be an overview of the concepts of ergonomics. This module is intended to introduce the concept of ergonomics and cumulative trauma as well as lay the groundwork for future modules.

Action Point: none

Fire and EMS Work

Requires you to:

- Always be prepared
- Respond quickly
- Think and react quickly
- Not always in control of schedule
- Work in hazardous situations

Physically & Emotionally Demanding

Purpose: To acknowledge the demanding nature of the job.

Emphasis: Fire and EMS work is a unique profession. It requires that personnel: are always prepared, can respond at a moment's notice, can think and react quickly, and assumes that the schedule is not always in workers control. Personnel cannot predict when an accident will occur or when response will be needed. Fire and EMS personnel are frequently called upon to work in hazardous situations. The bottom line is that this is a very physically and emotionally demanding job. The purpose of ergonomics and this class is to reduce physical stresses to workers' bodies wherever and whenever possible.

Action Point: none.

Firefighter Injuries, 2002

from the NFPA's Survey of Fire Departments for U.S. Fire Experience

	To/from incident	On fire ground	Non-fire emergency	Training
Burn	2.5 %	8.5 %	1.2 %	4.0 %
Smoke or gas inhalation	1.6 %	5.9 %	0.7 %	0.8 %
Wound, cut, bleeding, bruise	23.7 %	21.7 %	16.9 %	17.4 %
Heart attack/stroke	2.1 %	0.9 %	1.1 %	0.7 %
Strain, sprain, muscular pain	**49.7 %**	**41.6 %**	**56.7 %**	**59.0 %**
# cases	5,805	37,860	15,095	7,600

Purpose: Use injury data to show the importance of sprain and strain prevention and how much it could impact the health of FFs.

Emphasis: The data shown in this slide are national firefighter injury data. Down the first column you see the types of injuries. Across

the columns are the categories that show where the injury occurred such as to/from incident, on the fire ground, non-fire emergency, and at training.

Action Point: Ask the class: "For each column what type of injury has the highest percentage?" Strains, sprains, and muscular pain account for the highest percentage of injuries in each category. Ask "In your experience, does this seem right? What do these data indicate about what injury prevention measures you should be taking?"

Notes:

*** The data shown in this slide was the most recent national FF injury data at the time this material was developed (8-04). You may update this slide as new data become available. Also, you can add in slides showing your own department's injury statistics. Think about including information such as the body part injured, the event or activity leading to injury as well as the nature of the injury. Use injury data to demonstrate how sprains and strains are a problem. Discuss this and let the class talk about what they think about this problem. Also discuss how these injury data should show the importance of an injury prevention program that addresses soft tissue injuries.*

Terms for Musculoskeletal Injuries

- Work-related Musculoskeletal Disorder (WRMSD)
- Cumulative Trauma Disorder (CTD)
- Repetitive Strain Injury
- Overexertion or Overuse Injury
- Strains and Sprains
- Soft Tissue Injury

Purpose: Introduce terms commonly used for disorders related to cumulative trauma.

Emphasis: There are many names for musculoskeletal injuries but they all refer to the same types of injuries. These are not 'acute' injuries such as a fracture due to a fall.

Action Point: Ask the class if they are familiar with these terms. Ask them to provide examples of a few of these types of injuries. For example, carpal tunnel syndrome, tendonitis at the elbow, shoulder bursitis. Would a lumbar disc herniation be an example of a cumulative trauma injury? Why or why not?

How do Injuries Occur?

Acute injuries
- Happen *immediately*
- Can become chronic
- Re-injury possible

Chronic injuries
- Pain or symptoms lasting more than a month

Cumulative trauma
- Happens *over time*

Purpose: Explain the difference between the types of injuries that they are at risk for during the course of their jobs.

Emphasis: They are all familiar with acute injuries. Cumulative damage and chronic injuries are the emphasis here since they can take years to develop and result in disabling injuries during middle age. Acute and chronic injuries can contribute to cumulative trauma if they are not allowed to heal properly. Similarly, cumulative trauma weakens tissue and can result in an unexpected acute injury. Cumulative trauma injuries can be prevented by applying ergonomics. These are the types of injuries this training will focus on preventing.

Action Point: Ask the group if they can think of any example of how cumulative damage might result in an acute injury.

Tissue Repair

Phases of repair of soft tissue:

1. *Acute (<72 hours):* coagulates blood to stop bleeding, brings in WBC to clean up dead tissue and bacteria
2. *Repair (48 hours to 6 weeks):* deposition of new collagen (scar tissue)
3. *Remodeling (3 weeks to 12 months):* collagen remodeled to increase functional capabilities

Purpose: To provide detail about tissue repair and how this process can result in unexpected injuries

Emphasis: This is a cyclic process that continues repeatedly over time, lots of time. Note that deposition of collagen takes 48 hours to 6 weeks and the whole process can take up to a year.

Action Point: Ask them or suggest they think about the consequences of insufficient tissue repair time.

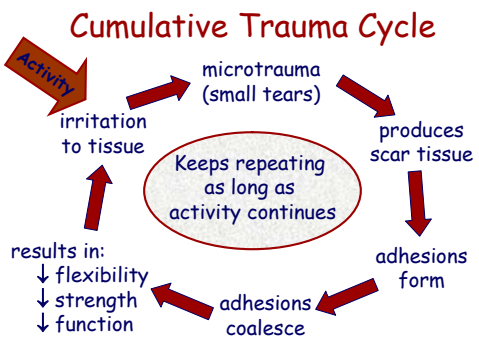
Tissue Repair (cont'd)

- Body creates a scar internally much like a scar from an external wound
- Scar tissue is fibrotic - not the same as the original tissue
  - laid down in chaotic manner to be strong
  - Reduced elasticity
- If tissues are continually disrupted due to use repair is never complete
- *Adhesions* form
- A chronic inflammatory cycle is created

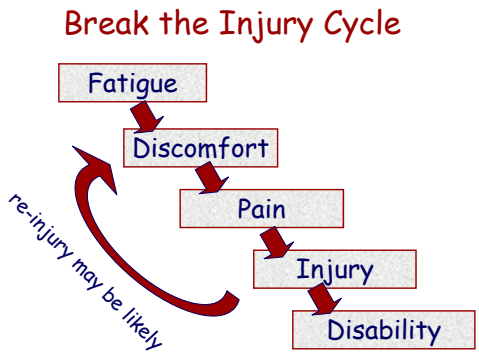
Purpose: Continuation of tissue repair explanation.

Emphasis: Damaged tissue does not heal by creating more of the original tissue. Instead, *fibrotic tissue* is created. Fibrotic tissue does not have the same properties as the original tissue. For example, it does not have much elasticity so it tears more easily. Also, fibrotic tissue is laid down in a chaotic manner, so that it is strong, which further reduces elasticity. We call this fibrotic tissue *scar tissue* and we've all seen it externally from cuts on our arms and legs. However, internally, this fibrotic tissue sticks, or adheres to all the tissue it comes into contact with. We call these *adhesions*. The problems with adhesions is that the next time you stretch the tissues, whether it's a muscle or a ligament, the non-elastic fibrotic tissues tear a little bit, and the process of producing scar tissue repeats itself. Over time the adhesions formed begin to clump together and the upshot is reduced ability to stretch the tissues and to produce strength by contracting or shortening the tissues.

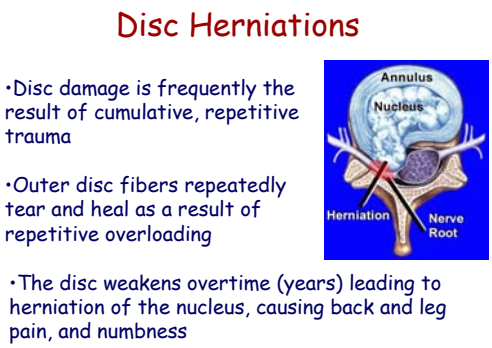
Action Point: none.



Purpose: A visual illustration of the chronic injury cycle.
Emphasis: This chronic cycle results in decreased flexibility, decreased strength, and can ultimately lead to a serious acute injury of the musculoskeletal system. Emphasize that repeating the same irritation to the soft tissue over and over is what leads to cumulative trauma.
Action Point: Ask the class if they've ever seen an example of adhesions resulting in reduced range of motion? One example is a person with severe burns, in which there is a great deal of fibrotic scar tissue and limited mobility.

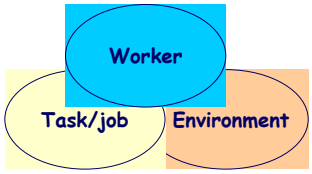


Purpose: Fatigue may be the first sign that tissues are injured and need time to heal
Emphasis: Listening to the body is important. So is finding ways to reduce fatigue, repetition, and tissue overload, factors that ultimately lead to injury. This is accomplished by practicing good body mechanics and through use of ergonomic tools and improved work practices. Also, being aware of this cycle can help you to recognize early signs of musculoskeletal injury. Be aware of your body and if you notice fatigue or discomfort after doing an activity, that might be a sign that you need to change something before it becomes an injury.
Action Point: none.



Purpose: To illustrate an example of a cumulative trauma with severe consequences.
Emphasis: This process happens over months in some people, and over years in others. Cumulative trauma is common in workers in their 40's and 50's after many years of performing a set of tasks. The body does not heal as rapidly at this age, so recovery can be extended and incomplete. These injuries may result in permanent partial disability.
Action Point: Ask the class to name 3 other common types of cumulative trauma. For example, lateral epicondylitis (tennis elbow) and other tendonitis, adhesive capsulitis (Frozen shoulder), Carpal Tunnel Syndrome, Hand Arm Vibration Syndrome (HAVS), Bursitis.

What is Ergonomics?



The goal of ergonomics is to design the job to fit the worker,
NOT fit the worker to the job.

Purpose: To discuss the definition of ergonomics.

Emphasis: Ergonomics is the relationship between the worker, the task or job and the environment. The goal of injury prevention is to design the job to fit the worker and not to fit the worker to the job. Every worker has certain anatomical, physiological and psychological capabilities, and the task and work environment should be designed to fit this. Emphasize that ergonomics is adapting the workplace, rather than adapting the worker. Many people believe that ergonomics is just making the worker more fit through fitness training, such as stretching and strength training. Also for some people, body mechanics is their idea of ergonomics. These activities are important for staying healthy and preventing injury, but research has shown that body mechanics and fitness alone are ineffective approaches to injury prevention.

Action Point: Explain the above point to the group and ask them why fitness alone cannot prevent injury. They should be able to point out that no matter how fit you are, there are many situations in Fire and EMS that require workers to lift heavy loads, such as very heavy patients being removed from a crowded bedroom or bathroom. Ask them to come up with two or three other examples, such as repetitive activities, and activities requiring awkward postures.

Risk Factors for Musculoskeletal Disorders

- Excessive force
- Awkward and/or prolonged postures
- Repetition
- Direct Pressure
- Temperature Extremes
- Vibration
- Work organization

Purpose: To begin the discussion of risk factors.

Emphasis: There are known risk factors that are related to the incidence of musculoskeletal disorders (read through list). We will discuss these in more detail in the following slides.

Action point: There is a risk factor handout that goes with this section. The handout has the risk factors listed and for some of the risk factors there is space for the workers to write down examples. Make sure the class has the handout as you start this section because at the end you will prompt them to fill it in.

Excessive Forces

Common risky problems:

- Lifting and carrying
- Pushing and pulling
- Reaching to pick up loads
- Prolonged holding
- Pinching or squeezing

Purpose: To introduce and explain excessive forces.

Emphasis: High forces occur when excessive strength must be used to accomplish a task.

Action Point: Read through the list and ask if other examples come to mind.

Awkward Postures

Common risky postures:

- Working overhead
- Kneeling all day
- Reaching to pick up loads
- Twisting while lifting
- Bending over to floor/ground
- Working with wrist bent

Purpose: To introduce and explain awkward postures.
Emphasis: An awkward posture is any uncomfortable position. For each joint, anything that is out of 'anatomical position' is considered awkward, especially when you hold the position for a prolonged period of time.
Action Point: Ask class to provide specific examples from their work.

Repetitive Motions

Same posture or motions again and again

- Repetitive motion can be very frequent over short period of time

- Cumulative trauma can be less frequent but repeated over time

Purpose: Introduce and explain the concept of repetitive motions.
Emphasis: Repetitive motions are motions that are repeated at a high frequency over a short period of time as shown in this top example. The top example represents a job such as computer keyboarding, where a worker might use the same hand movements hundreds or more times a day and the time until injury manifests is relatively short. The lower example is more like the jobs performed by fire/EMS personnel, since most tasks are not repeated several times in a minute, but more risky tasks are repeated several times in a shift through a working career. A good example of this type of repetition would be lifting the gurney with a patient into the medic unit.
Action Point: Ask the class how this relates to their work.

Contact Stress/ Poorly Designed Equipment

Common equipment problems to watch for:

- Does not have a good grip
- Too heavy
- Hard to use
- Uncomfortable
- Bad condition
- Wrong tool/equipment for the job

Purpose: Introduce and discuss direct pressure and poorly designed equipment.
Emphasis: Contact stress (direct pressure) or poorly designed equipment or tools is when tools or equipment that you use cause discomfort because of the way the tool or equipment is held. Contact stress on any part of the body can compromise blood flow and therefore risk injury to the soft tissues.
Action Point: Ask for examples from their jobs.

Extreme Temperatures

Common warning signs:

- Dehydration
- Compromised tissues
  - Muscle cramps
  - Restless leg syndrome
- Poor circulation

Purpose: Introduce concept of temperature extremes as it relates to ergonomics.

Emphasis: Extreme temperatures occur when FF/EMS personnel work in extreme cold or heat without proper protection from the elements. This can affect their soft tissues. Explain that temperature extremes cause muscles to function poorly. In hot conditions, when workers may perspire and become dehydrated, the result may be depleted electrolytes (calcium, magnesium, potassium and sodium), the elements needed to send nerve signals to the brain and make muscles respond appropriately. When electrolytes are low the muscles may cramp. When temperatures are low, tissues lose their compliance (they become less elastic). The body is stiffer in this situation. When called upon to jump or reach or otherwise stretch, the muscles and tendons may be injured.

Action Point: After reading the list. Ask the class why temperature extremes might affect their MS system and be an ergonomic problem.

Vibration

Can lead to injury when you are:

- Using reciprocating tools
- Using grinding or impact tools
- Using vibrating tools
- Working in or on motorized vehicles

Purpose: To introduce the concept of vibration as an ergonomic issue.

Emphasis: Vibration, either whole-body or hand/arm, is a risk factor for several disorders. Whole-body vibration may be experienced when riding in your apparatus. Hand/arm vibration is associated with the tools you use. Explain that whole-body vibration can lead to lumbar disc damage. When vibration is combined with other risk factors, such as posture, the risk is increased.

Action Point: Ask the class if they can name several injuries associated with vibration. For example: carpal tunnel syndrome and hand-arm-vibration syndrome.

Work Organization

Common issues to look for:

- Scheduling
- Lack of planning
- Communication
  - with crew
  - with other patient stakeholders
- Work practices

Purpose: Introduce the concept of work organization as it relates to ergonomics.

Emphasis: Work organization is also a risk factor for MS injury. This includes the way in which work is organized and personnel are deployed and scheduled.

Action Point: Ask for examples of work organization changes that might reduce the risk of MS injury. For example, crews of 4 rather than 3 reduce the loads carried by

having 4 people lift instead of 3. Are there other examples? Are these types of ergonomic changes practical? Why or why not? Identify barriers and ask how they can move beyond the barriers.

An Activity is Likely to Become an Injury

When:

- You perform the activity frequently
- You do the activity a long time
- The work intensity is high
- There are a combination of factors

Purpose: Explain that time, frequency, intensity and combining risk factors increases the risk of injury.

Emphasis: The risk factors alone do not necessarily make an activity risky. When an activity is frequent, lasts a long time, is intense and combines risk factors, then it is more likely to become an injury. These concepts are important to remember when you are doing a hazard assessment or when you are thinking of solutions.

Action Point: Ask them to think of some examples of how these might be applied. For example, if you have to be in an awkward posture, you can reduce the time you have to be in it and that would reduce your risk of injury.

Name Your Most Risky Tasks

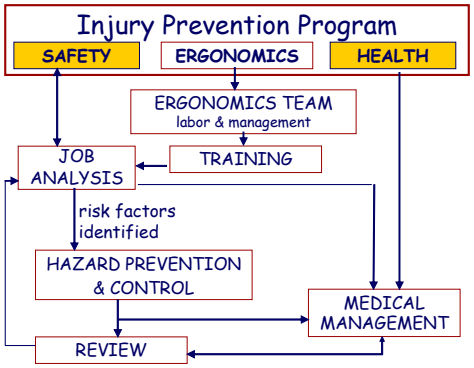
List three examples of tasks that you do at work to the risk factors that have 3 blanks next to them on your handout.

1. _____
2. _____
3. _____

Purpose: To look at some job tasks that create risk for MS injury.

Emphasis: Many job tasks in Fire and EMS are risky; emphasize that they focus not only on the impossible aspects of their job but also on the ones they could change. An example of a job/task that has heavy forces is lifting a patient into the medic unit in a gurney.

Action Point: Have the workers write in their examples of tasks that they think have specific risk factors on their handout. Give them 5-10 minutes to fill it in. While they are filling it in, write the risk factors on a board or flipchart. After they have had time, ask them to share their examples and write them on the board under each risk factor. After you generate a list for each risk factor and you can see how many tasks you have, ask them if they think that they have a risky occupation for musculoskeletal injury. Discuss these risk factors as much as needed. If the tasks listed are difficult to change to reduce injury risk, discuss what the barriers are and how they might be overcome.



Purpose: Provide an overview of an injury prevention program.
Emphasis: An ergonomics program should be part of an injury prevention program. This diagram shows how ergonomics fits between health and safety in such a program. An ergonomics team that has both labor and management members could be a part of a safety committee. After receiving training, the ergonomics team and line personnel can perform hazard analysis to determine what the best hazard prevention strategy and controls are. A key component to remember is that everything should be reviewed and always updated as procedures, equipment, personnel change with a job. Also, a medical management program is essential to be proactive in managing soft tissue injuries.
Action Point: Ask if the department has a safety committee or an equipment committee. Ask if they think they can fit ergonomics into their injury prevention program.

Ergonomic On-line Resources

FEMA has Fire and EMS Ergonomics:
search for "ergonomics" on http://www.fema.gov/

Elements of Ergonomics Programs – NIOSH
http://www.cdc.gov/niosh/homepage.html

Oregon OSHA
http://www.orosha.org/consult/ergonomic/ergonomics.htm

Federal OSHA
http://www.osha.gov/SLTC/ergonomics/index.html

Purpose: Provide on-line resources for ergonomic programs.
Emphasis: Training and information can come from a variety of sources. These websites have free and valuable ergonomics information. There is even free ergonomics information specific to Fire and EMS from FEMA.
Action Point: Suggest they look up these websites and see what is available for their department.

Ergonomics Program Elements

- ✓ Assessment of musculoskeletal hazards
- ✓ Prevention and control of musculoskeletal hazards
- ✓ Training
- A medical management system
- Procedures for reporting injuries
- A plan for the implementation of the program
- Methods for evaluating the program

Purpose: Introduce the elements of ergonomic programs.
Emphasis: This is a list of Ergonomics Program Elements drawn from the Book "Fire and Emergency Medical Services Ergonomics" published by FEMA. The full source is listed in the references section. All of these elements are very important. For line personnel the first three are important *(click the mouse for the checks to appear)*. They are the elements that you can contribute to. Line personnel must also follow the procedures set up in the other elements and be aware of how important they are for the ergonomics program to be

successful. Tell the class that you will now briefly talk about these first elements which will be also be taught in other modules.
Action Point: none.

Assessment of Hazards

- Breaking each specific job down into elements
- Identifying conditions within a job that contribute to risk

Performed by person with ergonomics training:
- Safety committee members
- Line personnel

Purpose: Introduce the concept of Job Hazard Assessment.
Emphasis: The hazard assessment tool provides an organized method for identifying and eventually addressing jobs and job tasks that put workers at risk for injury. Before you can come up with solutions, you must do an assessment to understand the hazard. Recognizing the hazards is the first step toward injury prevention. With some training, line personnel can perform a hazard analysis or you can have the ergonomics team or safety committee members complete hazard analyses. Let them know that this topic will be covered in greater depth in another module.
Action Point: none.

Prevention and Control

- ✓ Set short term and long term goals
- ✓ Think outside the box – come up with many solutions
- ✓ Decide on the optimal solution by thinking about
  - ✓ Barriers
  - ✓ Cost
  - ✓ Amount of risk reduced

Purpose: Introduce Prevention and Control.
Emphasis: Once you have identified your hazards, you can begin to think about how to prevent or control the hazards. The ergonomics team should set short- and long- term goals. These can be decided based on whether a solution might address a single problem or several problems. Even if it is a smaller solution, it might make a big impact because of the frequency with which the task is done. The longer term goals may be to solve bigger issues, but may take many resources or a lot of time to implement. Overall, when thinking prevention and control you should think outside the box and come up with as many different solutions as you can. You then decide on your optimal solution by thinking about the barriers to the solution, the cost and most importantly how much of the risk is reduced. It is very easy to be resistant to any change, but you can think of what would be ideal then work back from there on making it reasonable.
Action Point: none.

Ergonomic Solutions

Effectiveness		Personal control
Equipment or Engineering		
Job organization		
Personal protective equipment		
Bodymechanics		

Purpose: Introduce the concept of ergonomic solutions.
Emphasis: There is a hierarchy to ergonomic solutions. On one side there is the effectiveness of the solution in reducing or eliminating the injury risk. On the other side there is the degree of personal control. These are inversely

related: generally as personal control increases, the effectiveness decreases.

The most effective solutions for risk reduction are equipment changes or engineering controls *(click the mouse to make it appear on screen)*. Changing to better designed equipment or redesigning the apparatus or station can reduce risk of injury. Ask the class if they can think of any examples. This may not be in a worker's personal control but as line personnel, workers should have an equipment committee or another means to recommend equipment or design changes.

Next in the hierarchy is job organization *(click the mouse to make it appear on screen)*. Job organization has been discussed as a risk so think of how the work protocols and schedules could be a solution. Ask the class if they can think of any examples. Workers have little personal control over this as well, but each worker can contribute to making the organization healthier.

Next on the list is personal protective equipment *(click the mouse to make it appear on screen)*. Providing a protective barrier to protect joints or promote neutral posture is considered ergonomic personal protective equipment. Ask the class if they can think of any examples. A worker has some personal control over this solution since he/she would decide to use this equipment.

The least effective solution in reducing risk is body mechanics *(click the mouse to make it appear on screen)*. Body mechanics is using proper body alignment while working. Ask the class if they can think of any examples. The worker has most personal control over this. When developing solutions, it is important to keep this hierarchy in mind for setting short-term and long-term goals.

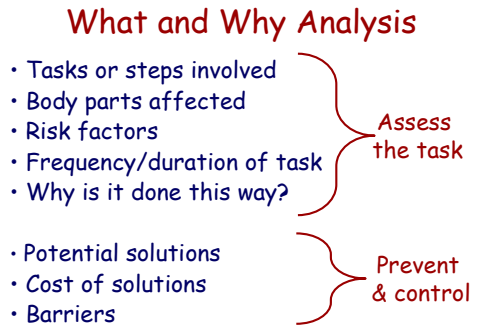
Action Point: Prompt the class to think of examples of these types of solutions after describing them; you should have several in mind in case the class does not have examples. You can even add pictures of them. Sample examples:

Equipment or engineering: Stair chair with tracks that can descend stairs, bariatric ambulance that uses a winch to pull gurney up ramp into the medic unit.

Job organization: Making team lifts the standard work practice, having enough staff on crew to have 4 people on an apparatus.

Personal protective equipment: Knee pads for use in drills without live fire, lumbar rolls to promote neutral spine when sitting (in the vehicles, in the station).

Bodymechanics: Using appropriate lifting techniques (keeping spine neutral, load close, large base of support).



Purpose: Introduce the 'what and why' analysis.

Emphasis: An example of how you would do a hazard assessment and come up with solutions is a 'what and why' analysis. The first part of the 'what and why' is assessing the task. This includes: *(list the steps in Assess the Task)*. The next part is prevention and control. This includes: *(list the steps in Prevent and Control)*. In future training, we will complete a 'what and why' analysis and learn more about how to apply ergonomics.

Action Point: none.

Conclusions

- Cumulative trauma occurs over time
  - may not result in an injury for many years
  - may be disabling
- Applying ergonomics = injury prevention
- Understand injury risk factors
- Some situations may have little room for improvement, but with others you have the control to improve:
  - equipment
  - work practices
  - bodymechanics

Purpose: Summarize the talk.
Emphasis: The main take-home messages from this training are:
Applying ergonomics is key in your department's injury prevention program.
Understanding musculoskeletal injury risk factors is the first step to reducing the risks.
Due to the nature of emergency services, you will not be able to control all of the situations you are in at work. You must think of where you can make a difference and when you do have control to improve equipment, work practices and bodymechanics to reduce your risk of injury.
Action Point: none.

Other Ergonomics Training Topics

- Job hazard analysis
- Ergonomic solutions
- Bodymechanics & Back Health
- Ergonomics for command staff

Purpose: Let the class know about other ergonomic classes that are available.
Emphasis: These topics are covered in other training modules. Ergonomics isn't just for line workers, but management must also be involved to make lasting changes.
Action Point: You may use this to assess the interest of your department in having all this training. It is highly recommended to complete all the modules to promote the best ergonomics program, but if training time is limited, you should choose the topics that are most relevant to your department.

? ? ? ? Questions and Evaluation

Thank you for your attention

Purpose: To answer questions not addressed during the talk.
Emphasis: Feedback will help you to know what other modules should be taught or how the training can be improved.
Action Point: Take any questions and have the class fill out evaluation forms.

This page is intentionally blank.

Risk Factors for Musculoskeletal Injuries Handout

Excessive Force/weight
Continually using a lot of force (lifting, pushing, or pulling)

1. _____
2. _____
3. _____

Awkward Postures
When a job duty requires an uncomfortable position (bending, twisting, stooping, reaching, gripping, working overhead).

1. _____
2. _____
3. _____

Prolonged postures
Maintaining one position for long periods of time (standing all day or sitting all day).

1. _____
2. _____
3. _____

High Repetition
Repeated activity with the same set of muscles or when performing the same motion over and over.

1. _____
2. _____
3. _____

Extreme Temperature and Poor Ventilation
Working in very cold or very hot temperatures.

1. _____
2. _____
3. _____

Direct Pressure
When your body constantly presses against a hard or sharp surface. Sensitive areas are the sides of fingers, palms, wrists, forearms, elbows, and knees.

Poor Work Organization
Leaving little time for your body to recover from demanding work activities (fast paced work, no breaks, limited variety of work tasks, stressful situations).

Combined factors
When the above risk factors are combined the chances for an injury are much greater. The longer you are exposed to risk factors, the greater the chance of injury. For example, when you repeatedly bend in an awkward posture to lift a heavy patient.

Ergonomics for Fire and EMS Departments

Introduction to Ergonomics & Cumulative Trauma

University of Oregon
Labor Education and Research Center

This material has been made possible by a grant from the Oregon Occupational Safety and Health Division, Department of Consumer and Business Services

LABOREGON
LERC

UNIVERSITY OF OREGON

Today's Workshop

Will provide information on:

- Injuries
- Cumulative Trauma
- Risk factors for musculoskeletal injury
- Elements of an ergonomics program
- Resources for developing an ergonomics program

Fire and EMS Work

Requires you to:

- Always be prepared
- Respond quickly
- Think and react quickly
- Not always in control of schedule
- Work in hazardous situations

Physically & Emotionally Demanding

Firefighter Injuries, 2002

from the NFPA's Survey of Fire Departments for U.S. Fire Experience

	To/from incident	On fire ground	Non-fire emergency	Training
Burn	2.5 %	8.5 %	1.2 %	4.0 %
Smoke or gas inhalation	1.6 %	5.9 %	0.7 %	0.8 %
Wound, cut, bleeding, bruise	23.7 %	21.7 %	16.9 %	17.4 %
Heart attack/stroke	2.1 %	0.9 %	1.1 %	0.7 %
Strain, sprain, muscular pain	**49.7 %**	**41.6 %**	**56.7 %**	**59.0 %**
# cases	5,805	37,860	15,095	7,600

Terms for Musculoskeletal Injuries

- Work-related Musculoskeletal Disorder (WRMSD)
- Cumulative Trauma Disorder (CTD)
- Repetitive Strain Injury
- Overexertion or Overuse Injury
- Strains and Sprains
- Soft Tissue Injury

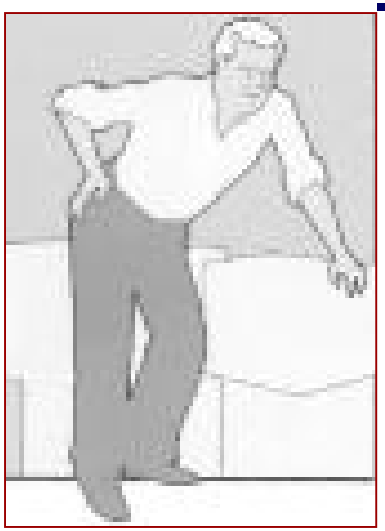
How do Injuries Occur?

Acute injuries

- Happen *immediately*
- Can become chronic
- Re-injury possible

Chronic injuries

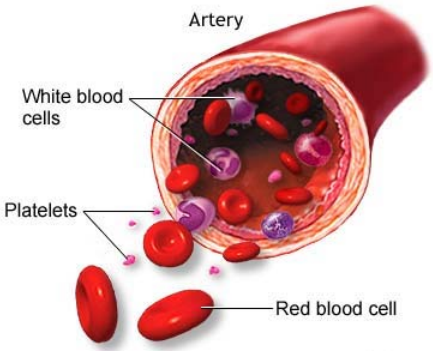
- Pain or symptoms lasting more than a month



Cumulative trauma

- Happens *over time*

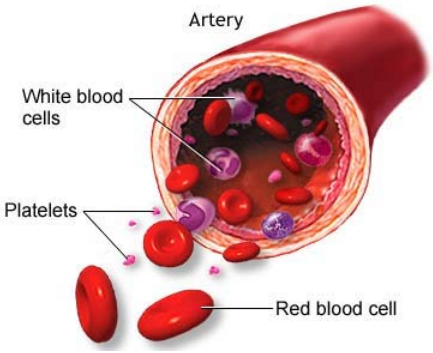
Tissue Repair



Phases of repair of soft tissue:

1. *Acute (<72 hours):* coagulates blood to stop bleeding, brings in WBC to clean up dead tissue and bacteria
2. *Repair (48 hours to 6 weeks):* deposition of new collagen (scar tissue)
3. *Remodeling (3 weeks to 12 months):* collagen remodeled to increase functional capabilities

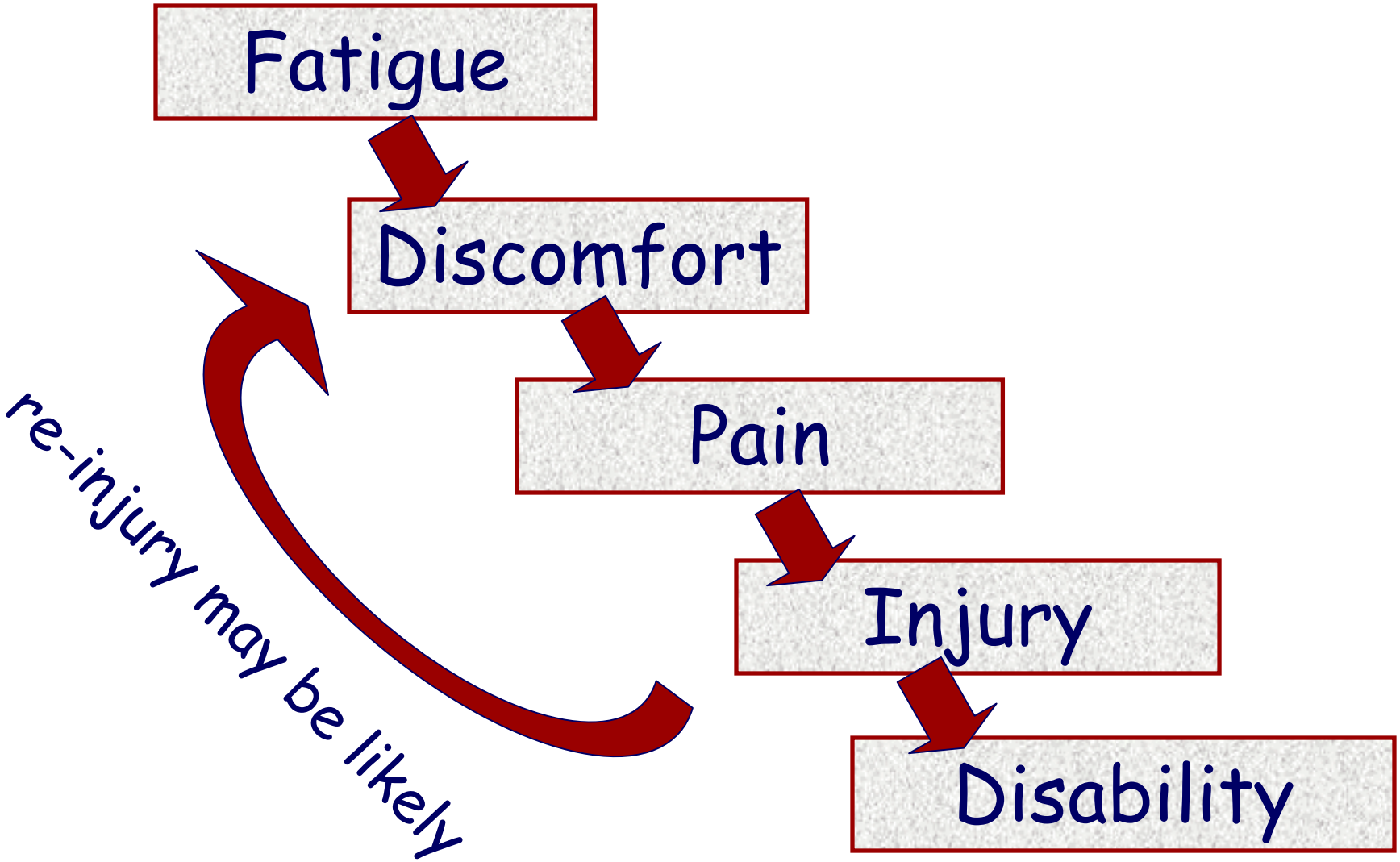
Tissue Repair (cont'd)



- Body creates a scar internally much like a scar from an external wound
- Scar tissue is fibrotic - not the same as the original tissue
  - laid down in chaotic manner to be strong
  - Reduced elasticity
- If tissues are continually disrupted due to use repair is never complete
- *Adhesions* form
- A chronic inflammatory cycle is created

Cumulative Trauma Cycle

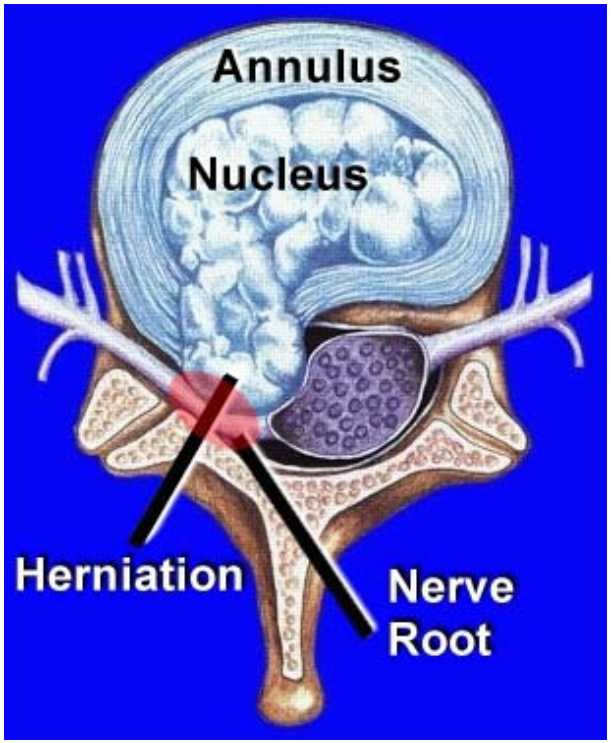
Break the Injury Cycle



Disc Herniations

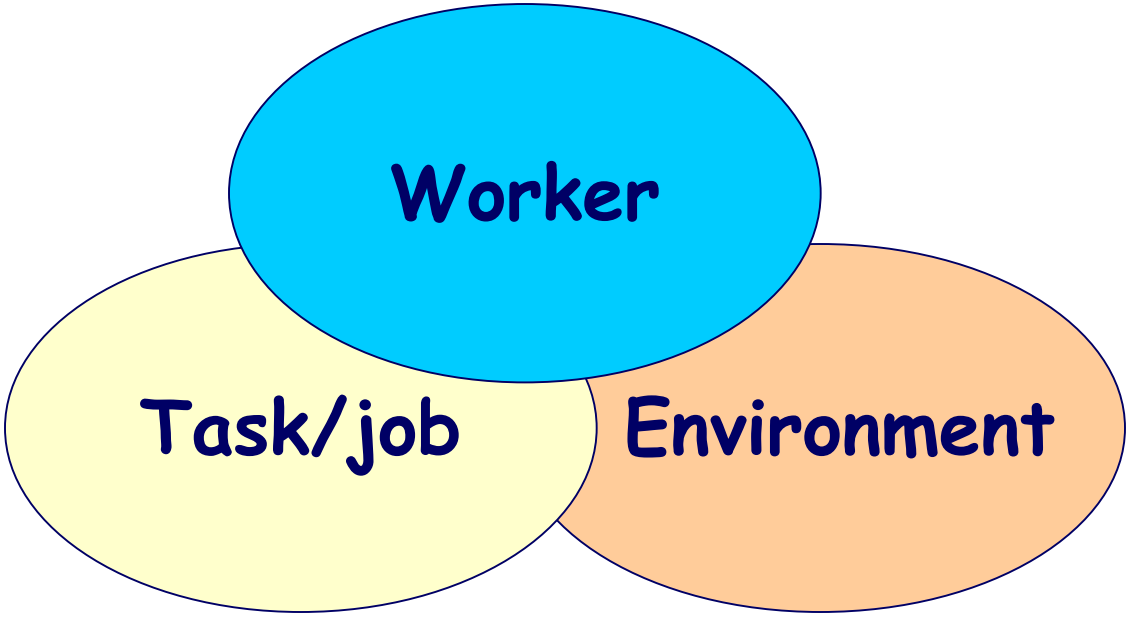
- Disc damage is frequently the result of cumulative, repetitive trauma

- Outer disc fibers repeatedly tear and heal as a result of repetitive overloading



- The disc weakens overtime (years) leading to herniation of the nucleus, causing back and leg pain, and numbness

What is Ergonomics?



The goal of ergonomics is to design the job to fit the worker,
NOT fit the worker to the job.

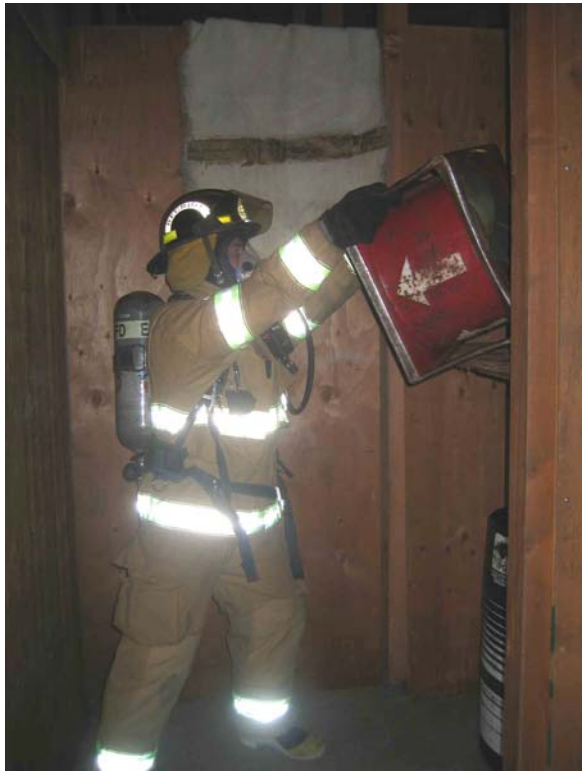
Risk Factors for Musculoskeletal Disorders

- Excessive force
- Awkward and/or prolonged postures
- Repetition
- Direct Pressure
- Temperature Extremes
- Vibration
- Work organization

Excessive Forces

Common risky problems:

- Lifting and carrying
- Pushing and pulling
- Reaching to pick up loads
- Prolonged holding
- Pinching or squeezing



Awkward Postures

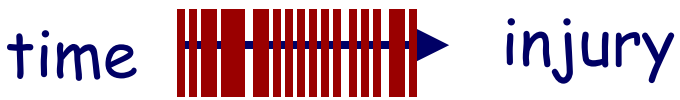
Common risky postures:

- Working overhead
- Kneeling all day
- Reaching to pick up loads
- Twisting while lifting
- Bending over to floor/ground
- Working with wrist bent

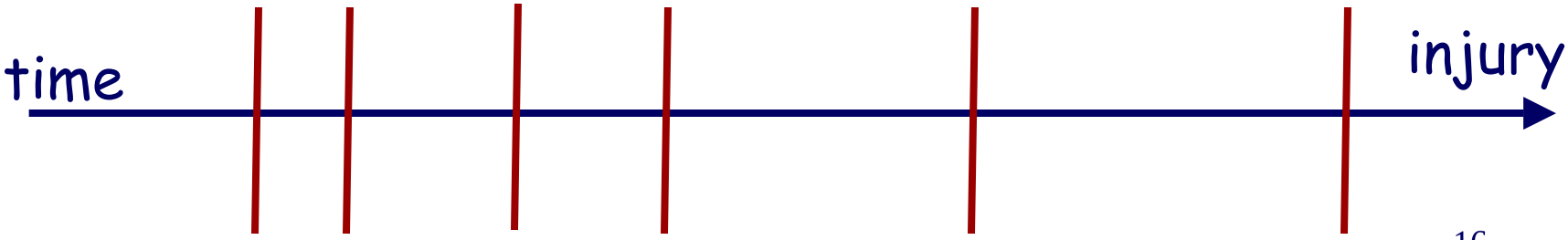
Repetitive Motions

Same posture or motions again and again

- Repetitive motion can be very frequent over short period of time



- Cumulative trauma can be less frequent but repeated over time



Contact Stress/ Poorly Designed Equipment

Common equipment problems to watch for:

- Does not have a good grip
- Too heavy
- Hard to use
- Uncomfortable
- Bad condition
- Wrong tool/equipment for the job

Extreme Temperatures

Common warning signs:

- Dehydration
- Compromised tissues
  - Muscle cramps
  - Restless leg syndrome
- Poor circulation

Vibration

Can lead to injury when you are:

- Using reciprocating tools
- Using grinding or impact tools
- Using vibrating tools
- Working in or on motorized vehicles

Work Organization

Common issues to look for:

- Scheduling
- Lack of planning
- Communication
  - with crew
  - with other patient stakeholders
- Work practices

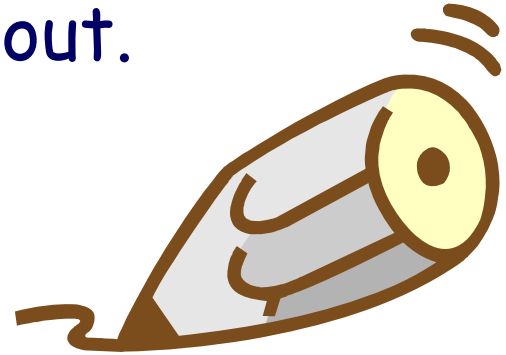
An Activity is Likely to Become an Injury

When:

- You perform the activity frequently
- You do the activity a long time
- The work intensity is high
- There are a combination of factors

Name Your Most Risky Tasks

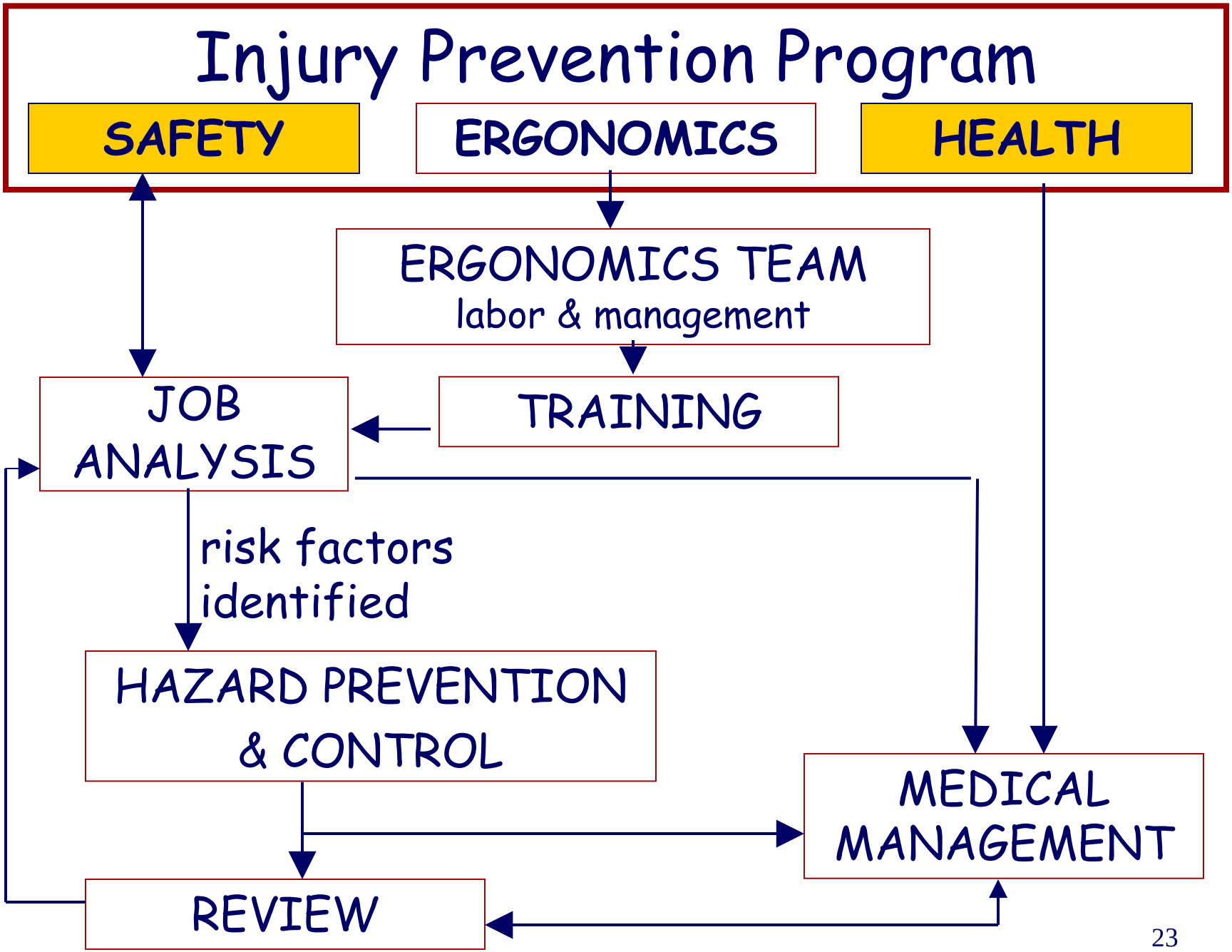
List three examples of tasks that you do at work to the risk factors that have 3 blanks next to them on your handout.



1. _____

2. _____

3. _____


Injury Prevention Program
SAFETY
ERGONOMICS
HEALTH
ERGONOMICS TEAM
labor & management
JOB ANALYSIS
TRAINING
risk factors identified
HAZARD PREVENTION & CONTROL
MEDICAL MANAGEMENT
REVIEW

Ergonomic On-line Resources

FEMA has Fire and EMS Ergonomics:
search for "ergonomics" on http://www.fema.gov/

Elements of Ergonomics Programs – NIOSH
http://www.cdc.gov/niosh/homepage.html

Oregon OSHA
http://www.orosha.org/consult/ergonomic/ergonomics.htm

Federal OSHA
http://www.osha.gov/SLTC/ergonomics/index.html

Ergonomics Program Elements

- ✓ Assessment of musculoskeletal hazards
- ✓ Prevention and control of musculoskeletal hazards
- ✓ Training
- A medical management system
- Procedures for reporting injuries
- A plan for the implementation of the program
- Methods for evaluating the program

Assessment of Hazards

- Breaking each specific job down into elements
- Identifying conditions within a job that contribute to risk

Performed by person with ergonomics training:

- Safety committee members
- Line personnel

Prevention and Control

- ✓ Set short term and long term goals
- ✓ Think outside the box – come up with many solutions
- ✓ Decide on the optimal solution by thinking about
  - ✓ Barriers
  - ✓ Cost
  - ✓ Amount of risk reduced

Ergonomic Solutions

Effectiveness		Personal control
	Equipment or Engineering	
	Job organization	
	Personal protective equipment	
	Bodymechanics	

What and Why Analysis

- Tasks or steps involved
- Body parts affected
- Risk factors
- Frequency/duration of task
- Why is it done this way?

Assess the task

- Potential solutions
- Cost of solutions
- Barriers

Prevent & control

Conclusions

- Cumulative trauma occurs over time
  - may not result in an injury for many years
  - may be disabling
- Applying ergonomics = injury prevention
- Understand injury risk factors
- Some situations may have little room for improvement, but with others you have the control to improve:
  - equipment
  - work practices
  - bodymechanics

Other Ergonomics Training Topics

- Job hazard analysis
- Ergonomic solutions
- Bodymechanics & Back Health
- Ergonomics for command staff

? ? ? ? Questions and Evaluation

Thank you for your attention

Instructor Guide for Ergonomic Hazard Analysis

Title: Ergonomic Hazard Analysis

Date Developed: 4/2005

Time Required: 90 minutes

Number of Slides: 28

Materials/Resources Needed:
Hazard Analysis PowerPoint presentation -electronic form or transparencies
Computer system with PowerPoint software installed and projection system (if using electronic form)
Hard copies of PowerPoint slides for handouts
Copies of 'What and Why' handout with example
Copies of blank 'What and Why' handout

Objective: To provide information for Fire/EMS Personnel including:
1) Review of ergonomics definition
2) Review risk factor for musculoskeletal disorders
3) Understand the elements of an ergonomics program
4) Learn the process of conducting a worksite ergonomic hazard analysis

Motivation: To properly implement an injury prevention program to reduce musculoskeletal injuries, a hazard analysis must become a part of the health and safety program.

Overview: This module reviews the basic principles of ergonomics and risk factors for musculoskeletal injury. It also addresses a method for conducting onsite hazard evaluation to identify risky job tasks. We strongly recommend this be taught after the introductory class but prior to delivering the module on Ergonomic Solutions. However, it can be taught before or after the module on body mechanics.

Ergonomics for Fire and EMS Departments

Ergonomic Hazard Analysis

University of Oregon
Labor Education and Research Center

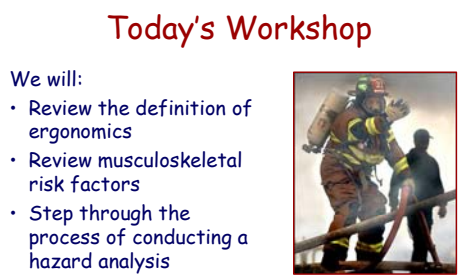
This material has been made possible by a grant from the Oregon Occupational Safety and Health Division, Department of Consumer and Business Services

LABOREGON
LERC

Purpose: Introduce yourself and the title of today's topic: Ergonomic Hazard Assessment.
Emphasis: Acknowledge the sponsors listed on the slide. If you plan on teaching the other modules, you should comment that this is part of a series of classes. Other modules available in the "Ergonomics for Fire and EMS Departments" include:

Introduction to Ergonomics (which should have been taught previously), Sparing Your Back, Developing and Implementing Ergonomic Solutions, Body Mechanics and Cumulative Trauma, and Command Staff Ergonomics. This module most logically should be taught after the introductory ergonomics module but before the Solutions module. This module is intended to be a 90-minute course, but you may decide it will take more or less time to teach it.

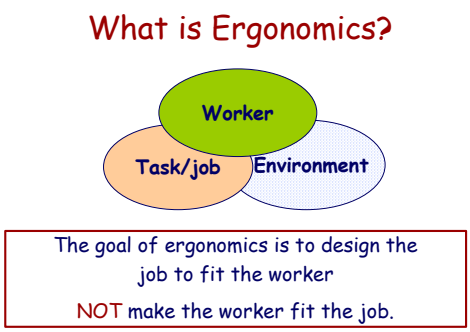
Action Point: Ask for a show of hands of those who have had an ergonomics class before and who knows what ergonomics means. This will help you gauge the level of knowledge.



Purpose: To introduce today's module.

Emphasis: The focus of the class will be a hands-on workshop for conducting a hazard analysis at your station.

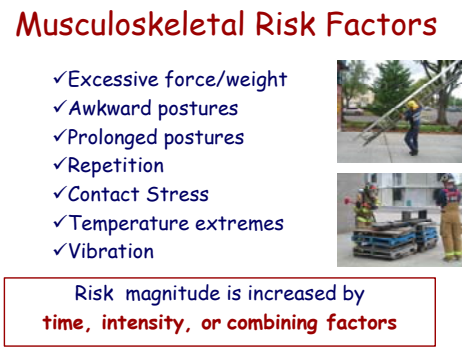
Action Point: none.



Purpose: Review the definition of ergonomics.

Emphasis: Ergonomics is defined as the interaction between the worker, the task or job and the environment. It involves designing the work to optimize worker performance. It is important to stress that the goal of ergonomics is adapting the workplace, rather than adapting the worker. Many people believe that ergonomics is just making the worker complete the job more safely through fitness training, such as stretching and strength training. For some people, body mechanics is their idea of ergonomics. These activities are important for staying healthy and preventing injury, but research has shown that body mechanics and fitness alone are not effective approaches to injury prevention. Improving the task or the work environment are the major goals of ergonomics.

Action Point: Explain the above point to the group and ask them why this might be so. They should be able to point out that no matter how fit you are, there are many circumstances in fire and EMS that require workers to use poor body mechanics and to lift excessively heavy loads, such as very heavy patients being moved from a crowded bedroom or bathroom. Ask them to name two or three other examples where being fit and body mechanics would not apply.



Purpose: To review musculoskeletal risk factors.

Emphasis: Many activities commonly performed by Fire/EMS personnel are risky. It is important to be aware of these risks and the fact that risk increases dramatically when combining factors, when the activities are repeated over time and when the intensity is great. Also, it is important to understand these risk factors to complete a hazard analysis (*click the mouse to make the risk factors and box appear).*

EXCESSIVE FORCE/WEIGHT: occurs when excessive strength must be used to accomplish a task, such as lifting, pulling and pushing.

AWKWARD/PROLONGED POSTURES: are any uncomfortable positions. For each joint, anything that is out of 'anatomical position' or neutral posture is considered awkward, especially when you hold the position for a prolonged period of time.

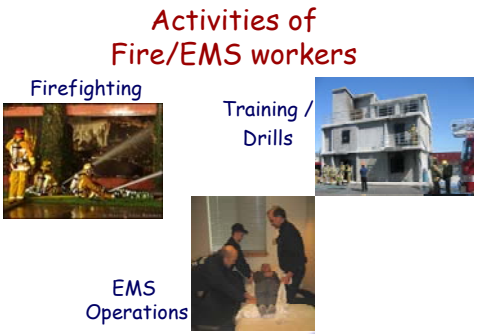
REPETITIVE MOTIONS: are motions repeated either over a short period of time

CONTACT STRESS: occurs when poorly designed equipment or tools causes discomfort because of the way the tool or equipment is held. Direct pressure on any part of the body can compromise blood flow and therefore compromise the soft tissues.

TEMPERATURE EXTREMES**:** occur when FF/EMS personnel work in extreme cold or heat without proper protection from the elements. This can affect soft tissues.

VIBRATION: either whole-body or hand/arm, is a risk factor for several disorders. Whole-body vibration may be associated with riding in your apparatus. Hand/arm vibration is associated with the tools you use. Explain that whole body vibration can lead to lumbar disc damage. When vibration is combined with other risk factors the impact increases.

Action Point: Ask the group to name 3 risk factors for musculoskeletal injury before you show them the risk factors. The pictures should give some hints.



Purpose: To talk about the different categories of activities of the job.

Emphasis: To do hazard analysis, you must think about how to "break" down the tasks that you do. Fire and EMS personnel are called upon to perform a variety of hazardous jobs. These 3 slides review the types of activities commonly performed by Fire and EMS, and is used to set the stage for the types of job duties that should be considered when conducting hazard analyses.

Action Point: Ask if they think there are other categories of activities.

Common Activities Involving Ergonomic Hazards: Fire Fighting

- High rise fires
- Ventilation and overhaul procedures
- Hose laying operations
- Ladder work
- Forcible entry
- Extrications
- Extended procedures

Purpose: To call attention to specific fire fighting activities that carry risk for musculoskeletal disorders/injuries (MSD), as well as for other types of injury.
Emphasis: While all of these jobs are performed under conditions of duress, there is still room to make changes. 41.6% of fire-ground injuries are strains and sprains and 49.7% of injuries occurring while traveling to or from an incident are strains/sprains.
Action Point: Ask whether there are other fire activities that carry risk for musculoskeletal injury.

Common Activities Involving Ergonomic Hazards: Training & Drills

- Hose rolling
- Carrying heavy equipment
- Physical exertion

Purpose: To call attention to specific training and drill activities that carry risk for musculoskeletal injury, as well as for other types of injury.
Emphasis: Point out that 59% of training injuries are strains and sprains, and 26% of all MS injuries occur on the training ground.
Action Point: Ask whether there are other aspects of training that pose risk for musculoskeletal injury.

Common Activities Involving Ergonomic Hazards: EMS Operations

- Patient extrication
- Patient transportation

Purpose: To call attention to specific EMS activities that carry risk for musculoskeletal injury, as well as for other types of injury.
Emphasis: 56.7% of non-fire emergency injuries are strain and sprains.
Action Point: Ask what other aspects of EMS operations are hazardous.

Some Perspective…….

- NIOSH Guidelines:
  Load limit for lifting: 51 lb
  Spine compression force: 764 lb

- Spine compression forces for patient handling activities:
  - Pulling 105 lb patient (with bedsheet) from bed to stretcher: 832-1708 lb
  - Carrying 105 lb patient down stairs using stretcher: 1012-1281 lb

Purpose: Review occupational lifting and spine compression guidelines and put them in perspective.

Emphasis: Activities they perform every day are over-stressing their bodies. The National Institute for Occupational Safety and Health (NIOSH) has guidelines for protecting workers. The weight limit they recommend for a worker to lift under ideal conditions is 51 pounds and the spine compression force is 764 pounds. Listed on this slide are two patient handling activities and their measured spine compression*. This eventually results in damage to muscles, ligaments and discs. The body can take these types of stresses a certain number of times but once a person exceeds that number damage WILL occur. Therefore ANYTHING they can do to reduce the stress will extend their body's health.

Action Point: You should point out that many things that the Fire and EMS handle, i.e. equipment and patients, exceed the guideline weight of 51 pounds and the spine compression guideline is also exceeded. Ask the group if this surprises them. Does it make them think about the tasks they do and that they need to work towards improving how they do them?

*Biomechanical analyses of paramedics simulating frequently performed strenuous work tasks. Lavender SA; Conrad KM; Reichelt PA; Johnson PW; Meyer FT *Applied Ergonomics* 2000 Apr; 31(2): 167-77.

Ergonomics Program Elements

- Assessment of musculoskeletal hazards
- Prevention and control of musculoskeletal hazards
- Training
- A medical management system
- Procedures for reporting injuries
- A plan for the implementation of the program
- Methods for evaluating the program

Purpose: Review the ergonomics program elements and emphasize today's module, Assessment of Musculoskeletal Hazards.

Emphasis: This is a list of the 7 ergonomics program elements drawn from the book "Fire and Emergency Medical Services Ergonomics" published by FEMA. The full information for this is listed in the resource section. All of these elements are very important. This training goes into detail on the first element which line personnel should be involved in, that is, prevention and control of hazards.

Action Point: Ask the class if they remember these from a previous module. Ask what they think is the definition of ergonomic hazard assessment. Then go to the next slide for discussion.

Why Do A Job Hazard Assessment?

- Each job has actions that stress the body
- Stress takes a number of forms
  - Physical: muscles,joints, nerves
  - Environmental: heat, cold, noise or vision
  - Psycho-social/organizational: scheduling, emotional trauma, poor supervision
- Recognizing hazards is the first step toward injury prevention

Purpose: Explain the benefit of doing hazard assessment.

Emphasis: Why should they do a hazard assessment? Because each job or task has its own set of unique actions and body stresses. The first step in minimizing and controlling injury is to identify activities and tasks that place the body at risk of injury. Examples of these stresses are physical stresses such as heavy weights and awkward postures, and environmental stresses such as heat, cold, noise, visual.

We will concentrate on physical stresses that affect the musculoskeletal system. It is also important to emphasize that stress can lead to an immediate injury (acute trauma) but more importantly, it can lead to injuries that occur over time (cumulative trauma). The stresses that lead to cumulative trauma injuries may not be apparent without going through the detail involved in a hazard analysis.

Action Point: Ask the group what they think *physical stress* is? One answer is physical exertion or body position. Example outcomes include: muscle and joint stress pain, reduced muscle strength, numbness, and cumulative trauma.

Ask the group what they think *environmental stress* is? Answers include temperature, noise and vision. Example outcomes include: muscle cramps, heat illness, shivering, loss of flexibility in extremities, fatigue, hearing loss, fatigue, headache, and reduced visual acuity.

Ask the group what they think *Psycho-social stress* is? One example is emotional stress caused by work or co-workers. Example outcomes inlcude: hypertension and depression.

What is a Job Hazard Assessment?

- Breaking each specific job down into elements
- Identifying conditions within a job that contribute to risk

Performed by person with ergonomics training
- Safety committee members
- Line personnel

Purpose: To define hazard assessment and who should complete it.

Emphasis: The hazard assessment tool provides an organized method for identifying and eventually addressing jobs and job tasks that put workers at risk for injury. Because the jobs performed by Fire/EMS are all very hazardous, it is important to look at the individual elements of jobs. In this case the word "job" refers to individual jobs within the workers entire job description. For example, transporting patients is one job, responding to fires is another job, while doing paper work is yet another job. Sometimes, even though a job cannot be eliminated, some of the risky aspects of the job can be altered. This can have the effect of reducing the overall risk of injury.

Action Point: Using the picture on the slide as an example, ask the group to name some of the components of the job illustrated in the picture. For example:

1) climbing a ladder to the roof, 2) carrying the saw and other tools, 3) securing footing, and 4) using the chain saw to cut through the roof. Ask if there are more components to performing this job.

Steps to an Assessment

1. Identify and prioritize jobs/tasks
2. Break down each job into discrete tasks
3. Study and assess each task
   - Determine the specific risk factors for each task

Purpose: Spell out the individual steps involved in performing a hazard assessment, which will be discussed in more detail in the following slides.
Emphasis: Emphasize the importance of breaking each 'job' down into discrete 'tasks'. Even though a job might not be changeable, sometimes elements of the job are amenable to change or alterations. Each department should have a strategy to assess the hazards.
Action Point: none.

---

1. Identify and Prioritize Jobs

Identify jobs where:
- Work-related injuries have occurred previously
- Frequent non-severe or severe injuries occur
- Past injuries result in restriction from doing job
- Workers leave because of inability to perform physical requirements of job
- Workers have difficulty sustaining quality performance doing job
- Workers complain of pain, fatigue, discomfort that does not resolve with rest

Purpose: In-depth information: identify and prioritize hazardous jobs.
Emphasis: Once a list of jobs has been created it should be prioritized. Using these guidelines, you will be able to decide what jobs and tasks need to be assessed more in-depth. Prioritizing the list will be unique to each department.
Action Point: Ask the group what criteria their department might use to prioritize risky jobs. Some examples are: 1) cost to resolve, 2) bang for the buck; sometimes it is decided to work to resolve several small problems that are easier to tackle, rather than one large, difficult and expensive problem. For example, how much would it cost to purchase a bariatric stretcher versus how much would be saved if even one back injury was prevented? However, rather than an expensive stretcher, perhaps it is better to go for the low-hanging fruit, such as purchase of slide sheets to reduce low back stress during lateral transfers. These are the types of criteria that must be decided by a department, and line personnel can provide valuable input into these decisions.

2. Break Job Down into Tasks

List components of doing a job such as when handling a patient:

- Lift patient from bed on to stretcher
- Secure patient on stretcher
- Transport patient from house to ambulance
- Lift patient into ambulance
- Secure patient in ambulance

Purpose: This slide outlines the second step of performing a hazard analysis: breaking the job down into tasks.

Emphasis: This is the place to spend a bit more time on breaking a job down into tasks. Use the picture to the right to illustrate the idea of breaking a job down into components. The job here is transporting a non-mobile patient from their bed into the ambulance *(click the mouse to have the list appear)*.

Action Point: Ask the group to come up with a list of the tasks involved with transporting a patient and write their suggestions on a board before you show them the answers on the slide. Then compare their list with the list on this slide.

---

3. Perform Assessment

Be a DETECTIVE !

Observe:

- Worker performing task
- Work environment
- Work tools and equipment
- Work organization
- Task demands

Purpose: This is the third step in performing a hazard analysis assessment.

Emphasis: Workers must be detectives when assessing any job. They must be certain that they look at all the aspects of it (read the 'Observe' list).

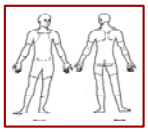
Action Point: Ask the group to think about this list and come up with what they might look for in a job. Here is a partial list to discuss and suggest to the class:

1) How are the upper extremities used? This is important since injuries to the shoulder, elbow and wrist are common. What is the number of total hand manipulations performed per task (frequency)?
2) How much effort or force is involved with performing the task?
3) What tools are being used? Are these tools well designed to limit stress to the body? Are they sources of vibration?
4) What types of personal protective equipment (PPE) are available? Are they used routinely?
5) What are the levels of adjustability of environmental conditions?
6) What postures are assumed when performing jobs?
7) How many workers are required to do the job? How many would be ideal to do the job?

3. Perform Assessment (cont.)

Record observations using:

- Check lists
- Photos
- Video analysis
- Interviews
- Small group discussions
- Symptom surveys



Purpose: Discuss available methods for recording job task elements.

Emphasis: Explain that there are many ways of performing a job hazard assessment. The assessment can be more elaborate, including using video cameras, photos, and instruments that measure force and vibration. They can also be quick assessments gathered using small group discussion and worker interviews. More complex problems may require more in-depth analysis. Standard checklists and symptom surveys are available through some of the Internet resources mentioned in the introduction module. A sample "body map" is shown on this slide. This is common for a worker to use to indicate where he or she is having pain or symptoms.

Action Point: Ask the group if they do safety checks at their stations. Ask how they do them and how they solve their safety issues. If they do, perhaps they can begin to think how an ergonomic assessment could be a part of the safety checks.

---

3. Perform Assessment (cont.)

- Measure workstations
  - reach distances
  - work surface heights
- Measure tool
  - size
  - weight
  - does it vibrate?
  - grip

Purpose: Consider making measurements of tools and workstations.

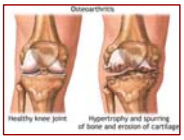
Emphasis: Inexpensive equipment such as a tape measures and bathroom scales can be used to measure the weight of whatever needs to be lifted and work heights. Ergonomic consults are available through Oregon OSHA to make site visits and measure aspects of job tasks that you identify as needing assessment.

Action Point: none.

Consider the Worker

What are the worker's physical limitations?

- ✓Age
- ✓Height
- ✓Fitness level
- ✓Previous injuries



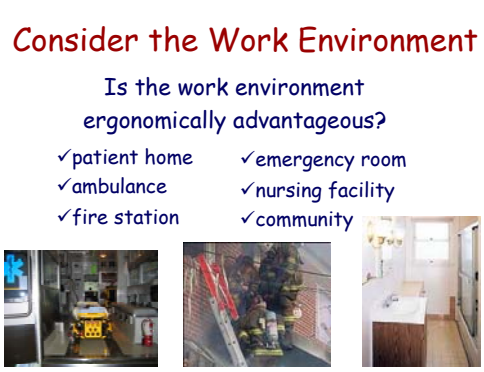
What body parts are being stressed?

- ✓Neck
- ✓Low back
- ✓Shoulders
- ✓ Knees

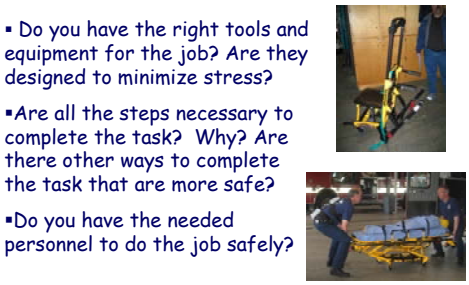
Purpose: Start the group thinking about factors that are worker-specific.

Emphasis: The health of Fire/EMS personnel is important. If workers are injured they cannot perform their job, they cannot carry their weight for the team. Read through this list of worker physical limitations. Also read through the list for the body part that is stressed. Stress that when conducting a hazard assessment they should look at the posture of the worker while he/she is doing the job to determine what body part is stressed.

Action Point: Ask the group why each factor is important: age, height, fitness level and previous injury.
AGE: Cumulative trauma injuries increase with age. The body has a limited number of times that it can perform an activity and over time tissues break down, leading to injury.
HEIGHT: Height is important because being either too tall or too short can impact the person's ability to reach or bend for certain tasks.
FITNESS LEVEL: Muscle imbalance can result in decreased speed and coordination of movement. These factors can predispose workers to injury.
PREVIOUS INJURY: Past injuries mean that healthy tissues have been replaced by fibrous scar tissue, which has less elasticity and is less strong. Therefore, past injuries may make the person more susceptible to future injury to the same tissues.
Also discuss why these body parts are important and what other body parts should be watched?



Purpose: List environmental factors that affect the job being analyzed.
Emphasis: Ergonomically advantageous means that the environment is in the optimal set-up for the worker to do the task, and musculoskeletal risk factors such as bending, force or reaching are minimized. Even though some environmental conditions are beyond the worker's control, there are many instances in which the work environment can be adapted. It is important to look for those openings rather than focusing on the uncontrollable situations.
Action Point: Try to start a discussion about how to evaluate the work environment critically. Ask them to think about the environments listed on the slide. Prompt them to name some specific environmental factors. For example: surface heights, postures required due to the environment, such as in the ambulance, in a patient's home or in a care facility.



Purpose: To consider job/task factors.
Emphasis: Tools and equipment can help or hinder Fire/EMS personnel. For each type of job, the tools and/or equipment used should be evaluated. Other important aspects are work practices and job organization.
Action Point: Use the questions in the slide to start a discussion. Ask the group if

they can think of other questions they might consider when looking at a job. For example: Are there tools/equipment that they think would make the job easier? If so, what are they? If not, why? How can they find out about new tools/equipment? How can they work with the department to purchase the equipment?

What and Why Analysis

Job: Carrying medical supplies on every call

Say your department uses a hard pack that weighs 12 pounds empty…

Purpose: To introduce the 'What and Why' analysis.

Emphasis: Use the example of a job they do on every call, carrying the medical supplies. Each department will have its own way of carrying them, but for this example, say your department uses a hard pack that weighs 12 pounds empty and is bulky.

Action Point: Hand out the completed 'What and Why' example with the medic pack on it. The next slide will help you walk the class through the analysis of the hard pack.

What and Why Analysis

- What are the steps involved in doing this task?
- What body parts are under stress?
- What specific risk factors are present?
- Why must it be done this way?
- What are some things that can be done to reduce or eliminate the risk factors?
- What is the cost of this solution?
- What are barriers for this solution?

Purpose: To go through the 'What and Why' analysis of the hard pack.

Emphasis: This is only one tool for breaking a job down into component parts. They should feel free to invent other tools or to revise this form. However, whatever tool is used should provide a means of looking at a job in an organized, systematic manner.

Action Point: Examine each column listed on the table in the handout and are bulleted in this slide. Start with the first column; point out the steps that have been listed. See if the group agrees that these are the steps for this job, and ask if there are others they consider important. Then go through the table and discuss each column associated with each step in the task. Seek input from the class about these steps and columns. Ask if this form would be useful and if not, why not?

Potential Solution

Alternate Medic Packs

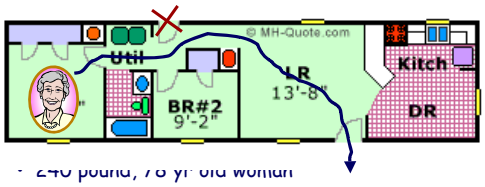
Purpose: To think about a potential solution for the hard medic pack example.
Emphasis: Show the alternative packs that other departments use.
Action Point: Discuss this solution with the class. Would any of these packs work for them? Why or why not? If there is resistance, is it for practical reasons or is it emotional? Use this as an opportunity to promote innovative solutions or to explore reasons for resistance to change.

The What and Why Analysis

The dreaded single wide mobile home

Purpose: To provide experience performing a hazard analysis in a realistic situation.
Emphasis: They should take this example seriously and try to think 'out of the box' and be innovative and creative. While it is a difficult situation, with effort they may craft innovative methods to more safely approach this situation.
Action Point: For this example break the class into small groups of 4-5. Hand out a 'What and Why' form to each group. Have each group spend about 10-15 minutes completing a 'What and Why' analysis. Feel free to change the scenario to suit the group. Instruct the group to work through each step of the 'What and Why'. After the groups have finished, bring them back as a single group and discuss their analysis. If possible, create a list on the board for each category of the analysis. Spend time on the barriers and ways to overcome these barriers. Assist the group with thinking of innovative ways of overcoming barriers.

Floor Plan



- 240 pound, 78 yr old woman
- Fell in master bedroom, is not ambulatory
- Back door blocked
- Need to transport her to hospital

Purpose: A specific example is provided.
Emphasis: Present the floor plan and use the scenario, or create a new scenario based on your experience and the specific class being taught. Emphasize that in almost any situation there is at least one aspect that can be changed. Draw on the variation within the class. Sometimes older workers have learned safer methods 'the hard way' but sharing these with the class can illustrate that more than one method is possible.

Action Point: Use the 'What and Why' analysis to break down the transportation of the patient into steps. Are any of the steps able to be made safer? Again, try to get the group to imagine innovative solutions. At this point, when 'brainstorming' they should not be constrained by cost or practicality. They should let the sky be the limit and explore all possibilities. Then they should look at the barriers to those possibilities and discuss whether some of those barriers can be overcome. This is important for promoting creative and innovative ideas and for letting the class know that it is OK to consider doing some things differently.

Review and Conclusions

- ✓ Musculoskeletal injuries result when risk factors occur alone or in combination.
- ✓ Job hazard analysis is a tool for examining and assessing tasks that place workers at risk for musculoskeletal injury.
- ✓ Hazard analysis is the first step in finding ergonomic solutions and preventing injuries.

Purpose: Brief review of important points.
Emphasis: Risk is increased with time, intensity and frequency of performing the activity. Workers do have a say in their work environment and the hazard analysis provides them with tools to quantify the problems and to make strong arguments to management for improvement.
Action Point: none.

? ? ? ? Questions and Evaluation

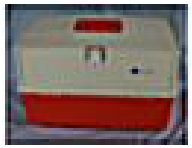
Thank you for your attention

Purpose: To answer questions not addressed during the talk.
Emphasis: Feedback will help you to know what other modules should be taught or how the training can be altered or improved.
Action Point: Take any questions and have the class fill out evaluation form.

This page is intentionally blank.

“What and Why?” Ergonomic Job Analysis

Task/Activity Title: Carrying medical equipment on each call **Person completing analysis**: Ergo class

What are the steps involved in doing this task?	What body parts are under stress?	What specific risk factors are present?	Why must it be done this way?	What are some things that can be done to reduce or eliminate the risk factors?	What is the cost of this solution?	What are barriers for this solution?
Task Carrying Plano 747M Trauma Box 20-3/8"L x 11-1/2"W x 12-3/4"H			Need medical supplies at scene, need quick access to all supplies since unknown what will be needed	Reduce supplies that are carried in tackle box	$0	Deciding what supplies needed/ required, appropriate approval
Steps 1. removing from truck, engine or medic unit	Shoulder, back	Awkward posture, could be heavy weight	Pack is stored in truck at scene	Is it stored at (or can be moved to) waist level on the truck? Move bag closer to body before lifting.	$0	Truck design/storage, Personal behavior
2. holding in hand, carrying distance possibly has other equipment (air bag, heart monitor)	Shoulder Back hand	Awkward posture, heavy weight, unbalanced weight	Tackle box is big & awkward and has to be carried away from body so it does not knock legs	Improve grip on handle, add soft shoulder straps or Find alternate pack for supplies or multiple packs: soft case by Medco or MedPac	$0-20 $50-240 each	Can it be cleaned/ decontaminated? Will it allow good access to supplies? Can it be carried more comfortably? Approval? Cost?
3. setting down at scene	Shoulder low back, arms	Awkward posture, heavy weight	No control over scene, victim may be on ground, bed, chair?	Use proper bodymechanics, bend knees and hips when setting down	$0	Personal behavior
4. opening, finding all equipment needed, closing	Low back, depends on scene	awkward prolonged postures	Same as above	Placing equipment so you do not have to twist or turn to reach supplies and victim	$0	Personal behavior
5. lifting to carry	Low back, arms, shoulders	Heavy weight, awkward postures	Same as above	Use proper bodymechanics, move pack closer to body	$0	Personal behavior
6. carrying back to truck, engine or medic unit	Shoulder back	Awkward posture, heavy weight	Same as 2	Same as 2	Same as 2	Same as 2
7. placing in truck	Low back, shoulders, arms	Awkward postures	Same as 1	Same as 1	Same as 1	Same as 1

This page is intentially blank.

“What and Why?” Ergonomic Job Analysis

Task/Activity Title: **Person completing analysis**:

What are the steps involved in doing this task?	What body parts are under stress?	What specific risk factors are present?	Why must it be done this way?	What are some things that can be done to reduce or eliminate the risk factors?	What is the cost of this solution?	What are barriers for this solution?
Task						
Steps						

Ergonomics for Fire and EMS Departments

Ergonomic Hazard Analysis

University of Oregon
Labor Education and Research Center

This material has been made possible by a grant from the Oregon Occupational Safety and Health Division, Department of Consumer and Business Services

LABOREGON
LERC

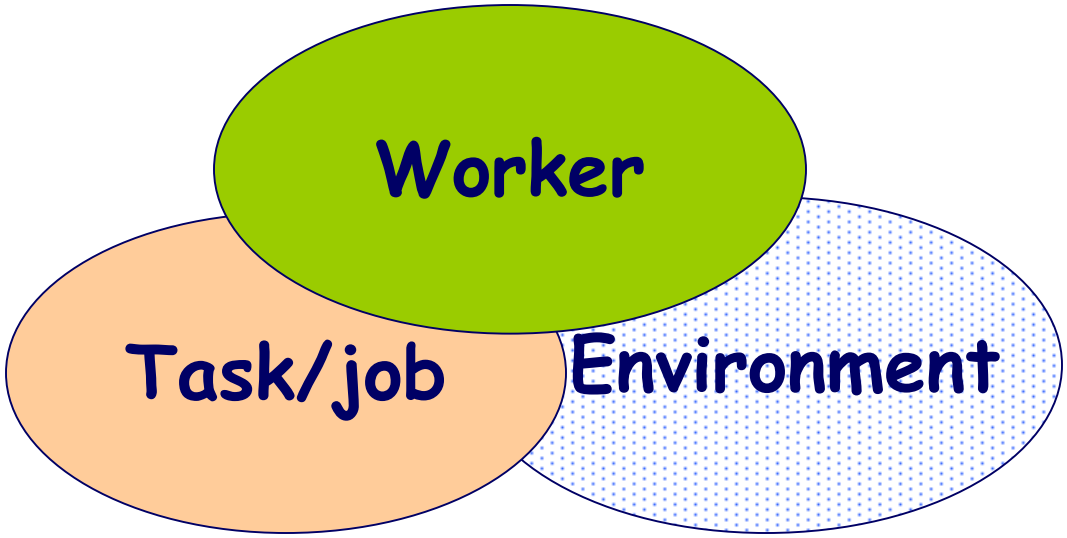
UNIVERSITY OF OREGON

Today's Workshop

We will:

- Review the definition of ergonomics
- Review musculoskeletal risk factors
- Step through the process of conducting a hazard analysis

What is Ergonomics?



The goal of ergonomics is to design the job to fit the worker

NOT make the worker fit the job.

Musculoskeletal Risk Factors

- ✓Excessive force/weight
- ✓Awkward postures
- ✓Prolonged postures
- ✓Repetition
- ✓Contact Stress
- ✓Temperature extremes
- ✓Vibration

Risk magnitude is increased by

time, intensity, or combining factors

Activities of Fire/EMS workers

Firefighting

Training / Drills

EMS Operations

Common Activities Involving Ergonomic Hazards: Fire Fighting

- High rise fires
- Ventilation and overhaul procedures
- Hose laying operations
- Ladder work
- Forcible entry
- Extrications
- Extended procedures

Common Activities Involving Ergonomic Hazards: Training & Drills

- Hose rolling
- Carrying heavy equipment
- Physical exertion

Common Activities Involving Ergonomic Hazards: EMS Operations

- Patient extrication
- Patient transportation

Some Perspective…….

- NIOSH Guidelines:
  Load limit for lifting: 51 lb
  Spine compression force: 764 lb

- Spine compression forces for patient handling activities:
  - Pulling 105 lb patient (with bedsheet) from bed to stretcher: 832-1708 lb
  - Carrying 105 lb patient down stairs using stretcher: 1012-1281 lb

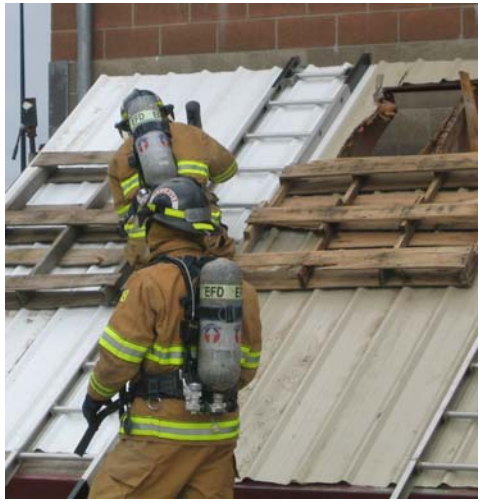
Ergonomics Program Elements

- Assessment of musculoskeletal hazards
- Prevention and control of musculoskeletal hazards
- Training
- A medical management system
- Procedures for reporting injuries
- A plan for the implementation of the program
- Methods for evaluating the program

Why Do A Job Hazard Assessment?

- Each job has actions that stress the body

- Stress takes a number of forms
  - Physical: muscles,joints, nerves
  - Environmental: heat, cold, noise or vision
  - Psycho-social/organizational: scheduling, emotional trauma, poor supervision



- Recognizing hazards is the first step toward injury prevention

What is a Job Hazard Assessment?

- Breaking each specific job down into elements
- Identifying conditions within a job that contribute to risk

Performed by person with ergonomics training

- Safety committee members
- Line personnel

Steps to an Assessment

1. Identify and prioritize jobs/tasks
2. Break down each job into <u>discrete</u> tasks
3. Study and assess each task

   - Determine the specific risk factors for each task

1. Identify and Prioritize Jobs

Identify jobs where:

- Work-related injuries have occurred previously
- Frequent non-severe or severe injuries occur
- Past injuries result in restriction from doing job
- Workers leave because of inability to perform physical requirements of job
- Workers have difficulty sustaining quality performance doing job
- Workers complain of pain, fatigue, discomfort that does not resolve with rest

2. Break Job Down into Tasks

List components of doing a job such as when handling a patient:

- Lift patient from bed on to stretcher
- Secure patient on stretcher
- Transport patient from house to ambulance
- Lift patient into ambulance
- Secure patient in ambulance

3. Perform Assessment

Be a DETECTIVE !

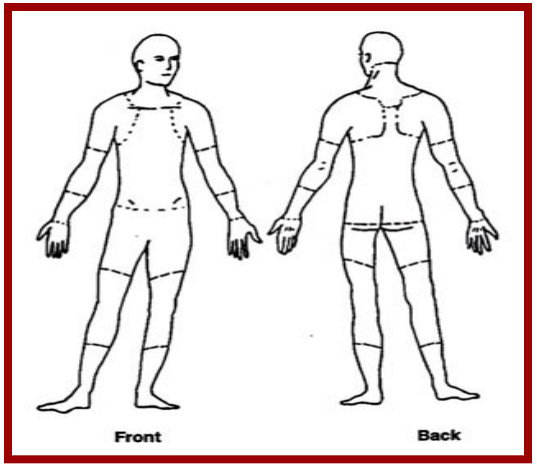
Observe:

- Worker performing task
- Work environment
- Work tools and equipment
- Work organization
- Task demands

3. Perform Assessment (cont.)

Record observations using:

- Check lists
- Photos
- Video analysis
- Interviews
- Small group discussions
- Symptom surveys



3. Perform Assessment (cont.)

- Measure workstations
  - reach distances
  - work surface heights
- Measure tool
  - size
  - weight
  - does it vibrate?
  - grip

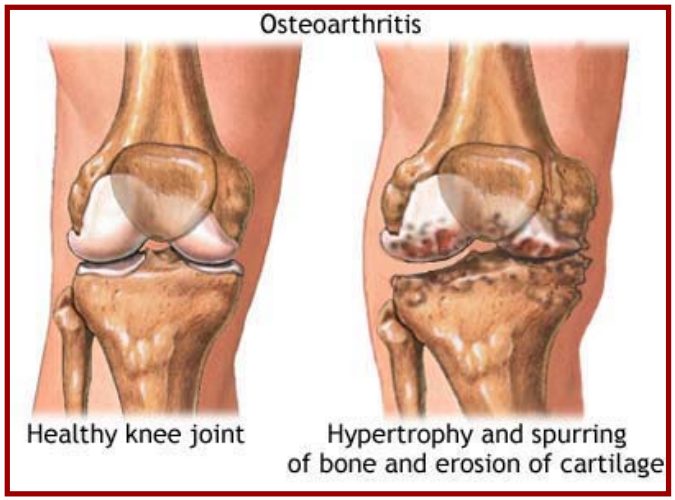
Consider the Worker

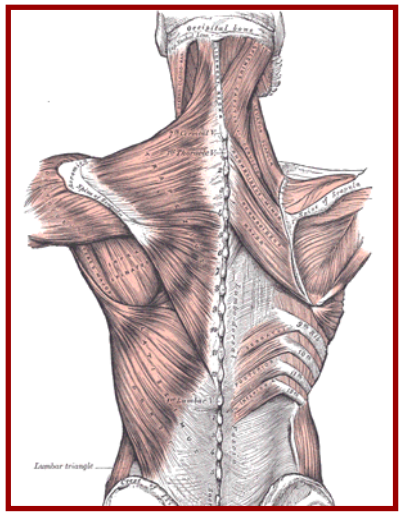
What are the worker's physical limitations?

- ✓Age
- ✓Height
- ✓Fitness level
- ✓Previous injuries

What body parts are being stressed?

- ✓Neck
- ✓Low back
- ✓Shoulders
- ✓ Knees





Consider the Work Environment

Is the work environment ergonomically advantageous?

- ✓patient home
- ✓ambulance
- ✓fire station
- ✓emergency room
- ✓nursing facility
- ✓community

Consider the Job/Tasks

- Do you have the right tools and equipment for the job? Are they designed to minimize stress?
- Are all the steps necessary to complete the task? Why? Are there other ways to complete the task that are more safe?
- Do you have the needed personnel to do the job safely?

What and Why Analysis

Job: Carrying medical supplies on every call

Say your department uses a hard pack that weighs 12 pounds empty…

What and Why Analysis

- What are the steps involved in doing this task?
- What body parts are under stress?
- What specific risk factors are present?
- Why must it be done this way?
- What are some things that can be done to reduce or eliminate the risk factors?
- What is the cost of this solution?
- What are barriers for this solution?

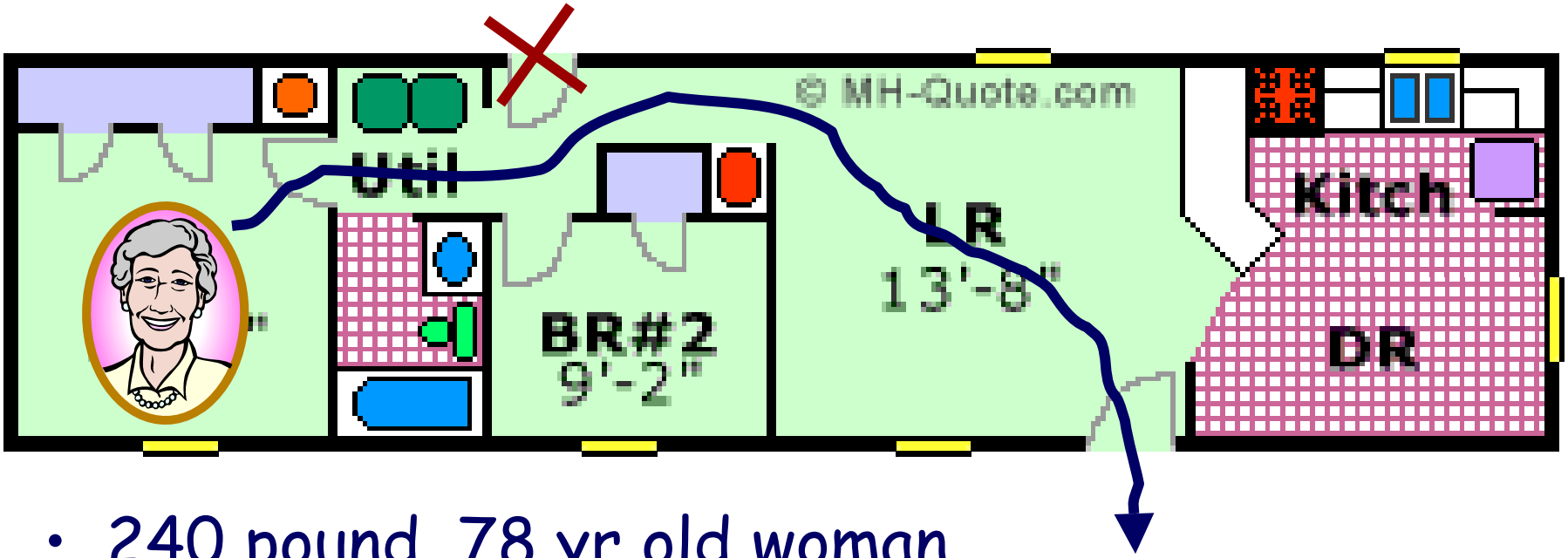
Potential Solution

Alternate Medic Packs

The What and Why Analysis

The dreaded single wide mobile home

Floor Plan



- 240 pound, 78 yr old woman
- Fell in master bedroom, is not ambulatory
- Back door blocked
- Need to transport her to hospital

Review and Conclusions

- ✓ Musculoskeletal injuries result when risk factors occur alone or in combination.
- ✓ Job hazard analysis is a tool for examining and assessing tasks that place workers at risk for musculoskeletal injury.
- ✓ Hazard analysis is the first step in finding ergonomic solutions and preventing injuries.

Questions and Evaluation

Thank you for your attention

Instructor Guide for Solutions Module

Title: Developing and Implementing Ergonomics Solutions

Date Developed: 4/2005

Time Required: 90 minutes

Number of Slides: 29

Materials/Resources Needed:
Developing and Implementing Ergonomics Solutions PowerPoint presentation-electronic form or transparencies
Computer system with PowerPoint software installed and projection system (if using electronic form)
Hard copies of PowerPoint slides for handouts
Hard copy of Solutions Analysis handout with examples for instructor
Hard copies of Solutions Analysis blank handout

Objective: To provide information on ergonomic solutions including:
1) Reviewing injury risk factors
2) Discussing solutions hierarchy
3) Reviewing hazard analysis
4) Exploring potential solutions
5) Examining barriers to solutions

Motivation: To provide information on a means of developing appropriate ergonomics solutions and implementing them.

Overview: This module explains how to develop appropriate ergonomic solutions and how to implement them. Some time will be dedicating to emphasizing that there is a hierarchy to the types of solutions and that striving to implement higher level solutions is more effective at reducing injury risk, although all solutions help. An exercise to help develop solutions and think about what barriers might be present is also included. We recommend this module should be taught after the hazard analysis module since developing solutions naturally follows realizing the hazards.

Purpose: Introduce yourself and the title of today's topic.
Emphasis: Acknowledge the sponsors listed on the slide. This module most logically should be taught after the Introductory Ergonomics and Hazard Analysis modules. Other modules available in the "Ergonomics for Fire and EMS Departments" include: Introduction to Ergonomics and Cumulative

Trauma (which should have been taught already), Ergonomic Hazard Analysis (which should have been taught already), Body Mechanics and Back Health, and Command Staff Ergonomics. This module is intended to be a 90-minute course.
Action Point: Ask for a show of hands of those who have had an ergonomics class before and who knows what ergonomics means. This will help you gauge the level of knowledge.

Today's Workshop

Will:

- Review injury risk factors
- Discuss solutions hierarchy
- Review hazard analysis
- Explore potential solutions
- Examine barriers to solutions

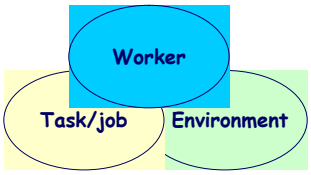
Purpose: This module is intended to discuss how to develop ergonomic solutions once hazards are identified and how to implement them.
Emphasis: The focus of the class will be a hands-on workshop for developing ergonomic solutions, identifying barriers and implementing solutions, for hazards at your station.
Action Point: Ask for a show of hands of those who have had the basic introduction to ergonomics or the Hazard Analysis modules. This will help you gauge their knowledge and signal how much time you need to spend on those sections.

Musculoskeletal Risk Factors

- Excessive force/weight (pulling, lifting)
- Repetition
- Awkward postures
- Prolonged postures
- Temperature Extremes
- Direct pressure
- Poor work organization

Purpose: Review risk factors for musculoskeletal disorders.
Emphasis: Many activities commonly performed by fire/EMS personnel are risky. It is important to be aware of these risks and the fact that risk increases dramatically by combined risk factors, longer exposure and greater intensity.
Action Point: This should be review. Ask the group to name 3 risk factors for musculoskeletal injury before you show them the risk factors. (*Once students have listed risk factors, click the mouse to display them. If they cannot remember them, then review the material given in module one on these risk factors to make sure they understand these.)*

Review of Ergonomics

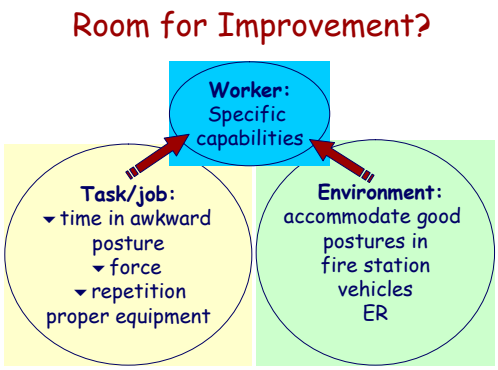


The goal of ergonomics is to design the job to fit the worker, NOT fit the worker to the job.

Purpose: Review the definition of ergonomics.
Emphasis: Ergonomics is defined as the interaction between the worker, the task or job and the environment. It is important to stress that the goal of ergonomics is adapting the workplace, rather than adapting the worker. Many people believe that ergonomics is just making the worker complete the job

more safely through fitness training, such as stretching and strength training. For some people, ergonomics means body mechanics. These activities are important for staying healthy and preventing injury but research has shown that body mechanics and fitness alone are not effective approaches to injury prevention. Improving the task or the work environment are the major goals of ergonomics.

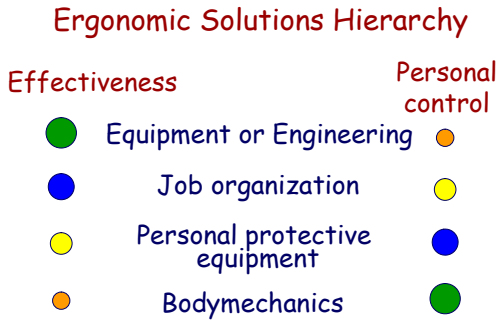
Action Point: Explain the above point to the group and ask them why this might be so. They should be able to point out that no matter how fit you are, there are many circumstances in fire and EMS that require workers to use poor body mechanics and to lift excessively heavy loads, such as very heavy patients being moved from a crowded bedroom or bathroom. Ask them to name two or three other examples where being fit and body mechanics would not apply.



Purpose: The intent of this slide is to get FFs/EMTs to think beyond behavioral solutions, that is, thinking that fitness is the only way to be safe from musculoskeletal injury.

Emphasis: For each of the components of the worker/work relationship, there are limitations for the improvement. Each person has specific capabilities, these can be improved upon but ultimately this is limited. The important point to remember is that the task and the environment should be fitted to the FF/EMT. More adjustments can be made to aspects that make a bigger impact on reducing the risk of injury, and this is where solutions should be focused.

Action Point: Ask the class which aspects of ergonomics are most commonly addressed at their station. If only one area is addressed ask them why and why the other areas are not addressed. Ask the class why it is common to focus only on the worker? This could be because it is easiest, the least costly and within personal control. It is often thought of as an immediate fix as opposed to going through a design change or an equipment change. Even though it is all these things – even if you are the strongest person and using the best body mechanics- you cannot lift a 500 lb patient. Other control measures must be in place to reduce your risk of injury.



Purpose: Review the concept of the hierarchy of ergonomic solutions.

Emphasis: There is a hierarchy to ergonomic solutions. On one side there is the effectiveness of the solution in reducing or eliminating the injury risk. On the other side there is the degree of personal control. These are inversely related: generally as personal control increases, the effectiveness decreases. The most effective solutions for risk reduction

are equipment changes or engineering controls *(click the mouse to make it appear on screen)*. Changing to better designed equipment or redesigning the apparatus or station can reduce risk of injury. Ask the class if they can think of any examples. This may not be in a worker's personal control but as line personnel, a worker should have access to an equipment committee or another means to recommend equipment or design changes.

Next in the hierarchy is job organization *(click the mouse to make it appear on screen)*. Job organization has been discussed as a risk so think of how the work protocols and schedules could be a solution. Ask the class if they can think of any examples. Workers have little personal control over this as well, but each worker can contribute to making the organization healthier.

Next on the list is personal protective equipment *(click the mouse to make it appear on screen)*. Providing a protective barrier to protect joints or promote neutral posture is considered ergonomic personal protective equipment. Ask the class if they can think of any examples. A worker has some personal control over this solution since he/she would decide to use this equipment.

The least effective solution in reducing risk is body mechanics *(click the mouse to make it appear on screen)*. Body mechanics is using proper body alignment while working. Ask the class if they can think of any examples. The worker has most personal control over this. When developing solutions, it is important to keep this hierarchy in mind for setting shorter term and longer term goals.

Action Point: Ask the class if they remember this hierarchy. Spend more time on it, if they do not remember. Prompt the class to think of examples. You can even add pictures of them.

Sample examples:

Equipment or engineering: stair chair with tracks that can descend stairs, bariatric ambulance that uses a winch to pull gurney up ramp into the medic unit.

Job organization: making team lifts the standard work practice, having enough staff on crew to have 4 people on an apparatus.

Personal protective equipment: knee pads for use in drills without live fire, lumbar rolls to promote neutral spine when sitting (in the vehicles, in the station).

Body mechanics: using appropriate lifting techniques (keeping spine neutral, load close, large base of support).

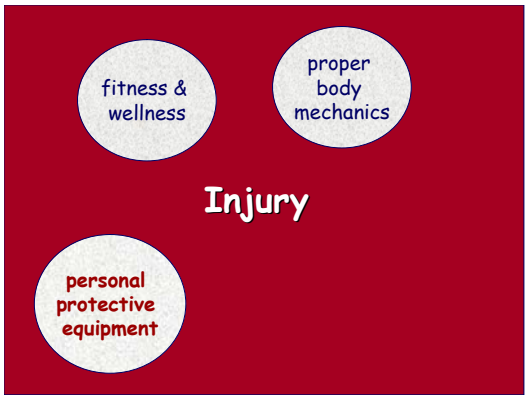
Purpose: To visualize the relative contribution toward injury prevention of each type of ergonomic solution.

Emphasis: Think about this entire screen as your risk for musculoskeletal injury – all the red. Assume that 100% prevention would cover the entire screen and change the color from red to blue. The next few slides demonstrate an estimate of the percent contribution of each type of solution to injury prevention. Each circle represents the amount

each particular solution reduces the risk of injury. The relative size of each area in the next few slides is roughly based on study findings of the effectiveness of each area in preventing injury.
Action Point: Ask them to consider their risk for musculoskeletal injury.

Purpose: Show the contribution of fitness injury prevention.
Emphasis: Increasing your fitness level and overall health can reduce your risk of injury... but only so much. Say it takes away this amount of your overall risk. It does not eliminate your risk completely. It may also increase you risk of injury if you are not healthy about your fitness or wellness practices.
Action Point: Who in the room has not had an injury related to their fitness activities?

Purpose: To show the contribution of body mechanics to injury prevention.
Emphasis: Adding proper body mechanics can help reduce your risk, but again only a limited amount. There may be times when proper body mechanics are not feasible or you forget to use them.
Action Point: Ask the class to describe several situations where using good body mechanics is not possible.

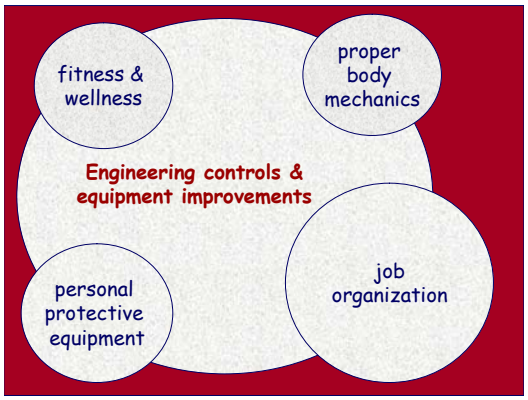


Purpose: To demonstrate the contribution of personal protective equipment to injury prevention.
Emphasis: Using personal protective equipment (PPE) will help reduce risk, but again, by a limited amount since it only applies to a few situations. You can see as we add more solutions, the more your risk is eliminated.
Action Point: Ask the class if they can think of example when you can and cannot use PPE.

Purpose: To emphasize the impact of job organization.

Emphasis: Job organization can be very effective in helping to prevent musculoskeletal injuries. These solutions will be fairly difficult to implement because they will require participation at multiple levels, such as by the line personnel as well as command staff. However, personnel, training, drills, work practices and work organization can be determined by the administration to reduce the risk of injury.

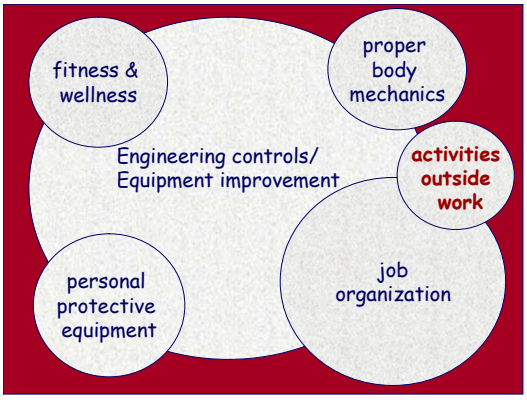
Action Point: Ask them what are barriers to implementing job organization changes and how might these barriers be removed?



Purpose: Emphasize the contribution of improvements in equipment.

Emphasis: Engineering controls or equipment improvements make the largest contribution toward preventing MS injuries. They are the most difficult solutions to implement because they require participation at many levels - city council, management, line personnel - and they cost money. However, they are the most effective measure for preventing injury.

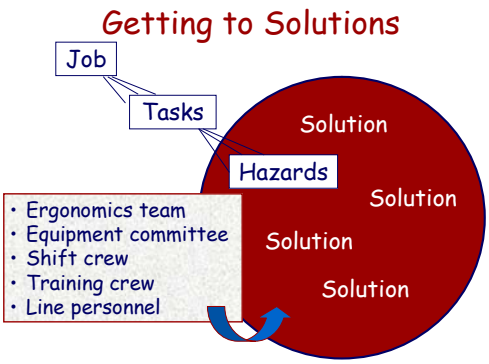
Action Point: Ask the class to think about examples of past equipment improvements in your department, perhaps gurneys or other patient handling devices. Are there any equipment solutions that they can think for the future?



Purpose: Contribution of outside activities and to summarize the additive effect of implementing ergonomic solutions.

Emphasis: 1) Being smart about activities that are done outside of work, such as sports and hobbies, can also help reduce the risk of injury at work since some injuries are due to cumulative trauma. 2) Workers' risk will never be completely eliminated with these ergonomic solutions because your job is inherently risky. It is very physically and emotionally demanding. However, the more solutions implemented, no matter on what level, the more injuries will be prevented.

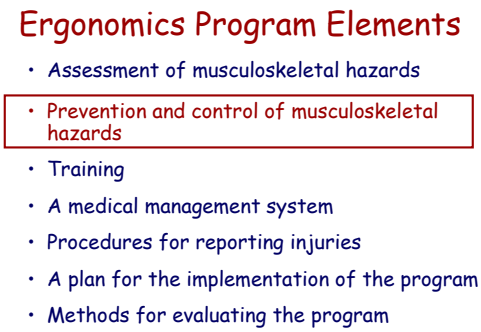
Action Point: Ask the class for their opinion about this model. Does it make sense? If not, why not? Do they agree with the proportion given to each area? Remind them that these area sizes are roughly based on studies that have determined the effectiveness of each category for preventing injury.



Purpose: To show where solutions fit in the picture. Once you have identified the hazards, solutions must be developed.

Emphasis: So once you have identified and prioritized the risky jobs and hazardous tasks, these hazards need to be addressed. The people charged with finding solutions to the identified hazards must brain storm a list of potential solutions that can be taken to the command staff. This could be done in conjunction with an ergonomics team, the equipment selection committee, a shift crew, the safety committee, the training crew or by a single individual. It is important for the department to decide how to manage the flow of information on solutions. There are potentially many solutions that could reduce the hazards. The key to implementing solutions is deciding what solution is optimal for the given situation.

Action Point: Ask the group for an example of when they addressed a safety issue or determined the need for new equipment. How did they go about it? Can they see how they might take ergonomic issues the same way or in an improved way based on their experience?



Purpose: Review the elements of ergonomic programs and emphasize today's module, prevention and control of hazards.

Emphasis: This is a list of Ergonomics Program Elements drawn from the book "Fire and Emergency Medical Services Ergonomics" published by FEMA. The full source is listed in the references section. This module is covering the second element of Prevention and Control of Hazards.

Action Point: Ask the class if they remember these from a previous module.

Job Hazard Assessment

1 Identify and prioritize jobs/tasks

2 Break down each job into discrete tasks

3 Study and assess each task

- Determine the specific risk factors for each task

What and Why Analysis

Job Title: Person completing Analysis:

Tasks or steps involved (or tasks conducted)	Body parts affected	Risk factors and potential?	Frequency and duration of task	Why is it done this way?

Purpose: To review the steps to a hazard analysis.
Emphasis: Review the steps: 1) Identify the jobs to be analyzed 2) break into tasks 3) and assess each task.
Action Point: none.

Solutions…

Purpose: Introduce solutions.
Emphasis: Workers solve problems all of the time. Be creative. Workers can solve safety and health problems too.
Action Point: Comic relief.

What and Why Analysis

- Tasks or steps involved
- Body parts affected
- Risk factors
- Frequency/duration of task
- Why is it done this way?

} Assess the task

- Potential solutions
- Cost of solutions
- Barriers

} Prevent & control

Purpose: Review of the 'What and Why' analysis.
Emphasis: Remind the group what the categories in a 'What and Why' analysis are. The first group of categories is part of the assessment phase while the last are the prevention and control phase. Focus on how each is important.
Potential solutions: It is important to come up with as many ideas as you can; remember to think outside the box. Think of what would be ideal as well as small and simple solutions.
Cost of solutions: As always, the cost of implementing a solution might be the biggest barrier. Think about not only the cost of the equipment or personnel time, but think about all the things that would have to go into place to make it realistically work: would additional training be needed? would more or less personnel be needed? what would be the cost to have it in all vehicles or just certain ones? etc. One thing to keep in mind when you are weighing costs is how much an injury costs... the cost of the solution may not seem so high compared to that.
Action Point: For each of these categories, ask the group to discuss them and get feedback on their thoughts. Ask why it is important to think about these as you are developing solutions.

Prevention and Control
AKA: Solutions

- ✓ Set short term and long term goals
- ✓ May address a single major problem
- ✓ May address several smaller/simpler problems
- ✓ Think outside the box

Purpose: Introduce how to address the problems identified through the hazard assessment.

Emphasis: Explain the concept of short-term goals and long-term goals. You might be able to come up with quick solutions that help reduce the risk until a bigger change can occur. Also keep in mind that sometimes one solution can benefit other aspects of the job; perhaps another job or task is affected by the equipment purchased for one job. Suggest that initially they try not to get bogged down in department bureaucracy. Well thought-out problems with well thought-out solutions will make an impact on the department safety committee. Change will not happen overnight but identifying solutions is the first step.

Action Point: Ask the class what "Think outside the box" means to them. Often departments are used to the way they do things and sometimes have a hard time thinking beyond their routine. To solve the really tough ergonomic problems that FFs and EMS workers have, you need to get the line personnel to think for themselves how they might make their jobs easier.

Solutions

- Come up with many solutions
  - Dream big and small
- Decide what is optimal
  - Barriers
  - Cost/benefit
- Best way to implement
  - Worker buy in
  - Department buy in
- Have a process

Purpose: More details about solutions.

Emphasis: After you have discussed thinking outside the box, this slide helps you to put into focus where to go with the solution ideas. After you have brainstormed all the possible solutions, you need to weigh in the pros and cons. You can decide what is optimal by determining the barriers or coming up with why a solution would not work. You also must look at the cost and the benefits of a solution; how much risk are you reducing for the cost of the solution? You also need to consider how each solution would actually be implemented. Often good ideas are lost because no one asked the worker what he or she wanted. Involving all affected parties in the decision process can make the implementation much easier. Finally, a process must be put in place to review the recommendations and proper feedback must be given and addressed.

Action Point: Ask the group how they think a process for developing and implementing solutions would work in their department.

Lateral Transfer Aids

- One "job" is the lateral patient transfer
- Use of a device reduces the stress to the low back by reducing the friction.
- It eliminates the need for the 3rd person on the bed

Drawsheet only

Drawsheet with lateral transfer device

Purpose: To provide an example of an effective ergonomic solution that is low cost.

Emphasis: The use of a friction reducing device can make the lateral transfer of a patient much easier. It reduces stress to the low back and the need for a person on the bed, which is THE most stressful job in a lateral transfer. The transfer aid is lightweight, inexpensive, easily carried with the gurney, easily cleaned and comfortable for the patient. The device is placed under the drawsheet and is commonly used in hospitals.

Action Point: Ask the group whether they currently use any lateral transfer device. If not, why not? Do they know of the different kinds that are available? Would they know how to request one in their department?

No-Lift System

ramp with special gurney

Bariatric Unit, AMR Portland

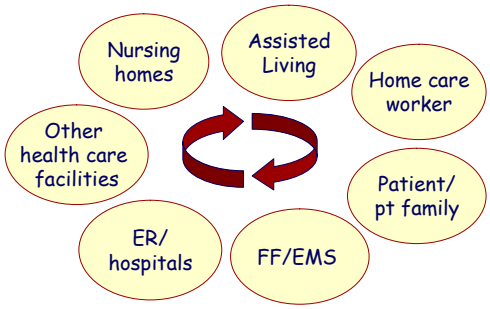
motorized winch & cable

Purpose: To show another example of a good ergonomic solution – one that is bigger but is very effective at reducing risk.

Emphasis: Another job is lifting the patient into the medic unit. If the patient is overweight, this can be a big source of risk to the workers lifting the gurney plus the patient into the medic unit. With this ramp and winch system, the need for anyone to lift the gurney is eliminated. The motorized winch is mounted into the medic unit and is attached, by cable, to a specialized gurney. This gurney holds more weight and has extended handles to move the patient in the lower position to decrease risk of instability. A ramp is easily fixed to the medic unit and the EMS worker guides the gurney as the winch does all the work. The patients love it because there are not several EMS workers struggling and it is a comfortable ride into the medic unit.

Action Point: Ask the group what they think about this solution. Would something like this work in their department, why or why not?

Ergonomic Communication



Purpose: Another example of a solution might be effective ergonomic communication.

Emphasis: For the EMS side of your work, total patient care is much more than the time you spend with a patient. Stakeholders go beyond FFs/EMS and fire departments. Consider some of the other stakeholders and how the department works and relates to them.

Action Point: Ask the group why assisted living facilities would be an important contact.

If they can not think of a reason, ask about how often they get called out to pick an obese patient up off the floor, or to do all the lifting while facility personnel stand by and watch. Is this a problem? What might a solution be? How can they communicate with this group to reduce some of the patient handling issues?

Ergonomic Communication

- Understanding the "bigger" picture can help all the workers involved
- Establish appropriate communication with stakeholders
  - Patient handling
  - Patient logistics
  - Patient care
- Develop policies

Purpose: Elaborating on "ergonomic communication."
Emphasis: Establishing communication with other stakeholders in your work is important. If you think that practices by other stakeholders increase your risk of injury, then as a department, you can develop policies that are appropriate to minimize this risk. For example, if one particular patient care facility is constantly calling you to check patients when they fall, what kind of policies does that facility have for handling their patients? Does their staff have the equipment they need and the training for the staff to handle these situations? Alerting the facility to abuse of your department in such a way is important not only for your safety, but for the safety of the patient and the other patient care workers. One department in Oregon has transportation summits (meetings) with all the stakeholders in the community. It allows for all parties to communicate about the many issues surrounding patient care and patient handling.
Action Point: Ask the group if they can think of other examples of how they could communicate better with other stakeholders and what issues they could address.

Solution for a job?

Job: Single person handling a ladder.

Purpose: To provide an example of a task to use to come up with solutions.
Emphasis: The next several slides will be participatory. You will try to involve the class into coming up with solutions.
Action Point: Get the class to think of what they have to do if they lift a ladder by themselves. How this is done may vary by department so change this slide as appropriate.

What and Why Job Hazard Analysis

"What and Why?" Ergonomic Job Analysis

Job Title: Firefighter **Person completing analysis**: Joe

1. What are the individual tasks or steps involved?	2. What body parts are under stress?	3. What specific risk factors are present?	4. Frequency/ Duration of task	5 Why is the task performed in this way?
Job Getting Ladder				
Tasks 1. Lift from engine	Low back, shoulder, neck	Heavy weight, awk postures	Infrequent, short duration	Lift off truck
2. Carry to site	Low back, shoulder	Heavy weight, awk postures	Infrequent, short duration	Need to walk
3. Place against wall	Low back shoulder, legs	Heavy weight, awk postures	Infrequent, short duration	Need to get tip up
4.				
5				
6.				
7.				

Purpose: To give a hazard assessment of lifting ladders.
Emphasis: Explain each of the column headings: 1) individual tasks, 2) body parts, 3) risk factors, 4) frequency, duration, 5) reason for performing task in this manner. Explain that each row is the discrete task for the job.

Action Point: Get the class to think about what identified hazards there are for this task and its components.

Solutions

Now think about:
- The tasks: lifting, carrying, placing
- Potential solutions for each
- Cost
- Benefit
- Barriers
- Implementation

Purpose: To give solutions a try.
Emphasis: Give the blank 'What and Why' handout to each worker (the instructor should have one that is filled in). Explain each of the column headings: tasks, solutions, cost, benefit, barriers, and implementation. Explain that each row is for a solution. This table is helpful to thinking through solutions and how to implement them. The next slide has the table.
Action Point: Have the class divide up into groups of 3 or 4. Go through the first row on the sheet as an example then have the class think of more solutions. Have them think of at least a couple of solutions for each task in the job. Give the class 10-15 minutes to come up with their solutions and fill in the table. Then have each group present them and discuss what solution they might decide on. Remember, it may be a solution that would impact all tasks, or just one of them. They may decide on multiple solutions.

Solution Analysis

Task	Potential Solutions	Cost	Benefit	Barriers	Implementation
Lifting ladder off truck	Alternative lightweight ladder				
Carrying the ladder					
Placing the ladder					

Purpose: To show the form.
Emphasis: Each person should have a form to fill out.
Action Point: Have the class critically think about solutions using this form.

Questions and Evaluation

Thank you for your attention

Purpose: Questions not asked during the talk can be answered at this time.
Emphasis: Feedback will help you to know what other modules should be taught or how the training can be improved.
Action Point: Take any questions and have the class fill out evaluation forms.

Solution Analysis - Instructor guide

Job: handling a ladder

Task	Potential Solutions	Cost	Benefit	Barriers	Implementation
Lifting ladder off truck	Alternative lightweight ladder	Ladder cost	Lower weight, improves all tasks	NFPA rated and approved?	Have to purchase for each vehicle. Have to train/drill with it.
“	Different mount that lowers ladder from truck	New mount, Retrofitting vehicles	Moves ladder to better position to lift from.	Is system quick enough? What height does it lower to and it is right for all workers?	Have to purchase for each fire engine and truck.
“	Make it a two person job	Personnel time	Reduces weight lifted by each person. More control with ladder for moving safely.	Is second person always available? If people are different heights does it help?	Make it a policy – command staff and line personnel buy-in. Have to add another to the crew on the vehicle, how does this change interactions/staffing?
Carrying the ladder	Alternative lightweight ladder	Same as above	Same as above	Same as above	Same as above
“	Make it a two person job.	Same as above	Same as above	Same as above	Same as above
“	Use ladder carrying devices – rollers,etc	Cost of device	Eliminates need to carry ladder	Ground is not always level, may be hard to maneuver devices. Might be hard to place ladder in/out of device. Might take more time. Where stored on vehicle?	Buy one or several different types and get worker feedback. Buy optimal one for all vehicles and train workers with it before using on all vehicles.
Placing the ladder	Alternative lightweight ladder	Same as above	Same as above	Same as above	Same as above
“	Make it a two person job.	Same as above	Same as above	Same as above	Same as above

This page is intentionally blank.

Solution Analysis

Job: handling a ladder

Task	Potential Solutions	Cost	Benefit	Barriers	Implementation
Lifting ladder off truck	Alternative lightweight ladder	Cost of ladder	Lower weight, improves all tasks for this job	NFPA rated and approved?	Have to purchase for each vehicle. If any differences in use, have to train and drill with it.
Carrying the ladder					
Placing the ladder					

Ergonomics for Fire and
EMS Departments

Developing & Implementing Ergonomic Solutions

University of Oregon
Labor Education and Research Center

This material has been made possible by a grant from the Oregon Occupational Safety and Health Division, Department of Consumer and Business Services

LABOREGON
LERC

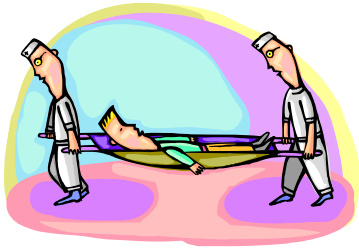
UNIVERSITY OF OREGON

Today's Workshop

Will:

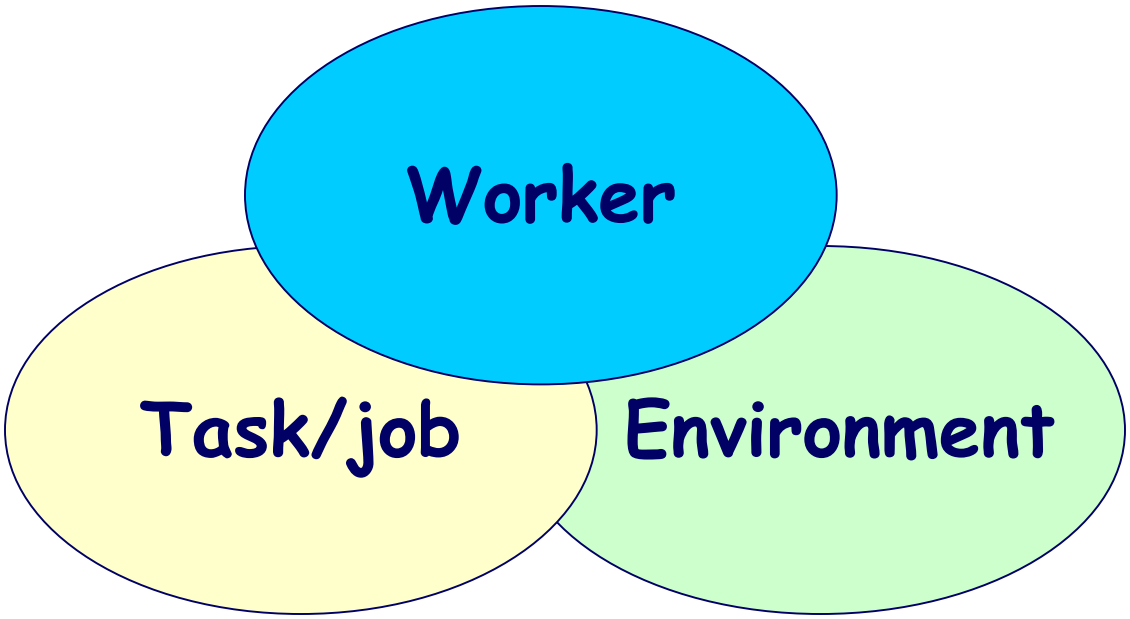
- Review injury risk factors
- Discuss solutions hierarchy
- Review hazard analysis
- Explore potential solutions
- Examine barriers to solutions

Musculoskeletal Risk Factors



- Excessive force/weight (pulling, lifting)
- Repetition
- Awkward postures
- Prolonged postures
- Temperature Extremes
- Direct pressure
- Poor work organization

Review of Ergonomics



The goal of ergonomics is to design the job to fit the worker, NOT fit the worker to the job.

Room for Improvement?

Worker:
Specific capabilities

Task/job:
- time in awkward
  - posture
  - force
  - repetition
- proper equipment

Environment:
accommodate good postures in
- fire stations
- vehicles
- ER

Ergonomic Solutions Hierarchy

Effectiveness		Personal control
	Equipment or Engineering	
	Job organization	
	Personal protective equipment	
	Bodymechanics	

Injury

fitness & wellness

Injury

fitness & wellness

proper body mechanics

Injury

fitness & wellness

proper body mechanics

Injury

personal protective equipment

fitness & wellness

proper body mechanics

Injury

job organization

personal protective equipment

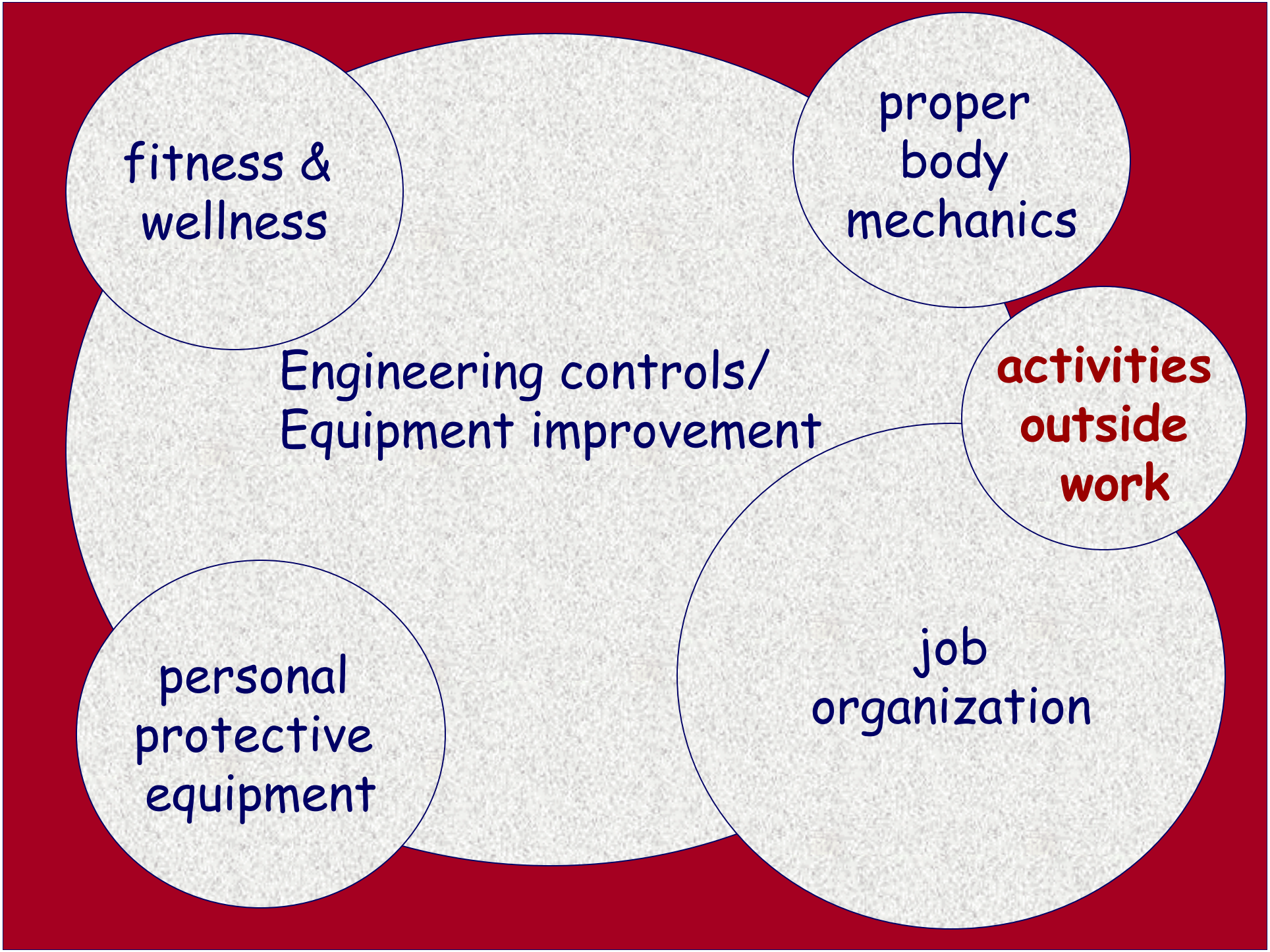
fitness & wellness

proper body mechanics

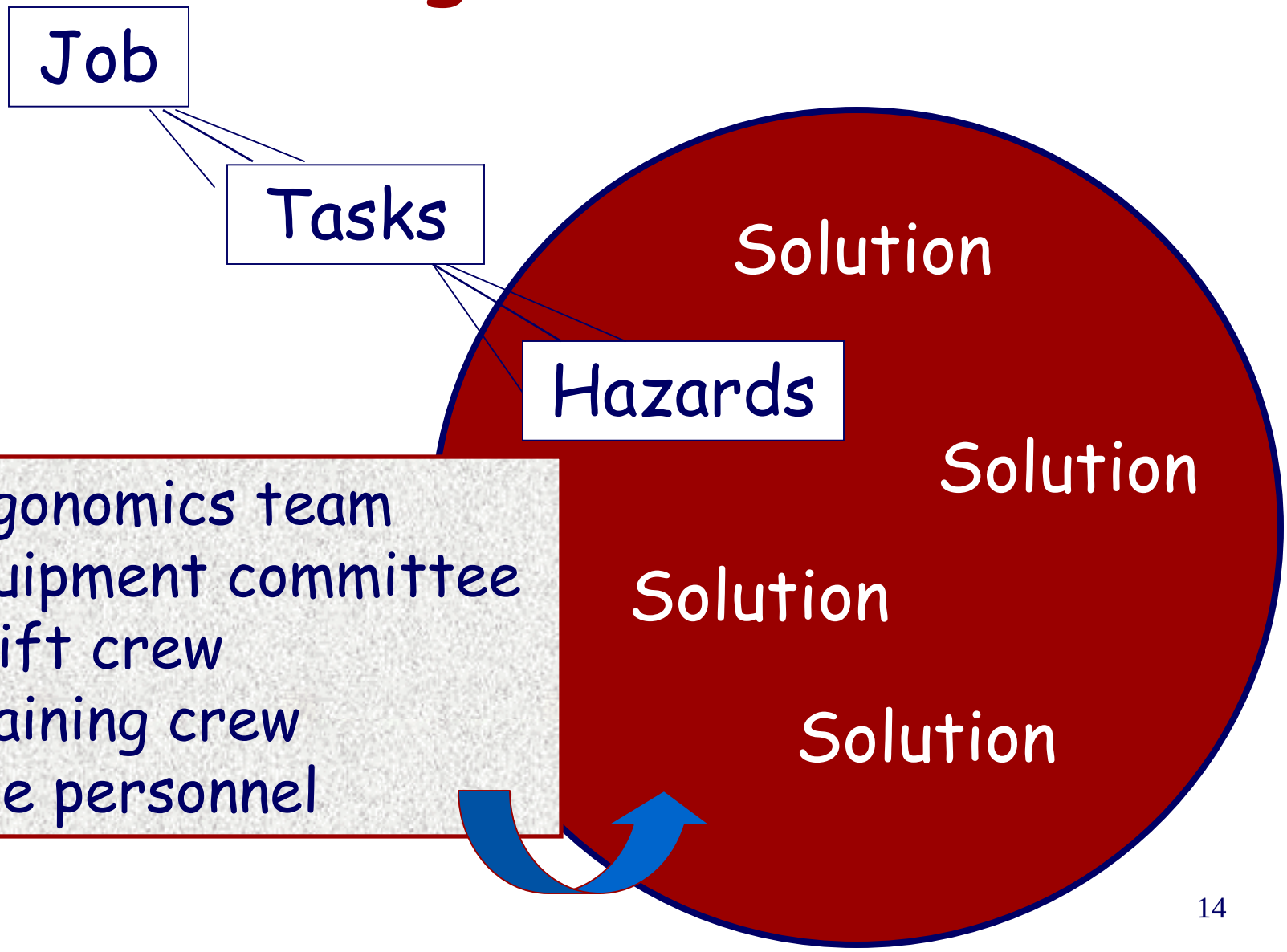
Engineering controls & equipment improvements

personal protective equipment

job organization


fitness & wellness
proper body mechanics
Engineering controls/ Equipment improvement
activities outside work
personal protective equipment
job organization

Getting to Solutions



- Ergonomics team
- Equipment committee
- Shift crew
- Training crew
- Line personnel

Ergonomics Program Elements

- Assessment of musculoskeletal hazards
- Prevention and control of musculoskeletal hazards
- Training
- A medical management system
- Procedures for reporting injuries
- A plan for the implementation of the program
- Methods for evaluating the program

Job Hazard Assessment

What and Why Analysis

Job Title: **Person completing analysis**:

1. What are the individual tasks or steps involved?	2. What body parts are under stress?	3. What specific risk factors are present?	4. Frequency/ Duration of task	5 Why is the task performed in this way?
Job				
Tasks 1.				
2.				
3.				
4.				
5				
6.				
7.				

1 Identify and prioritize jobs/tasks

2 Break down each job into <u>discrete</u> tasks

3 Study and assess each task

- Determine the specific risk factors for each task

Solutions…

What and Why Analysis

- Tasks or steps involved
- Body parts affected
- Risk factors
- Frequency/duration of task
- Why is it done this way?

Assess the task

- Potential solutions
- Cost of solutions
- Barriers

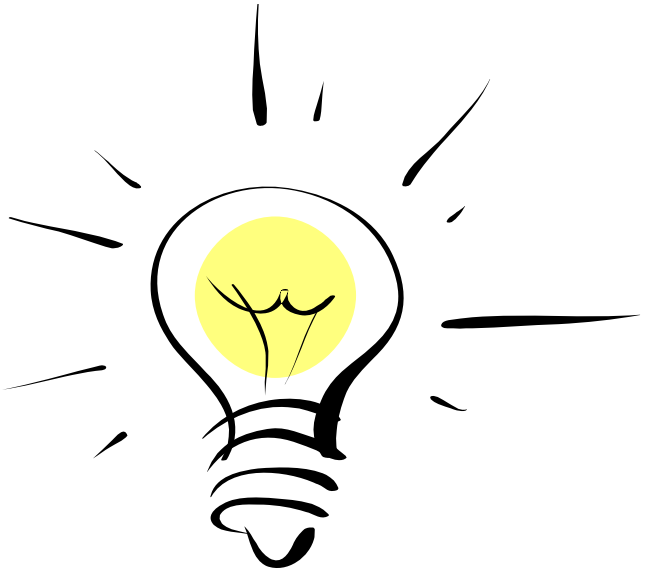
Prevent & control

Prevention and Control AKA: Solutions

- ✓ Set short term and long term goals
- ✓ May address a single major problem
- ✓ May address several smaller/simpler problems
- ✓ Think outside the box

Solutions

- Come up with many solutions
  - Dream big and small
- Decide what is optimal
  - Barriers
  - Cost/benefit
- Best way to implement
  - Worker buy in
  - Department buy in
- Have a process



Lateral Transfer Aids

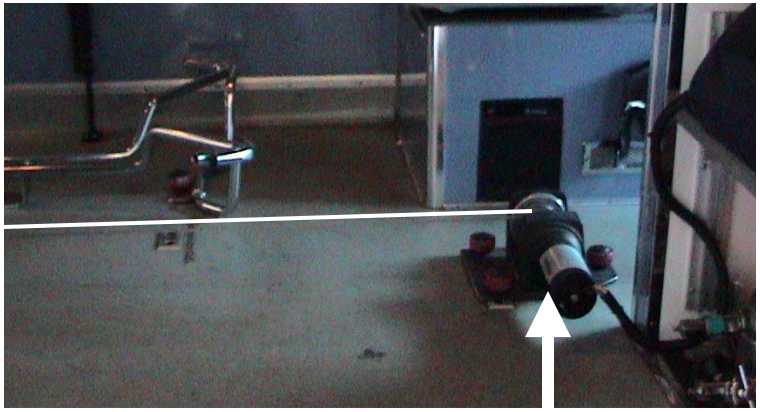
- One "job" is the lateral patient transfer
- Use of a device reduces the stress to the low back by reducing the friction.
- It eliminates the need for the 3rd person on the bed

Drawsheet only

Drawsheet with lateral transfer device

No-Lift System

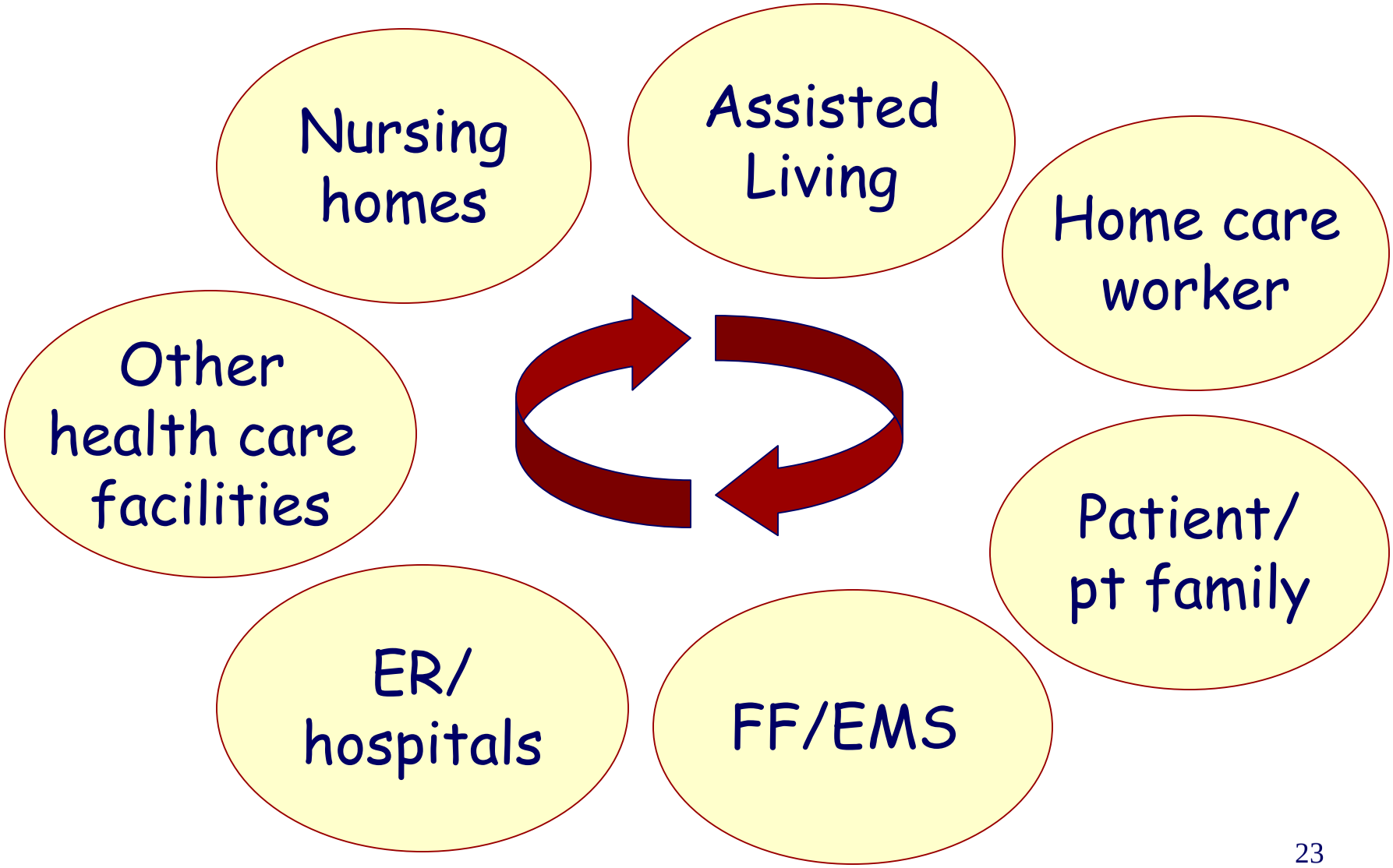
ramp with special gurney



motorized winch & cable

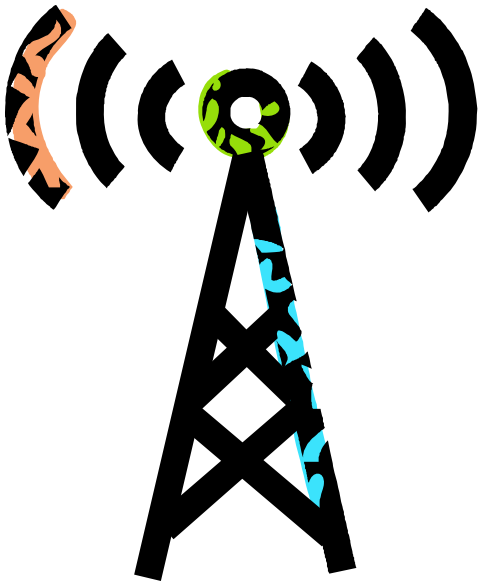
Bariatric Unit,
AMR Portland

Ergonomic Communication



Ergonomic Communication

- Understanding the "bigger" picture can help all the workers involved
- Establish appropriate communication with stakeholders
  - Patient handling
  - Patient logistics
  - Patient care
- Develop policies



Solution for a job?

Job: Single person handling a ladder.

What and Why Job Hazard Analysis

Job Title: Firefighter **Person completing analysis**: Joe

1. What are the individual tasks or steps involved?	2. What body parts are under stress?	3. What specific risk factors are present?	4. Frequency/ Duration of task	5 Why is the task performed in this way?
Job Getting Ladder				
Tasks 1. Lift from engine	Low back, shoulder, neck	Heavy weight, awk postures	Infrequent, short duration	Lift off truck
2. Carry to site	Low back, shoulder	Heavy weight, awk postures	Infrequent, short duration	Need to walk
3. Place against wall	Low back shoulder, legs	Heavy weight, awk postures	Infrequent, short duration	Need to get tip up
4.				
5				
6.				
7.				

Solutions

Now think about:

- The tasks: lifting, carrying, placing
- Potential solutions for each
- Cost
- Benefit
- Barriers
- Implementation

Solution Analysis

Task	Potential Solutions	Cost	Benefit	Barriers	Implementation
Lifting ladder off truck	Alternative lightweight ladder				
Carrying the ladder					
Placing the ladder					

Questions and Evaluation

Thank you for your attention

Instructor Guide for Body Mechanics and Back Health

Title: Body Mechanics and Back Health

Date Developed: 4/2005

Number of Slides: 34

Time Required to Teach: 120 minutes with breaks

Materials/Resources Needed:
Body Mechanics PowerPoint presentation-electronic form or transparencies
Computer system with PowerPoint Software installed and if using electronic format, a projection system
Hard copies of PowerPoint for handouts
Copies of body mechanics handouts
Copies of endurance exercise handouts
Wooden dowels or yard sticks for practicing neutral spine posture

Objective: To provide information for fire/EMS personnel including:

1) Review of ergonomics definition
2) Review risk factors for musculoskeletal disorders
3) Overview of spinal anatomy and physiology
4) Tips for practicing good body mechanics
5) Trunk muscle symmetry and stability
6) Trunk endurance exercises
7) Ergonomics in the gym

Motivation: To reduce musculoskeletal injuries and enhance understanding of spinal anatomy and physiology. Body mechanics principles are a component of ergonomics that are readily available to line personnel and need to be practiced daily in order integrate them into all aspects of work and personal activity. Body mechanics along with and back-health practices help reduce the risk of sustaining a musculoskeletal injury.

Overview: This module contains the basic principles of spinal anatomy, physiology, body mechanics and trunk 'core' endurance exercises. It may be taught before or after other modules, however it should be taught after the introductory module so that workers have a basic understanding of ergonomics and injury risk factors*.

* many of the back injury prevention concepts were adapted from the book entitled "Low back disorders: evidence-based prevention and rehabilitation" by Stuart McGill.

Ergonomics for Fire and EMS Departments

Body Mechanics & Back Health

University of Oregon
Labor Education and Research Center

This material has been made possible by a grant from the Oregon Occupational Safety and Health Division, Department of Consumer and Business Services

LABOREGON LERC

Purpose: Introduce yourself and the title of today's topic: Body Mechanics and Back Health.
Emphasis: Acknowledge the sponsors listed on the slide. If you plan on teaching the other modules, you should comment that this is part of several classes. Other modules available in the "Ergonomics for Fire and EMS Departments" include: Introduction to Ergonomics (which should have been taught already), Ergonomic Hazard Analysis, Developing and Implementing Ergonomic Solutions, and Command Staff Ergonomics. This module is intended to be a **120-minute** course with a break.
Action Point: none.

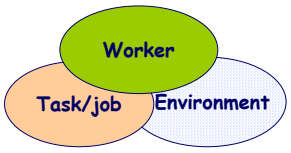
Today's Workshop

We will:

- Review ergonomics
- Practice body mechanics
- Talk about back health
- Introduce biomechanics
- Discuss muscle balance
- Stabilize the trunk

Purpose: To introduce the topics for the workshop.
Emphasis: This module is intended explain how to spare your back during any activity that you do. The class will cover a basic ergonomics review, back health, a brief introduction to the principles of biomechanics and how that applies to back health. Finally students will learn about muscle balance and this is important for trunk stabilization.
Action Point: Tell the class that this module is very participatory. They will be practicing body mechanics as well as trunk endurance exercises.

Review of Ergonomics

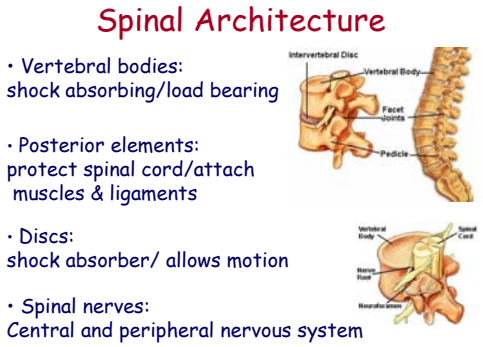


The goal of ergonomics is to design the job to fit the worker

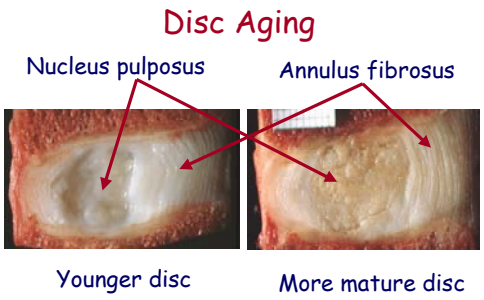
NOT make the worker fit the job.

Purpose: Review the definition of ergonomics.
Emphasis: Ergonomics is defined as the interaction between the worker, the task or job and the environment. It is important to stress that the goal of ergonomics adapting the workplace, rather than adapting the worker. The talk today is mostly going to be about the worker aspect and how body mechanics and back health are part of injury prevention. However, it is still important to understand that making changes to the task/job and to the environment are extremely important for risk reduction.
Action Point: none.

Purpose: Review risk factors for musculoskeletal injury.
Emphasis: Many activities commonly performed by fire/EMS personnel are risky. It is important to be aware of these risks and the fact that risk increases dramatically when: combining factors; over time; and when the intensity is great.
Action Point: Ask the group to name 3 risk factors for musculoskeletal injury before you show them the risk factors. Encourage them with a few examples if they do not remember why one risk factor is listed.

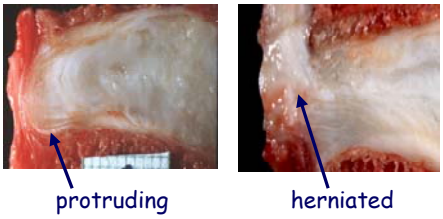


Purpose: Review spinal anatomy.
Emphasis: The spine is made up of four basics elements:
<u>Vertebral bodies</u> are the bony structures "stacked" to make up the spine. They absorb shock and also bear the load of the upper body.
<u>Posterior elements</u> are the bony structures posterior to the vertebral bodies that enclose the spinal cord. They include the pedicles and facet joints and serve as attachments for muscles and ligaments.
<u>Intervertebral discs</u> sit between the vertebral bodies. They allow motion, act as shock absorbers and facilitate movement.
<u>Spinal nerves</u> consist of 1) the spinal cord, which runs down the spine between the vertebral body and the posterior elements, and 2) the nerve roots, which exit the spine at the foramen between two vertebrae.
Two vertebrae and the disc between them make up what is called a 'motion unit', this is the basic unit of movement in the spine.
Action Point: none.



Purpose: To illustrate an aging disc.
Emphasis: Point out the nucleus pulposus. This is the center of the disc and it is a soft, phlegm like substance. The nucleus is surrounded by annulus fibrosus. The fibers of the annulus are oriented at 120 degrees from horizontal, which makes the disc able to resist great loads in the vertical or downward direction. This slide also shows the effect of natural aging – the disc becomes stiffer.
Action Point: none.

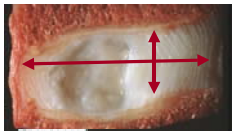
Damaged Discs



Purpose: To illustrate a disc with damage.
Emphasis: Point out the nucleus pulposus is displaced in these pictures. The picture on the left shows the nucleus is pressing against the annulus fibrosus into the tissues behind the disc. The picture on the right shows a herniated disc when the nucleus has pushed completely through the annulus. In the lower back these conditions can result in back pain, as well as pain and numbness that radiate down the back of the leg.
Action Point: none.

Disc Hydration

- There is a diurnal variation of hydration
- Most hydrated after laying down for several hours
- Associated with feeling stiff in morning



hydration will affect the shape of the disc

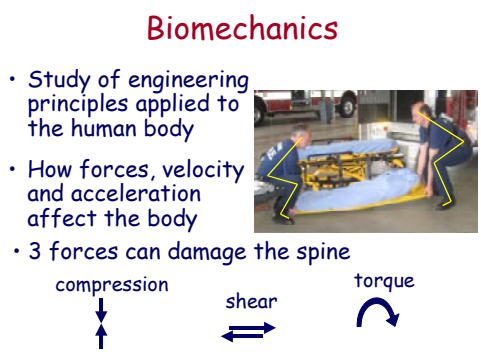
Purpose: Introduce the concept of disc hydration.
Emphasis: When one is standing the intervertebral discs are loaded with the body's weight and they compress. When we are supine or prone, such as during sleep, the discs are unloaded, they "fill" with surrounding fluids and rehydrate. This changes the space they take up between the vertebrae. The spine is actually longer after a night's rest because of the increase in the thickness of the disc. This may cause discomfort when flexing the spine after rising from bed due to the increased tension on the ligaments. Avoiding flexing (bending forward) first thing in the morning can reduce low back pain and reduce the risk of injury to the soft tissue of the back. This is an important concept for FF/EMS to remember since they can be awakened from sleep for emergency calls.
Action Point: Ask the class what does this mean? Can they keep the spine neutral during movements after rising? Allowing 20 – 30 minutes before flexing can help reduce your discomfort and injury risk.

Memory of the spine

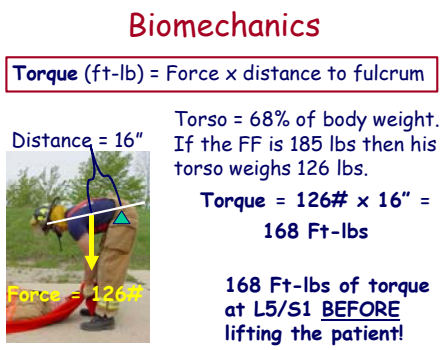
- After flexing for a long period
  - nucleus of the disc moves posterior
- They do not return to "normal" immediately.
- What to do:
  - Spend time standing upright
  - Keep lumbar region supported when seated
  - Gently extend the back

Purpose: Introduce the idea that discs and other soft tissues do not move right back into place after flexing.
Emphasis: After flexing for a long period time, like sitting or stooping for a prolonged period, the nucleus of the disc moves in the posterior direction and the posterior ligaments are stretched. These structures do not return to their normal state immediately when standing upright, therefore, the back is in a compromised state after standing. This can be avoided by: reducing flexion; using a lumbar support to maintain lumbar lordosis

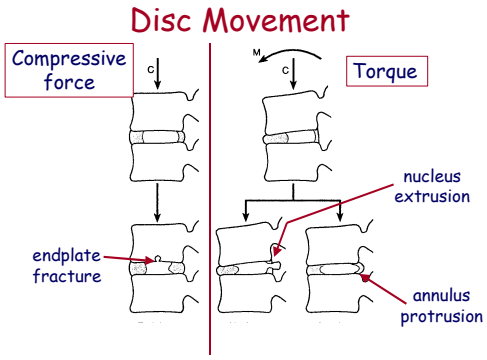
when sitting; spending time standing upright after flexing for long periods; and gently extending the back several times after rising from prolonged sitting or sleeping (this provides some negative pressure to get the nucleus back in place).
Action Point: none.



Purpose: Introduction to biomechanics.
Emphasis: Biomechanics is the study of engineering principles such as force, velocity and acceleration and how they affect the human body. This topic is important for understanding how the body remains healthy or becomes injured. High forces or weight applied to the spine can injure the discs and other elements of the spine. Three forces act on the spine and can cause injury. They are: Compression - The downward force on the spine in the vertical direction. The weight of your upper body constantly compresses your spine when you are standing upright. Shear - The force that acts in the horizontal direction, like sliding a piece of sandpaper across wood. These forces are important when you are bending forward (flexing) and creating a horizontally directed forces in the disc, pressing it posteriorly. Torque - The rotational or twisting force, like when using a socket wrench. It is important when you are bending forward, to the side or twisting, as you are creating a rotation about the point where you are bending.
Action Point: none.



Purpose: Explain affect of torque on the back.
Emphasis: The magnitude of force acting on the L5/S1 disc from the weight of your own torso is large; imagine what it is like when carrying a 200-pound patient. Going through this example, we can see that the weight of the torso (126 pound) multiplied by the distance from the center of the weight to the fulcrum (16 inches) gives us 168 ft-lbs of torque acting at the low back. If we add lifting a 200-pound patient the torque increases to 434 ft-pounds of torque on the L5/S1 disc. This torque is distributed to the bones, discs and soft tissues (muscles, ligaments) in the low back. The result of applying too much force is damage to these tissues, such as disc herniations, muscle strains and ligament sprains, and other overexertion type injuries. The point is that with these kinds of forces acting on the low back on a daily basis, damage is likely to occur. Practicing ergonomics principles is extremely important to eliminate or reduce these forces.
Action Point: none.



Purpose: To show how the disc changes/deforms as you move your body.

Emphasis: When a person is standing upright, the nucleus is evenly distributed across the vertebral body and the forces acting on the disc are uniformly dispersed, minimizing the risk of injury. A compressive force on the spine, such as the weight of the trunk, or when we lift a weight, results in a flattening of the disc. If this compression is excessive the endplate of the vertebrae can fracture and the disc "leaks" into the vertebrae. When flexing forward and/or twisting, torque and compressive forces are created, and the nucleus can be pushed or extruded posteriorly or laterally. With repeated flexion, especially when the spine is loaded with extra weight, like that of a patient or heavy equipment, the disc is at risk for herniation (what is sometimes incorrectly referred to as a "slipped disc"). This occurs when the outer annular fibers become weakened and tear, allowing the nucleus to move posteriorly into the spinal canal. This protrusion of the nucleus usually occurs in the posterior direction, since forward flexing is a very common posture. The result can be impingement of the nerves as they exit the spine, causing pain and numbness that radiates to the legs. Explaining how forward flexion and twisting postures can lead to disc damage is an important concept for spinal health and an understanding of the need to enhance ergonomics in the workplace. The less the disc is stressed over the lifetime, the less likely it is that sufficient damage will occur to the disc and result in an injury such as a disc herniation.

Action Point: Ask the class what measures they think would help reduce the risk of herniation? For example: reducing the number of times they flex forward or twist; reducing the duration they remain in a flexed position; and minimizing the forces they place on the spine.

Some Perspective…….

- NIOSH Guidelines:
  Load limit for lifting: 51 lb
  Spine compression force: 764 lb

- Spine compression forces for patient handling activities:
  - Pulling 105 lb patient (with bedsheet) from bed to stretcher: 832-1708 lb
  - Carrying 105 lb patient down stairs using stretcher: 1012-1281 lb

Purpose: Review occupational lifting and spine compression guidelines and put them in perspective.

Emphasis: Activities that firefighters perform every day are over-stressing their bodies. The National Institute for Occupational Safety and Health (NIOSH) has guidelines to protect workers. The weight limit they recommend for a worker to lift, under ideal conditions, is 51 pounds. In this case, the spine compression force is 764 pounds. Listed on this slide are two patient handling activities and the measured spine compression*. Lifting heavy weights eventually results in damage to muscles, ligaments, discs and vertebrae. The spine can accommodate these types of stresses a limited number of times but once a person exceeds that number damage WILL occur. Therefore ANYTHING they can do to reduce the stress will extend their body's health.

Action Point: Point out that many things handled by fire and EMS personnel – equipment and patients- exceed the guideline weight of 51 pounds and also the spine compression guideline. Ask the group if this surprises them. Does it make them think about the tasks they do and how they need to work towards improving them?

*Lavender, 2000

Why Body Mechanics?

Just as taking care of the engine makes it last and work when you need it.....

Taking care of your body means it will last until retirement and function when you need it!

Purpose: To begin discussing why body mechanics are important for injury prevention.
Emphasis: Worker's bodies are like any mechanical piece of equipment; it wears out and can eventually break, so it behooves us all to minimize the wear and tear. Workers need to care for themselves in order to be able to care for their families. If they become injured and disabled they will not be able to continue working as a firefighter/EMS personnel. Many cumulative trauma injuries don't occur until workers are in their late 30's or 40's. This is a time when they have families to support, mortgages to pay and need to save for retirement. It is the worst possible time to be off work or consider a career change.
Action Point: none.

What is Body Mechanics?

- Moving and using your body in the best way possible to prevent injury
- It should be part of every activity
- Good bodymechanics takes practice and awareness
- It is most important when no other ergonomic solutions are available

Purpose: Define body mechanics.
Emphasis: Body mechanics is NOT intuitive. Use of body mechanics, while protective against injury, may actually require more effort to perform. So, if workers don't practice it, it will not become second nature when they need it, in those frantic emergency situations. Therefore, it is important to practice the concepts daily and to review them occasionally. Body mechanics not only applies to fire and EMS jobs but also to working around the station and when at home. Emphasize that body mechanics are an ergonomic solution they have control over and can practice everyday. However, they should remember that body mechanics are the LEAST effective ergonomic solution and should only be used when no other solutions are viable.
Action Point: none.

Body Mechanics: Neutral Spine Posture

- The single most important aspect of body mechanics
- Neutral spine is the reason body builders can lift so much weight without injury

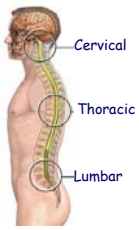
Purpose: Introduce the concept of neutral spine posture.

Emphasis: Neutral spine posture reduces stress to the bones, discs, muscles, and ligaments. Many disc herniations occur due to fracture of the vertebral endplate or protrusion of the disc. This can happen when the spine is overloaded or from repetitive overuse. Neutral spine posture distributes the load to the vertebrae evenly and reduces the chance of injury. The picture in the upper right shows how, with a neutral spine, weightlifters are able to lift large amounts of weight without injury. Neutral spine is the position where the spine is most stable, balanced, and least likely to be injured. The reason the lumbar lordosis is so important is that this part of the spine bears most of the body's weight, plus the weight of whatever load is being lifted. Management and prevention of back pain begin by understanding and utilizing neutral spine posture. Three natural curves are present in a healthy spine. The cervical lordosis is convex anteriorly. The thoracic spine is convex posteriorly, called a kyphosis, while the lumbar spine is again a lordosis. Neutral spine is important in helping to cushion the spine from the stress and strain associated with lifting. Learning how to maintain a neutral spine position also helps workers to move safely during activities like sitting, walking, and lifting. The abdominal muscles work alone, or with the hamstring muscles to produce posterior rotation of the pelvis, causing flattening of the lumbar lordosis, loss of lordosis, instability and slouching posture. If the hip flexors shorten and the back extensors contract the superior aspect of the pelvis is rotated anteriorly - increasing lumbar lordosis resulting in 'sway back'.

Action Point: Ask the group which posture on the bottom of the picture they are likely to assume? Ask whether they can they see the difference in the lumbar curve in these two pictures.

Neutral Spine Posture

- 3 Curves make your spine strong
- The loss of these curves means the back is less strong and stable and more prone to injury
- It is important to KEEP THESE CURVES when moving, bending and lifting
- The lumbar lordosis is the most important curve to maintain



Purpose: Explain neutral spine posture.

Emphasis: Neutral spine reduces stress to the bones, discs, muscles, and ligaments. Many disc herniations occur due to fracture of the vertebral endplate. This can happen when the spine is overloaded. Neutral spine posture distributes the load to the vertebrae and reduces the chance of an end fracture or disc herniation. Neutral spine is the place where the spine is most stable and least likely to be injured. The reason the lumbar lordosis is so important is that this part of the spine bears most of the body weight plus the weight of whatever load is being lifted and carried.

Action Point: none.

Practice Neutral Spine

- Place a yard stick along your spine
- With one hand feel the hollow of your lumbar lordosis
- Rock the pelvis slightly anterior and posterior
- Feel the lordosis increase and decrease
- Find your 'sweet spot' – this is your neutral spine

Purpose: To practice neutral spine rather than just talk about it.

Emphasis: Many people have lost the conscious ability to rock the pelvis and alter the lordosis. Tell the group it is like dancing, to move the pelvis anteriorly arch the back, to move it posteriorly, flatten the back and feel the lordosis disappear. Some individuals may have lost their natural lordosis. This may be due to tight muscles, such as the hamstrings, which pull the pelvis down. The opposite may also be true; people may develop too much lumbar curve or sway back. This happens when the psoas and low back erector spinae muscles become to tight or the abdominal muscles become weak. The psoas muscle attaches to the anterior aspect of all lumbar vertebrae and inserts on the greater trochanter. The erector spinae run along either side of the spine and assist with trunk flexion and extension.

Action Point: Practice neutral spine postures with forward bending. Have them work in pairs and use a cane, dowel, or a yardstick that you supply.

1.) Instruct one person in each group to place the stick along their partner's spine.

2.) Have them bend at the waist as if to pick a pencil off the floor, keeping the hips and knees straight. They should notice that the lordosis disappears. The head will come forward when they do this.

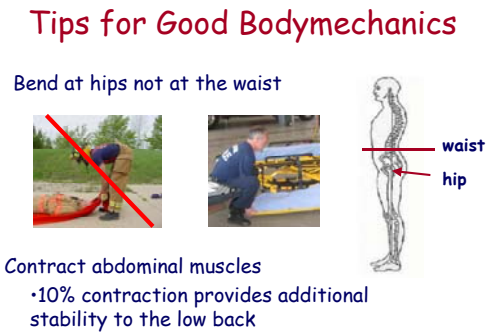
3.) Now, have them repeat the movement but bend ONLY at the hips (not the waist) and notice that the lordosis is maintained. The top of the stick should stay in contact with the back of the head when neutral spine is practiced. The bottom of the stick rests against the sacrum or tailbone. If they have a lordosis, they should notice a small gap or arch in their low back large enough to slide the edge of the hand between the stick and the spine. Have them practice a few "straight back" forward bends.

4.) Add the important aspect of bending at the knees (to use the strong thigh muscles), have them bend at the hips first, and then squat. Suggest they stagger their feet; their legs should be shoulder width apart. They may need to come onto their toes if they have tight calf muscles. They should consciously push their buttocks posteriorly and exaggerate the posture of arching the lumbar spine.

5.) Next, have them practice maintaining their lordosis using the squat posture while picking up a chair or some other light object in the room.

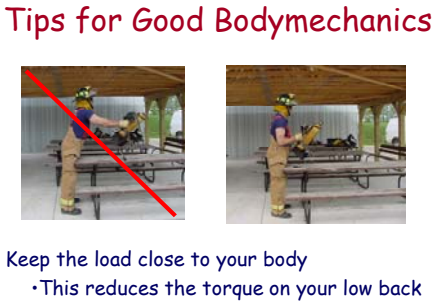
6.) Plan to spend up to 15 minutes on this exercise.

While lifting with the legs is important, there are situations where there is not enough room to fully squat. Yet, even when one has to bend, it is possible to do this while maintaining the lordosis in a neutral position if one bends at the hips rather than at the low back. This is not intuitive which is why it is important to practice the posture and get to know how it feels. With practice and awareness, bending at the hips and squatting from the knees become one motion and feel more natural. Practicing proper bending while maintaining neutral spine will protect the back and reduce the risk of back pain or injury during activities of daily living.



Purpose: Discuss body mechanic tips.
Emphasis: There is a handout for body mechanics. Remind the group to bend the knees and hips and to not bend at the waist. Bending at the waist removes the natural curve of your low back. Also, slightly contracting the stomach muscles can add substantial stability to the back. This is something they can do when they are doing any activity.
Action Point: They should understand the concept of bending at the hips rather than the waist from practicing neutral spine posture. Another important concept is bracing the abdominal muscles to increase the stability of the trunk. To do this they need only to isometrically (no movement) contract the abdominal muscles 10%. One-way to demonstrate this is to have the class contract these muscles maximally. Once they feel a maximum contraction, instruct them to imagine and try a 10% contraction. Point out that this bracing of the abdominal muscles is different than hollowing the stomach. They are not "sucking" in their stomach but rather minimally contracting the muscles.

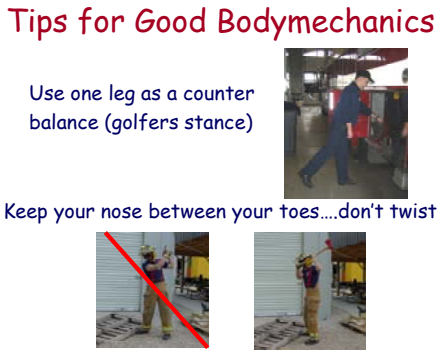
Purpose: Illustrate good body mechanics tips.
Emphasis: Wide base of support or staggered stance is important for preventing loss of balance.
Action Point: Have the class stand with their feet together and try to bend forward; you might even give a few people a gentle backward tap to demonstrate how easily you can push them off balance. Then have them stagger their feet, maintaining to demonstrate how much more stable they are when they maintain a wide base of support. Also, point out that with staggered feet they can transfer their body weight forward or backward by shifting their weight on their feet. This could be used to their advantage when moving heavy items as they can use their body weight to help.



Purpose: To illustrate good body mechanics.
Emphasis: Torque on the low back is the twisting or bending force. Sufficient torque damages ligaments, tendons and discs. Explain to the class that keeping the load away from their low back increases the torque on their back and can lead to injury. It also makes the weight feel much heavier. By bringing loads close to

their body, they are decreasing the weight, torque and overall stress to the low back. An example is to ask them to consider how long they could hold a 10-pound bowling ball with their arms stretched out in front of them. Then, ask them to consider how long they could hold the same ball if it was near their chest. This example illustrates the fatiguing effect of torque. This fatigue can cause damage and injury.

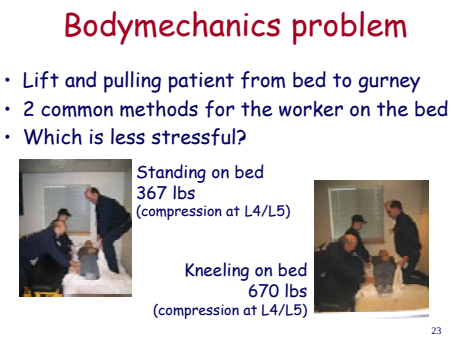
Action Point: Ask the class which posture is more advantageous and why? Ask them how they can use this information. Are there times when they can scoot or slide patient or other items closer to their body before lifting?



Purpose: To illustrate good body mechanics.

Emphasis: These activities reduce the stress on the low back. Using the golfer's pose, with one foot extended behind, one leg is used as a counter balance for the torso; this reduces the stress to the low back. Notice how golfers do this even when picking up a tee – even though it is light, since they do this frequently, they have learned how to spare their back. Tell the class to 'keep their nose between their toes,' this keeps their spine from twisting, another posture that places their back at risk for injury. Twisting is dangerous when you are applying force to your back. These pictures show how swinging an axe is changed from twisting the spine, when the FF is swinging across his body, to not twisting, when the firefighter swings from above downward. This is also important when they are moving a load. They should always move their feet to keep their nose between their toes, instead of twisting their spine.

Action Point: Ask the class for examples where they might be able to practice these good body mechanics tips. For example, with the golfer's stance, when they pull equipment from the vehicles, could they do this? What are activities when they might have to twist, could they think of how to do it without twisting? An example might be when they are pulling hose from a truck or engine. Instead of pulling and twisting as they step down from the vehicle, is there another way it could be done? What about when they handle patients? When using certain equipment walking down stairs, do they twist to see where they are going? How could this be corrected?



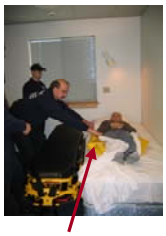
Purpose: To provide an example of stresses placed on the back and an alternative.

Emphasis: The less stressful technique for the low back is standing on the bed according to the spine compression values estimated at the L4/L5 (Lavender, 2000). Use the less stressful transfer technique whenever possible.

Action Point: Ask the group whether there are times when the less stressful transfer technique could be used and is not. Why not?

Even Better…

- Use a lateral transfer aid to decrease the friction so the patient slides easier.
- Eliminates the need for a person to be on the bed to help move the patient to the gurney.



Lateral transfer aid

24

Purpose: To provide an example of an effective ergonomic solution.
Emphasis: The use of a friction-reducing device can make the lateral transfer of a patient much easier. It reduces stress to the low back and the need for a person on the bed, which is THE most stressful job in a lateral transfer.
Action Point: Start a discussion about the practicality of using a lateral transfer device.

Back Injury Prevention

- ✓ Avoid forward bending first thing after waking
- ✓ Vary work/tasks
- ✓ Avoid lifting with a fully flexed spine
- ✓ Keep all motions and lifting close to body
- ✓ Use techniques to minimize weight of load being handled

25

Purpose: Tips for back injury prevention*.
Emphasis: This is a summary of all the points we have made in the previous slide as well as some "common sense" tips that are good to emphasize. Go through the list. Remind the class why each is a tip for back injury prevention. For example:
1.) Avoid forward bending first thing after waking. This is because of the hydration of the disc as you lay down to sleep, which increases the pressure and stress to the discs immediately upon rising. Vary work/tasks. This keeps the back moving, reducing the time spent in awkward and prolonged postures.
2.) Avoid lifting with a fully flexed spine. Remember how great the torque is on the spine when only the torso is being lifted! Keeping the spine neutral when lifting is safest for the back.
3.) Keep all motions and lifting close to the body. Remember torque = force x distance from the load to the fulcrum, so the closer the distance, the less torque is being placed on the back.
4.) Use techniques to minimize weight of load being handled. Lifting only one side of something heavy at a time is a way to reduce the load lifted. An example of this is when they place the gurney into the medic unit. Usually they will put the "head" of the gurney in, therefore putting part of the weight on the vehicle, and then lifting the "feet".
Action Point: For each item on the list, brainstorm with the class on how they can incorporate the tips into their work. Coax them to come up with examples.

* McGill, 2002

Back Injury Prevention

- ✓ Allow equalization of your disc after prolonged sitting or stooping
- ✓ Stabilize spine, even during light tasks
- ✓ Reduce twisting torque
- ✓ Avoid prolonged sitting
- ✓ Provide protective clothing to foster good bodymechanics
- ✓ Reinforce good motor patterns

"practice makes permanent"

Purpose: Tips for back injury prevention (continued) * .

Emphasis: This is a summary of all the points we have made in the previous slide as well as some "common sense" tips that are good to emphasize. Go through the list. Remind the class why each is a tip for back injury prevention. For example:

1.) Allow equalization: Vertebral discs have memory and do not automatically go back into neutral position.

2.) Stabilize Spine: A very light contraction even when they are doing light tasks can help stabilize the spine.

3.) Reduce twisting torque: Remind them to keep their nose between their toes to reduce twisting effects on the back.

4.) Avoid prolonged sitting: Sitting = flexing the back. Tell them "If you must sit for long periods of time, take breaks and get the lordosis back!"

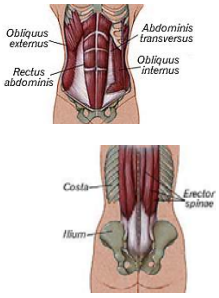
5.) Provide protective clothing: Sometimes they might keep loads away from their body because they do not want to touch the load, whether it is a patient who has vomited or dirty fire equipment. If there is a barrier between the load and the worker's clothes, even a sheet, this might allow workers to get closer, reducing the stress on their back.

6.) Reinforce good motor patterns: Just as an athlete practices the same motion over and over so he can "groove" the motor pattern, you must practice neutral spine and other good bodymechanics.

Action Point: For each item on the list, brainstorm with the class on how they can incorporate the tips into their work. Coax them to come up with examples.

* McGill, 2002

Healthy Back Muscles



Endurance

Symmetry

Tone

Strength

Flexibility

Purpose: Look at the many dimensions of the back and types of exercises needed to maintain a healthy back.

Emphasis: To have a healthy back, it is important to ensure the back muscles are healthy. Often strengthening the back muscles is thought to be most important but other aspects of fitness are more important for injury prevention. Definitions of the terms:

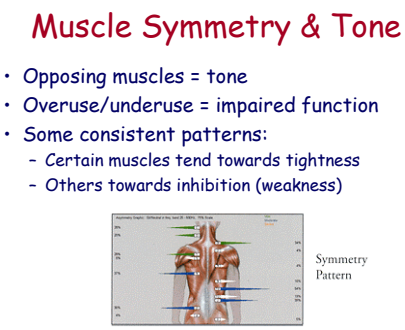
Endurance: ability to maintain a submaximal force for a period of time. **Symmetry:** making sure the opposite muscle groups have equal tone, strength and flexibility. **Strength:** maximal one-effort force. **Tone:** the small amount of contraction to maintain firmness while at rest. **Flexibility:** the functional ability of joints to move through a

full range of movement. Several points should really be emphasized here – these are backed by the following references:

1. Flexibility does not prevent injury. Studies on workplace stretching programs are inconclusive (Hess 2003) and not associated with reduction in sports injuries (Thacker, et al. 2004).

2. Muscle endurance has been shown to be protective to the low back. Good isometric *endurance* of back muscles may prevent first-time occurrence of low back pain and men with hypermobile (very flexible) backs are more likely to develop low back pain (Biering-Sorensen 1984). Muscular *endurance*, not strength is protective (Luoto 1995).

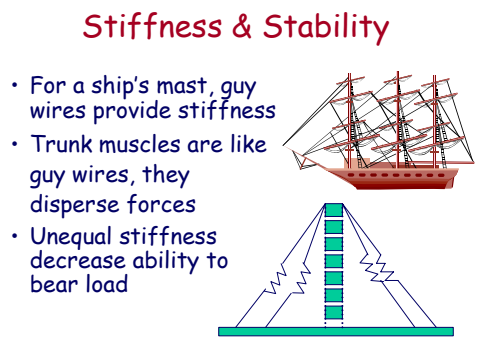
Action Point: Ask the group if they are familiar with all of these concepts. If not, take time to discuss them. The Endurance and Symmetry will be explained further in future slides so move on if they ask about these.



Purpose: Introduce the concept of muscle balance and symmetry and its importance to maintaining a healthy spine.

Emphasis: Certain muscles tend to become tight, while others tend to become weak. Tight muscles are 1/3 stronger than weak ones, creating imbalances. This also results in uncoordinated, inefficient movement. So, stretch these tight muscles: upper trapezius, levator scapulae, pectoralis major, lumbar erector spinae, psoas, and hamstrings. Then strengthen the muscles that tend to become weak: abdominals, gluteus maximus, lower scapula stabilizers (rhomboids, lower trapezius), and scalenes.

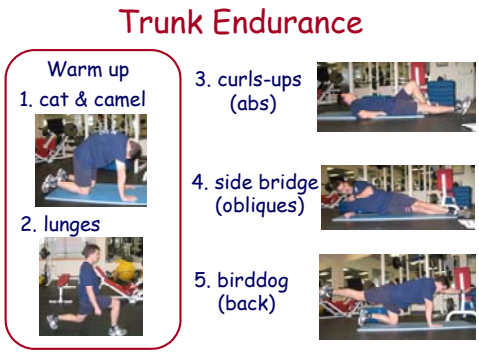
Action Point: Use an activity to illustrate an example of weak muscles. Have them pull their shoulder blades downward and together. Many will find this difficult to do because the rhomboids and lower trapezius muscles that perform this action may be weak. Instruct them do 10 repetitions as a break and to illustrate the point.



Purpose: To explain the role of trunk muscles in spine stability.

Emphasis: Just as the wires on a ships mast keep it stable under the loads of the sails and wind, the trunk muscles act much in the same way to keep the spine stable when you move and lift. This slide should re-iterate the importance of muscle balance to maintaining a healthy back. The trunk muscles include the abdominals, the abdominal obliques and the erector spinae. The natural curves of the spine are the result of these muscles, ligaments, and tendons that attach to the vertebrae of the spine, the pelvis and the ribs. Without these supporting structures, the spine

would collapse. They support the spine - much like guide wires support the mast of a ship. Controlling pelvic tilt is one way to begin helping to balance and stabilize the spine. As certain muscles of the back and abdomen contract, the pelvis rotates. As the superior aspect of the pelvis rotates forward, the lumbar curve increases. As the superior aspect of the pelvis rotates backward, the lumbar lordosis decreases or flattens. Rotation of the pelvis is like a wheel centered at the hip joint. The muscles of the upper thighs also attach to the pelvis and contraction of these muscles can be used to change the curve of the spine.
Action Point: none.



Purpose: To demonstrate some exercises to promote trunk stabilization*.
Emphasis: Use caution when showing exercises to the group! Only demonstrate these if you feel comfortable doing so and restrict participation to those without a current back injury. Warn participants that if they are uncomfortable performing any of the following exercises or feel any pain, they should stop immediately and consult their physician. Emphasize that these are endurance exercises, not strength exercises. This may feel unusual compared to other exercises they are used to performing. The point of these is to increase the endurance capabilities of the muscle groups that will help stabilize the trunk and spine. All of the endurance postures are designed to keep the spine neutral while they hold the contraction for as long as possible, therefore building up endurance. Since these are not strength exercises, they should be done daily.
Action Point: There is a handout summarizing these exercises. This activity may take 20 – 25 minutes. Have the group spread out on mats to practice the exercises. To properly build trunk endurance, the first step is to warm up. The first two exercises are excellent for this. Demonstrating the side bridges is an excellent example of endurance and balance. After showing the class how to correctly do the side bridge, have the group time themselves on the right side, then on the left, holding the position for as long as they can.
<u>1. Cat/Camel motions</u>
This exercise is meant to warm up the back through motion; <u>it is not a stretch so do not "push"</u> at the end ranges of the motion. It is used to reduce the spine viscosity.
-Get on all fours like a cat, hands below shoulders and knees below hips
-Inhale, rounding back upwards while bringing neck down
-Exhale and slump back down and raise head
-Perform slowly; each repetition should take about 3-5 seconds in each direction
-Repeat each side 3 to 5 times
<u>2. Slow lunges</u>
This exercise is meant to achieve knee and hip endurance and mobility.
•Stand upright, with spine neutral
•Slowly lunge one foot out in front, both legs should be bent
•Your front leg's knee should not be past your foot and not less than 90°

•You should be up on the toe of the rear foot
•Hold for 3-5 seconds
•Return to upright posture, repeat with opposite leg
•Repeat 3-5 times

3. Curl-ups

These exercises are for the rectus abdominis (your midline abdominal muscles). There are different variations of this; the basic one is described below.

•Lay on your back
•Place hands below lower back, supporting the lumbar region
•One leg should be bent 90°, other leg relaxed
•Your neck is a rigid line with the spine (no chin tucking or poking)
•Hold your tongue on roof of mouth behind front teeth
•Flex from the mid back, lifting the head and shoulders a few inches off the floor
•Hold 20-30 seconds, or longer
•Repeat 3-5 times

4. Side bridge

There are variations of the side bridge for the lateral obliques, transverse abdominis, and quadratus lumborum. Abdominal bracing is important.

•Lie on side supporting torso with elbow
•Place the top leg slightly in front of the bottom so that the sides of both feet are touching the floor (the top foot in front of the bottom)
•Place the top arm across the chest holding onto the opposite shoulder for bracing
•Straighten torso until the body is supported only by the elbow and feet and is in a straight line
•Hold as long as possible
•Once each side

5. Birddog

This exercise is for strengthening the back extensors. Abdominal bracing is also important for control and stability.

•Get on all fours like a cat, hands below shoulders and knees below hips
•Keep spine neutral by bracing the abdomen
•Raise one arm forward and the opposite leg backward, keeping the hips and shoulders level and spine neutral
•Hold for 20-30 seconds
•Repeat 5 times each side

* McGill, 2002

Body Mechanics in the Gym

- Labile surfaces (exercise balls)
- Training with equipment and machines usually isolates the joint
- Roman chair imposes twice the load as the birddog since both sides at once
- Avoid equipment that starts with back in flexed position

Purpose: To talk about how body mechanics and ergonomics apply to working out in the gym*.

Emphasis: Review each point below.

Exercise balls: These are great if they can stabilize their back while they do the exercises. Stress that they must be able to properly stabilize the trunk and keep their spine in

neutral posture. They should not compromise form in order to perform the exercises.

Isolating the joint: This is not a natural motion and does not mimic what the body experiences in "real" life.

Roman chair: Since they are contracting their back muscles at the same time in the Roman chair; they are placing twice as much force (from their own contraction) on their spine. Instruct them to not flex their back on the roman chair; this places the force on the back while in a flexed position, which can lead to injury.

Flexed position: Again, suggest they "refrain from doing exercises that flex your back". Repeatedly flexing the back increases the risk of damage and subsequent injury.

Action Point: Prompt the group to discuss these points and how they can apply them to their work out.

*McGill, 2002

Body Mechanics in the Gym

- Leg press rack – place one leg down
- Cable pull down – lower weight to chest instead of back
- Spine stability when breathing heavy
  - exercise bike to elevate breathing, then dismount and adopt the side bridge.
- Aerobic activity is good.

Purpose: To talk about how body mechanics and ergonomics might apply to working out in the gym.

Emphasis: Review each point below.

Leg press rack: When the weight is lowered the lumbar curve is lost. Suggest that they lower the amount of weight to be lifted and place one leg on the floor in order to maintain the lumbar curve. (top picture)

Cable pull down: Suggest they pull the weight to their chest instead of to their back. They can even face the machine if they can keep their feet on the ground while pulling down the weight (bottom picture).

Spine stability when breathing heavily: Firefighters may be in situations where their breathing rate is increased. It is important to "train" the trunk stabilizers to engage even with heavy breathing. Suggest they try getting off cardio equipment and assuming the bridge pose to see how well they can maintain the pose under heavy breathing conditions.

Aerobic activity: Activity is good for many reasons and it is also very good for the back.

Action Point: Prompt the group to discuss these points and how they can apply them to their work out.

Conclusions

- Proper bodymechanics –even for small tasks
- Neutral spine is key!!
- Stabilizing your spine can help you prevent injury – endurance
- Pursue other ergonomic solutions

Purpose: Brief review of important points.
Emphasis: Review the main points of the workshop. Remind them that body mechanics should be practiced regularly and at all times – even when getting something out of the oven. A big part of body mechanics is keeping the spine neutral – even in the gym. Trunk stabilization is the key to injury prevention and endurance protects them the most, not absolute strength. Stress that they should remember to pursue other ergonomic interventions such as proper equipment and engineering controls and administrative controls.
Action Point: none.

Questions and Evaluation

Thank you for your attention

Purpose: To answer questions not addressed during the talk.
Emphasis: Feedback will help you to know what other modules should be taught or how the training can be improved.
Action Point: Take any questions and have the class fill out evaluation forms.

Basic Bodymechanics

The following tips are basic body mechanics. Remember these when you do any activity. They may not come naturally so you will have to practice!

Use a wide base of support. Stand with your feet shoulder width apart with one foot a half step ahead of the other (stagger your feet). This not only provides a strong base of support, but you can shift your weight from one foot to the other to help move things.

Keep your back in a neutral posture. Maintain your back's natural curves to minimize the risk of injury. Muscles that support your back work optimally in this position and your back is most stable.

Gently contract your stomach muscles when you lift. Gently tightening your stomach muscles helps stabilize the low back to lift without injury.

Bring the weight close to your body. A heavy object that is held close to your body is easier to carry. There is less weight on your back and less stress on your back muscles.

Bend at the hips and lift with your legs. The muscles of your legs are stronger than your back and should be used for lifting. So, when you lift something that is below your waist, bend at the hips (and knees if necessary), keep the back in neutral posture and your legs will be doing most of the work.

Adjust the height you are working at when possible. Raise objects to waist height instead of working on them at floor level or lower objects to waist height instead of working on them at shoulder level.

To turn, move your feet (keep your nose between your toes). If you turn without moving your feet you are twisting your back. Twisting causes wear and tear on your discs, which can raise the risk of injury.

Plan your lift or move and test the load. This way you won't be caught by surprise by a heavy load or an awkward posture.

Push instead of pull. Pushing makes use of stronger muscles in the legs and back. Be sure to keep your spine in neutral posture DO NOT round the back.

Use one leg as a counter balance. When you bend forward to lift something light or to move something, if you have something to hold onto you can maintain neutral spine and raise one straight leg behind you as a counter balance. This balances the load to your spine and spares your back.

This page is intentionally blank.

Trunk Stabilization Exercises

Recommended exercise sequence for trunk stabilization: Do these every day! (McGill, 2002)

1. Cat/Camel motions:
This exercise is meant to warm up the back through motion; it is not a stretch so do not "push" at the end ranges of the motion. It is used to reduce the spine viscosity.

- Get on all fours like a cat, hands below shoulders and knees below hips.
- Inhale, rounding back upwards while bringing neck down.
- Exhale and slump back down and raise head.
- Repeat for 6 cycles

2. Slow lunges
This exercise is meant to achieve knee and hip endurance and mobility.

- Stand upright, with spine neutral
- Slowly lunge one foot out in front, both legs should be bent
- Your front leg's knee should not be past your foot and no less than 90°
- You should be up on the toe of the rear foot
- Return to standing upright, repeat with other leg
- Hold 3 – 5 seconds
- 3 – 5 repetitions

3. Curl-ups
These exercises are for the rectus abdominis (your anterior abdominal muscles). There are different variations of this; the basic one is described below.

- Lay on your back
- Place hands below lower back, supporting the lumbar region
- One leg should be bent 90°, other leg relaxed
- Your neck is a rigid line with the spine (no chin tucking or poking)
- Hold your tongue on roof of mouth behind front teeth
- Bend at thoracic region of back to barely lift the head and shoulders off the floor
- Hold 20-30 seconds, or longer
- 3-5 repetitions

4. Side bridge
There are variations of the side bridge for the lateral obliques, transverse abdominis, and quadratus lumborum. Abdominal bracing is important.

- Lie on side supporting torso with elbow
- Place the top leg slightly in front of the bottom so that the sides of both feet are touching the floor (the top foot in front of the bottom).
- Place upper arm across chest; hold onto the opposite shoulder to brace.
- Straighten torso until the body is supported only by elbow and feet and is in a straight line.
- Hold as long as you can
- 1 repetition each side

5. Birddog
This exercise is for the back extensors. Abdominal bracing is important.

- Get on all fours like a cat, hands below shoulders and knees below hips.
- Keep spine neutral by bracing the abdomen.
- Raise one arm forward and the opposite leg backward, keeping the hips and shoulders level and spine neutral.
- Hold 20 seconds
- 3 – 5 repetitions each side

Ergonomics for Fire and EMS Departments

Body Mechanics & Back Health

University of Oregon
Labor Education and Research Center

This material has been made possible by a grant from the Oregon Occupational Safety and Health Division, Department of Consumer and Business Services

LABOREGON
LERC

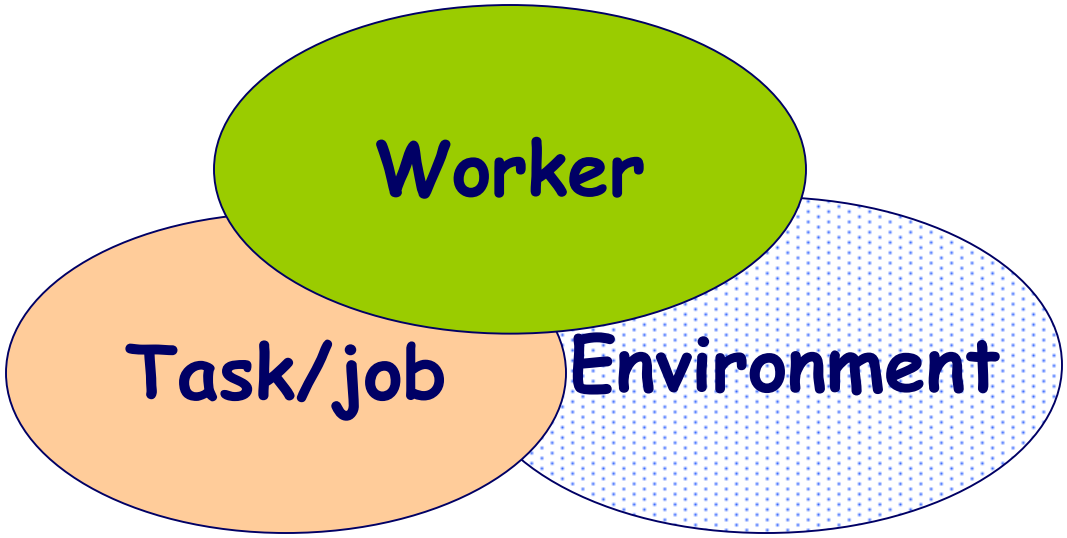
UNIVERSITY OF OREGON

Today's Workshop

We will:

- Review ergonomics
- Practice body mechanics
- Talk about back health
- Introduce biomechanics
- Discuss muscle balance
- Stabilize the trunk

Review of Ergonomics



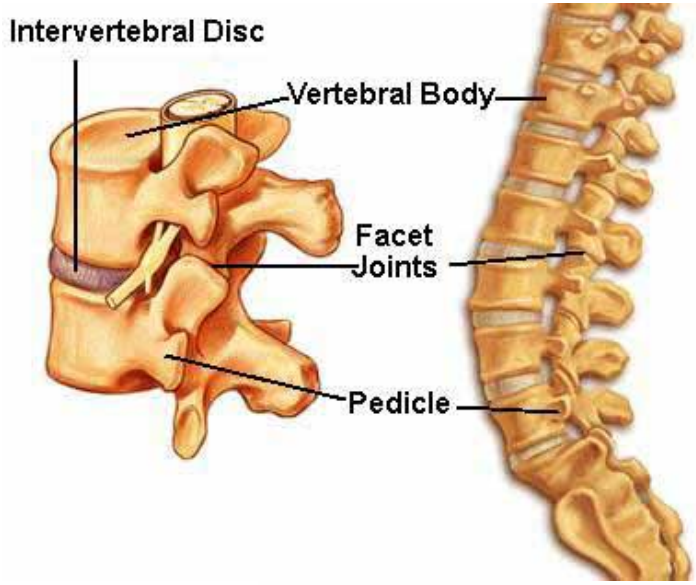
The goal of ergonomics is to design the job to fit the worker

NOT make the worker fit the job.

Musculoskeletal Risk Factors

- Excessive force/weight (pulling, lifting)
- Awkward postures
- Repetition
- Prolonged postures
- Temperature extremes
- Direct pressure
- Poor work organization

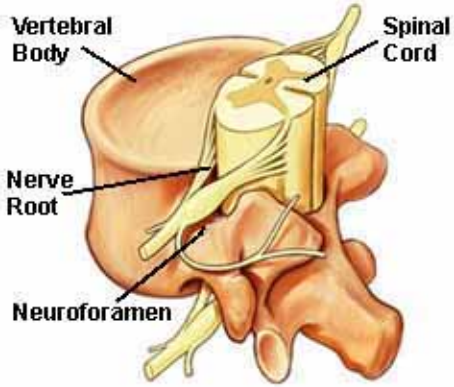
Spinal Architecture



- Vertebral bodies:
shock absorbing/load bearing

- Posterior elements:
protect spinal cord/attach muscles & ligaments

- Discs:
shock absorber/ allows motion

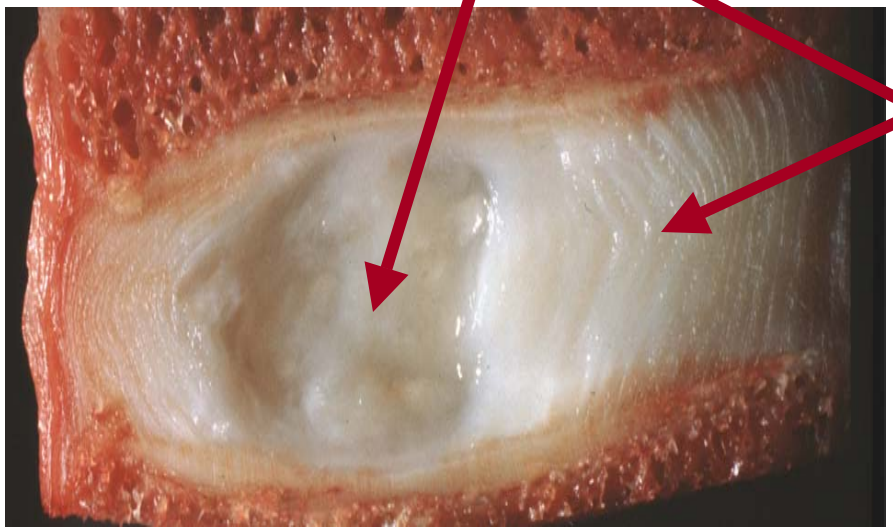


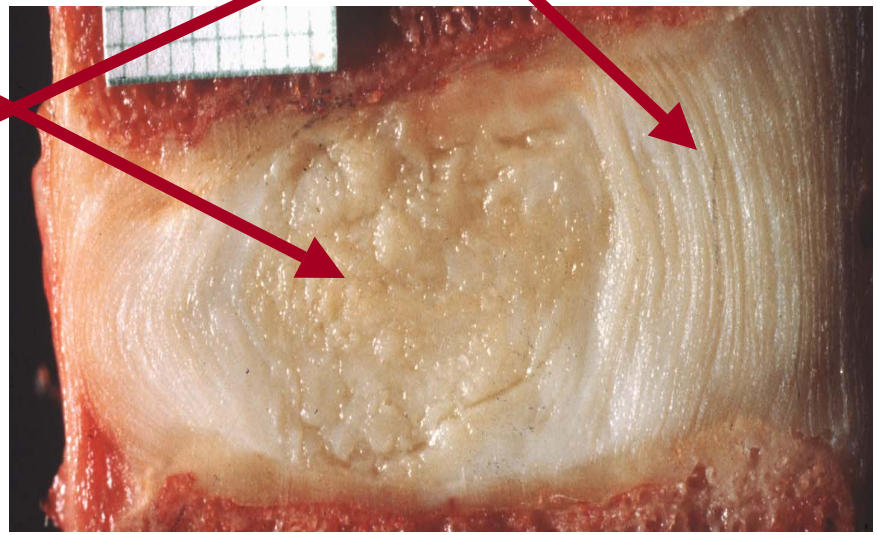
- Spinal nerves:
Central and peripheral nervous system

Disc Aging

Nucleus pulposus

Annulus fibrosus

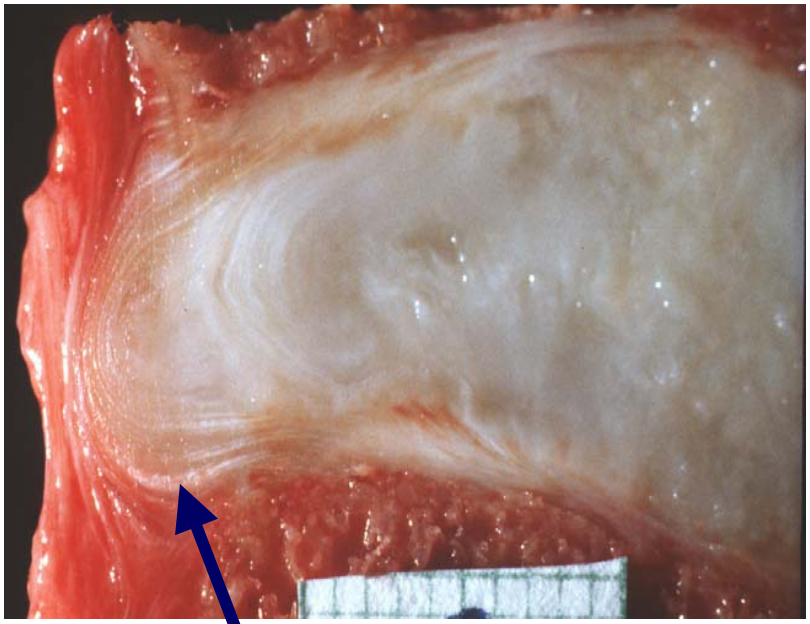




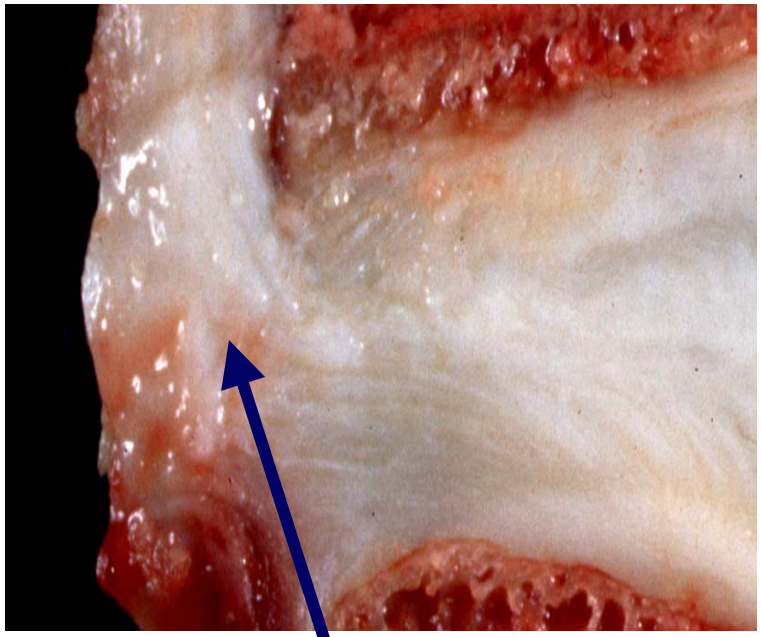
Younger disc

More mature disc

Damaged Discs



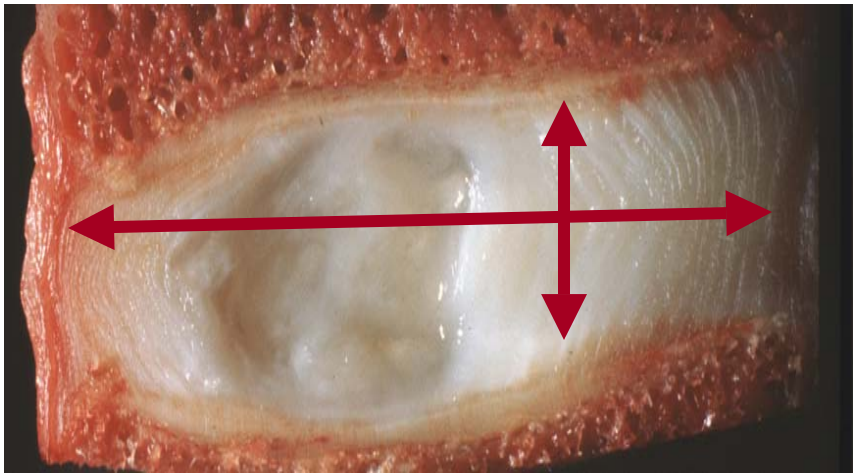
protruding



herniated

Disc Hydration

- There is a diurnal variation of hydration
- Most hydrated after laying down for several hours
- Associated with feeling stiff in morning



hydration will affect the shape of the disc

Memory of the spine

- After flexing for a long period
  - nucleus of the disc moves posterior
- They do not return to "normal" immediately.
- What to do:
  - Spend time standing upright
  - Keep lumbar region supported when seated
  - Gently extend the back

Biomechanics

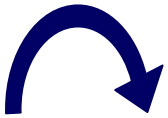
- Study of engineering principles applied to the human body
- How forces, velocity and acceleration affect the body

- 3 forces can damage the spine

compression

shear

torque



Biomechanics

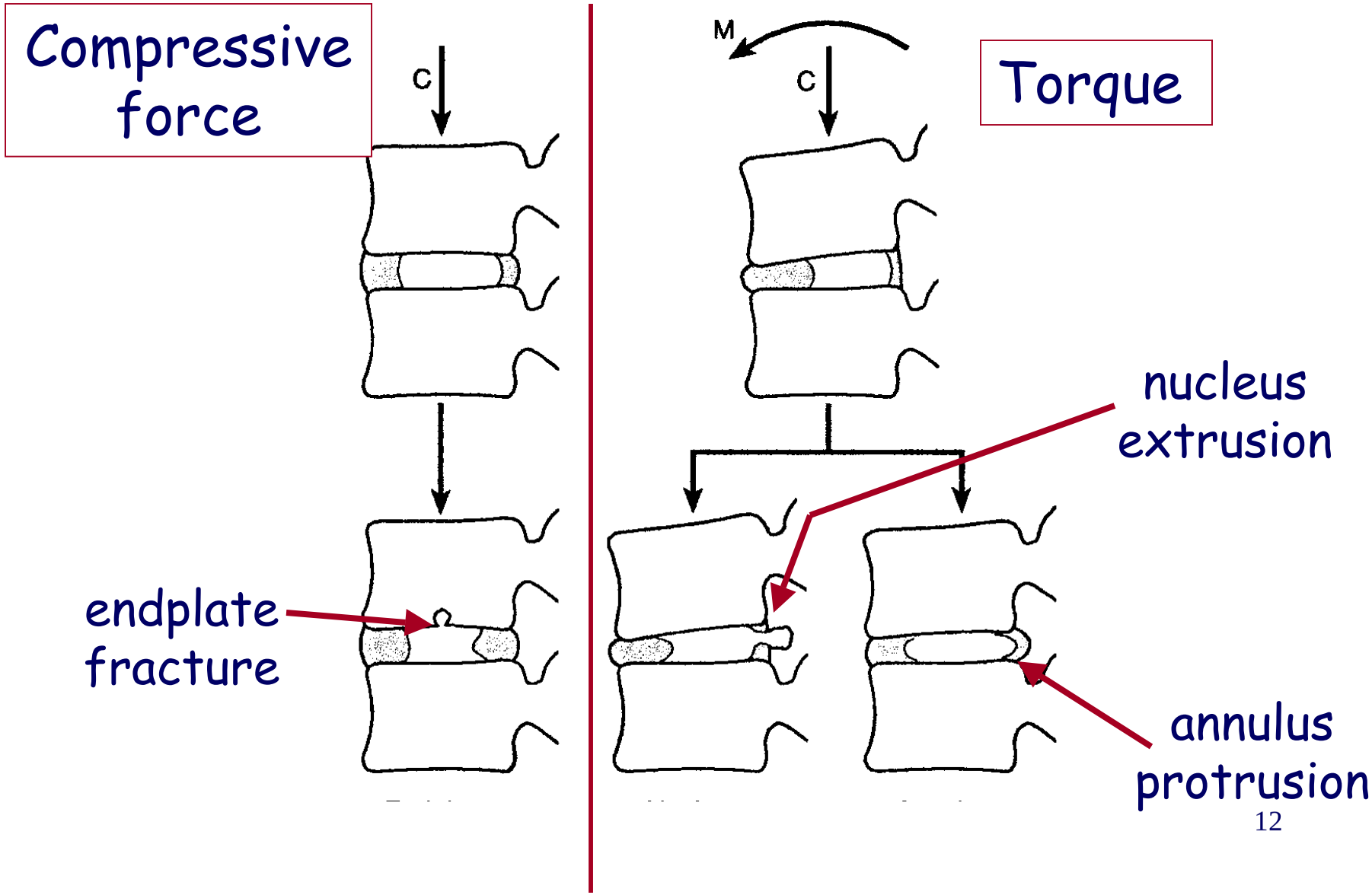
Torque (ft-lb) = Force x distance to fulcrum

Torso = 68% of body weight. If the FF is 185 lbs then his torso weighs 126 lbs.

Torque = 126# x 16" = 168 Ft-lbs

168 Ft-lbs of torque at L5/S1 <u>BEFORE</u> lifting the patient!

Disc Movement



Some Perspective…….

- NIOSH Guidelines:
  Load limit for lifting: 51 lb
  Spine compression force: 764 lb

- Spine compression forces for patient handling activities:
  - Pulling 105 lb patient (with bedsheet) from bed to stretcher: 832-1708 lb
  - Carrying 105 lb patient down stairs using stretcher: 1012-1281 lb

Why Body Mechanics?

Just as taking care of the engine makes it last and work when you need it…..

Taking care of your body means it will last until retirement and function when you need it!

What is Body Mechanics?

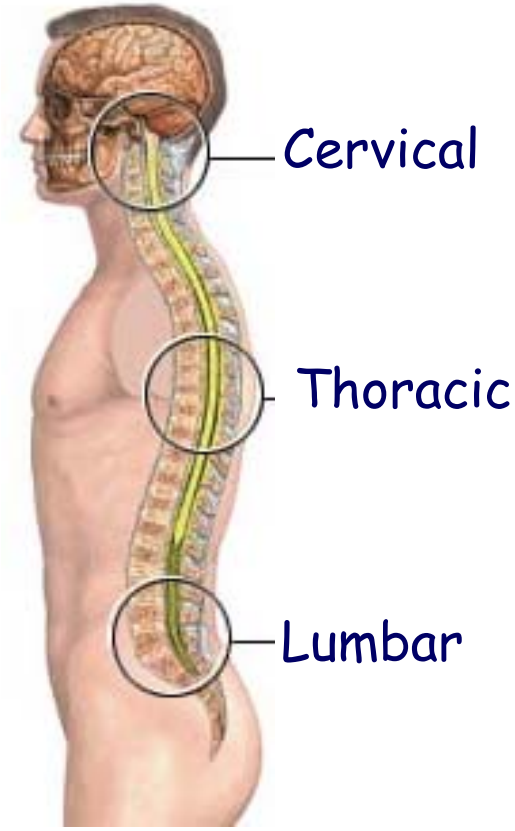
- Moving and using your body in the best way possible to prevent injury
- It should be part of every activity
- Good bodymechanics takes practice and awareness
- It is most important when no other ergonomic solutions are available

Body Mechanics: Neutral Spine Posture

- The single most important aspect of body mechanics
- Neutral spine is the reason body builders can lift so much weight without injury

Neutral Spine Posture

- 3 Curves make your spine strong
- The loss of these curves means the back is less strong and stable and more prone to injury
- It is important to KEEP THESE CURVES when moving, bending and lifting
- The lumbar lordosis is the most important curve to maintain

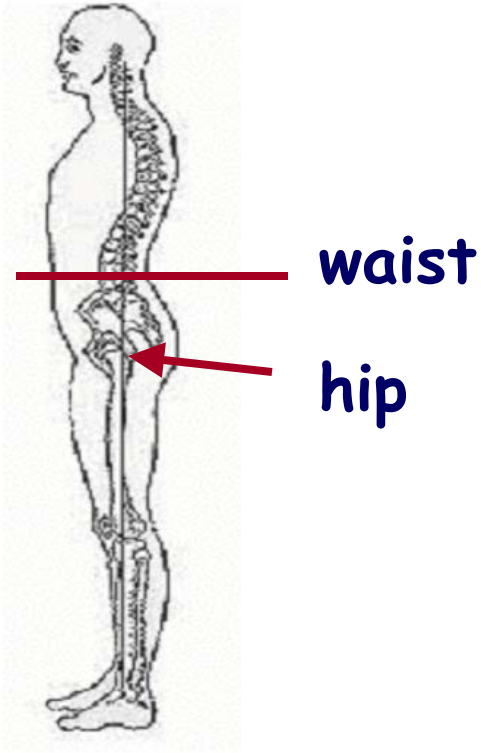


Practice Neutral Spine

- Place a yard stick along your spine
- With one hand feel the hollow of your lumbar lordosis
- Rock the pelvis slightly anterior and posterior
- Feel the lordosis increase and decrease
- Find your 'sweet spot' – this is your neutral spine

Tips for Good Body Mechanics

Bend at hips not at the waist



Contract abdominal muscles

- 10% contraction provides additional stability to the low back

Tips for Good Body Mechanics

Use a wide base of support

- Provides stability in the anterior-posterior direction

Use a scissored stance

- Provides stability medial-lateral direction

Plan your move

Tips for Good Body Mechanics

Keep the load close to your body

- This reduces the torque on your low back

Tips for Good Body Mechanics

Use one leg as a counter balance (golfers stance)

Keep your nose between your toes….don't twist

Body Mechanics problem

- Lift and pulling patient from bed to gurney
- 2 common methods for the worker on the bed
- Which is less stressful?

Standing on bed
367 lbs
(compression at L4/L5)

Kneeling on bed
670 lbs
(compression at L4/L5)

Even Better…

- Use a lateral transfer aid to decrease the friction so the patient slides easier.
- Eliminates the need for a person to be on the bed to help move the patient to the gurney.

Lateral transfer aid

Back Injury Prevention

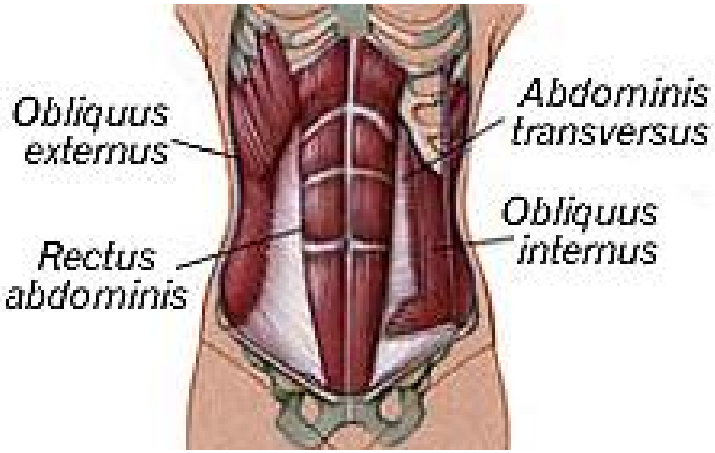
- ✓ Avoid forward bending first thing after waking
- ✓ Vary work/tasks
- ✓ Avoid lifting with a fully flexed spine
- ✓ Keep all motions and lifting close to body
- ✓ Use techniques to minimize weight of load being handled

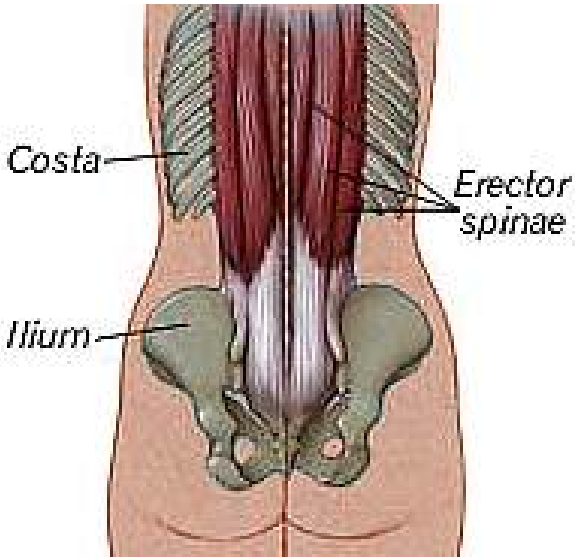
Back Injury Prevention

- ✓ Allow equalization of your disc after prolonged sitting or stooping
- ✓ Stabilize spine, even during light tasks
- ✓ Reduce twisting torque
- ✓ Avoid prolonged sitting
- ✓ Provide protective clothing to foster good bodymechanics
- ✓ Reinforce good motor patterns

"practice makes permanent"

Healthy Back Muscles





Endurance

Symmetry

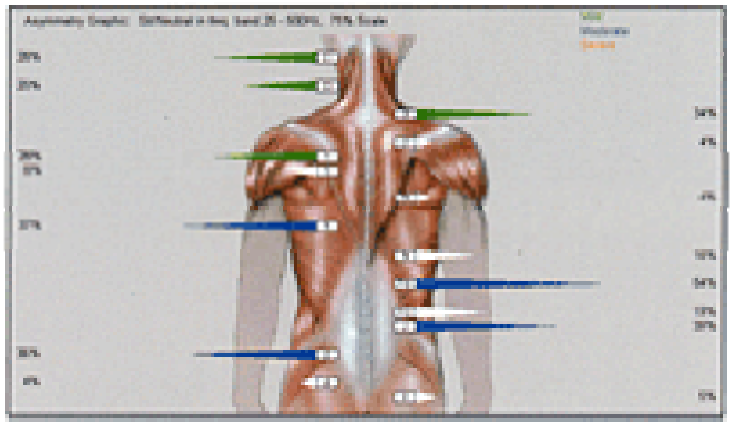
Tone

Strength

Flexibility

Muscle Symmetry & Tone

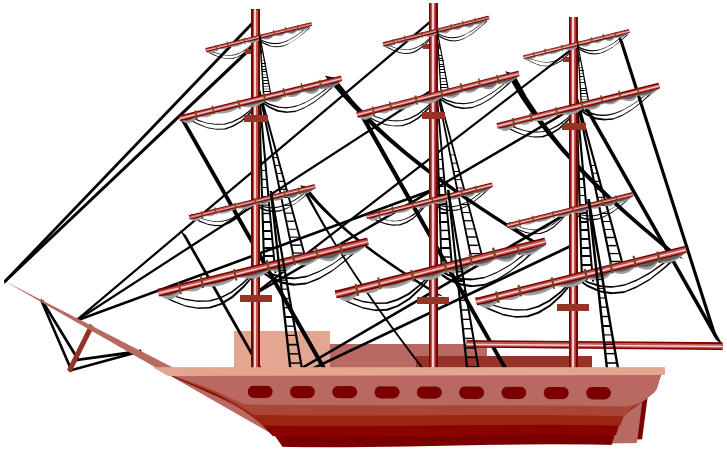
- Opposing muscles = tone
- Overuse/underuse = impaired function
- Some consistent patterns:
  - Certain muscles tend towards tightness
  - Others towards inhibition (weakness)

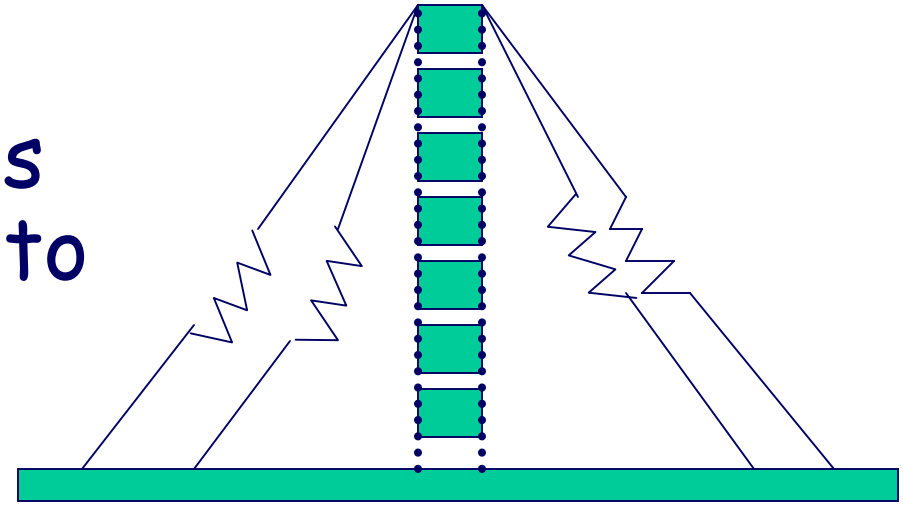


Symmetry Pattern

Stiffness & Stability

- For a ship's mast, guy wires provide stiffness
- Trunk muscles are like guy wires, they disperse forces
- Unequal stiffness decrease ability to bear load





Trunk Endurance

Warm up

1. cat & camel

2. lunges

3. curls-ups (abs)

4. side bridge (obliques)

5. birddog (back)

Body Mechanics in the Gym

- Labile surfaces (exercise balls)
- Training with equipment and machines usually isolates the joint
- Roman chair imposes twice the load as the birddog since both sides at once
- Avoid equipment that starts with back in flexed position

Body Mechanics in the Gym

- Leg press rack – place one leg down
- Cable pull down – lower weight to chest instead of back
- Spine stability when breathing heavy
  - exercise bike to elevate breathing, then dismount and adopt the side bridge.
- Aerobic activity is good.

Conclusions

- Proper bodymechanics –even for small tasks
- Neutral spine is key!!
- Stabilizing your spine can help you prevent injury – endurance
- Pursue other ergonomic solutions

Questions and Evaluation

Thank you for your attention

Instructor Guide for Command Staff Module

Title: Command Staff Ergonomics

Date Developed: 4/2005

Time Required: 60 minutes

Number of Slides: 30

Materials/Resources Needed:
Command Staff Ergonomics PowerPoint presentation in electronic form or transparencies of overheads to be used
Computer system with PowerPoint Software installed and projection system if using electronic form
Hard copies of PowerPoint slides for handouts

Objective: To provide information for command staff including:

1) Cumulative trauma
2) Risk factors for musculoskeletal disorders
3) Elements of an ergonomics program
4) Information and resources for developing an ergonomics program for the fire department

Motivation: To properly implement an injury prevention program to reduce musculoskeletal injuries, ergonomics must become a part of the health and safety program. It is important that management understand the role of ergonomics and how it can be implemented in the department.

Overview: This module contains the basic principles of ergonomics such as defining cumulative trauma, risk factors and ergonomic solutions. It also has the elements of an ergonomics program that need to be addressed by management. We strongly recommend this should be taught prior to the delivering the other modules to line personnel so that decisions on the ergonomics program can be shared with the line personnel at the time of their training.

Purpose: Introduce yourself and the title of today's topic, which is geared toward command staff and boards of directors.
Emphasis: Acknowledge the sponsors listed on the slide. Comment that this is part of several ergonomics training sessions. Other modules available in the "Ergonomics for Fire and EMS Departments" for line personnel include: Introduction to Ergonomics and Cumulative Trauma, Ergonomic Hazard

Analysis, Developing and Implementing Ergonomic Solutions, and Body Mechanics and Back Health. This module was written specifically to address issues faced by command staff. It is intended to be a **60-minute** course.
Action Point: Ask for a show of hands of those who have had an ergonomics class before and who knows what ergonomics means. This will help you gauge the level of knowledge.

Today's Workshop

Will provide information on:

- Cumulative Trauma
- Risk factors for musculoskeletal injury
- Elements of an ergonomics program
- Information resources for developing an ergonomics program in your department

Purpose: To introduce today's module.
Emphasis: The focus of the class will be an overview of the concepts of ergonomics. This module is intended to introduce the concept of ergonomics and how to develop an ergonomics program for injury prevention.
Action Point: none.

Fire and EMS Work

Requires workers to:

- Always be prepared
- Respond quickly
- Think and react quickly
- Not always be in control of schedule
- Work in hazardous situations

Physically & Emotionally Demanding

Purpose: To acknowledge the demanding nature of the job.
Emphasis: Fire and EMS work is a very unique profession. It requires that personnel: are always prepared; can respond at a moments notice; can think and react quickly; assumes that the schedule is not always in workers control; and cannot predict when an accident will occur or when response will be needed. Fire and EMS personnel are frequently called upon to work in hazardous situations. The bottom line is that this is a very physically and emotionally demanding job. The purpose of ergonomics and this class is to reduce physical stresses to workers bodies where ever and when ever possible.
Action Point: Ask the group, given these constraints, is it feasible to prevent musculoskeletal injuries? Try to solicit a range of opinions. This will help the instructor gauge where people stand and potential barriers and openings for ergonomics.

Cost of Injury

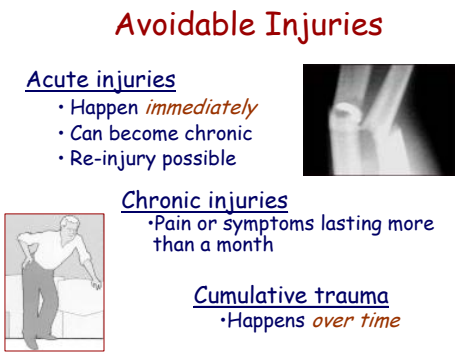
- 31.4 % of firefighter injuries due to overexertion
- Overexertion is due to pushing, pulling, holding, carrying, wielding or throwing objects
- Per claim, average workers' compensation cost of ***ALL*** injuries to firefighters = $5168
- Per claim, workers' compensation average cost for overexertion = $9715
- Of this $9715, only $3458 was for direct medical costs

4

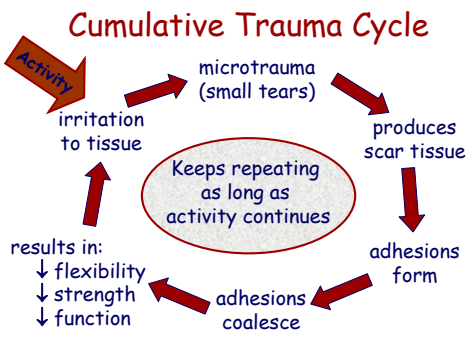
Purpose: Demonstrate the cost of musculoskeletal injuries and the cost of being nonresponsive. An ergonomics program can help to reduce these costs.
Emphasis: Each department should look at their own injury cost data for musculoskeletal injuries, such as overexertion, cumulative trauma and musculoskeletal injury. These data should also be evaluated by body part, such as

low back, knees, and wrists. This type of data can be useful for focusing ergonomics program efforts. Also, have the class note that over half the cost of overexertion injuries is due to indirect costs such as time loss. This data were drawn from *"Cause, Type, and Workers' Compensation Costs of Injury to Fire Fighters" By Walton SM, Conrad KM, Furner SE and Samo DG, Am J Ind Med, 2003; 43: 454-458*.

Further emphasize that when there are separate pots of money for the costs of ergonomics programs and equipment expenditures versus paying for injuries it becomes difficult to justify ergonomics programs. Departments must look to the long term and set budgets to allow an increasing budget for ergonomic solutions (such as equipment) and balance those costs with estimates of decreasing injury expenditures. Further, capital investments in ergonomic solutions and equipment can have the secondary benefit of enhancing productivity.
Action Point: Ask the audience if they know any of the costs for musculoskeletal injuries in their departments. Start a discussion about whether these costs are acceptable and the need to compare the cost of injury prevention to the cost of an active ergonomics program. They need to be aware that part of an effective ergonomics program entails capital purchase of new, ergonomic equipment that reduces the stress to the workers body. These costs may need to be amortized out over several years to see a reduction, so a long-term approach is important. Ask the group how ergonomic improvements might enhance productivity.

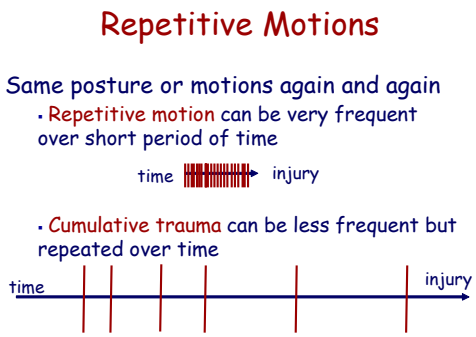


Purpose: Explain the difference between the types of injuries that they are at risk for during the course of their jobs.
Emphasis: They should all be familiar with acute injuries. Cumulative damage and chronic injuries are the emphasis here since they can take years to develop and result in disabling injuries during middle age. Acute and chronic injuries can contribute to cumulative trauma if they are not allowed to heal properly. This means 2-3 days at a minimum for daily cumulative trauma to heal. Realistically, this does not happen even though there is a great need to eliminate cumulative stresses to the body. Similarly, cumulative trauma weakens tissue and can result in an unexpected acute injury. Applying ergonomics principles can prevent cumulative trauma injuries. These are the types of injuries this training will focus on preventing.
Action Point: none.

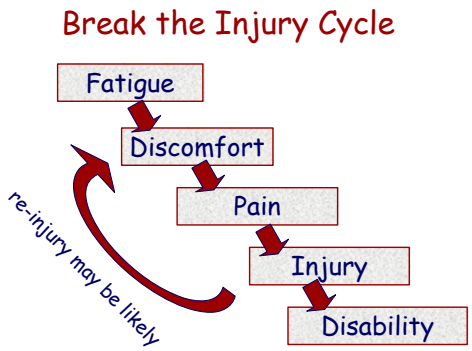


Purpose: A visual illustration of the cumulative injury cycle.
Emphasis: Go through the cycle starting with 'Activity' in the upper left hand corner. Emphasize that this cumulative cycle results in decreased flexibility, strength and function. It can ultimately lead to a serious, disabling injury of the musculoskeletal system. Emphasize that repetition of an irritating factor to the soft tissue is what leads to cumulative trauma.

Action Point: none.



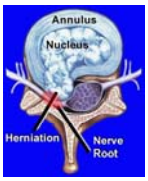
Purpose: Introduce and explain the concept of repetitive motions.
Emphasis: Repetitive motions are motions that are repeated at high frequency over a short period of time, as shown in this top example. The top example represents a job such as computer keyboarding, where a worker might use the same hand movements hundreds or more times a day and the time until injury manifests is relatively short. The lower example is more like the jobs performed by fire/EMS personnel, since most tasks are not repeated several times in a minute but more risky tasks are repeated several times in a shift through a working career. A good example of this type of repetition would be lifting the gurney with a patient into the medic unit.
Action Point: Ask the class how this relates to their work.



Purpose: Fatigue may be the first sign that tissues are injured and need time to heal.
Emphasis: Listening to the body is important. So is finding ways to reduce fatigue, repetition, and tissue overload, factors that ultimately lead to injury. Being aware of this cycle can help you to recognize early signs of musculoskeletal injury.
Action Point: none.

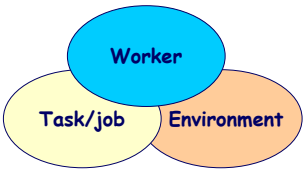
Disc Herniations

- Disc damage is frequently the result of cumulative, repetitive trauma as well as overexertion
- Outer disc fibers repeatedly tear and heal as a result of repetitive overloading
- The disc weakens overtime (years) leading to herniation of the nucleus, causing back and leg pain, and numbness



Purpose: To illustrate an example of a cumulative trauma with severe consequences.
Emphasis: This process happens over months in some people, and over years in others. Cumulative trauma is common in workers in their 40's and 50's after many years of performing a set of tasks. The body does not heal as rapidly at this age, so recovery can be extended and incomplete. These injuries may result in partial permanent disability. Ask the group to name 3 other common types of cumulative trauma. For example: lateral epicondylitis (tennis elbow) and other kinds of tendonitis; adhesive capsulitis (frozen shoulder); Carpal Tunnel Syndrome; Hand Arm Vibration Syndrome (HAVS); and bursitis.
Action Point: Initiate a discussion about cumulative trauma in low back injuries. Ask if they are aware of how low forces combined with repetition and frequency can lead to a severe and potentially disabling injury.

What is Ergonomics?



The goal of ergonomics is to design the job to fit the worker, NOT fit the worker to the job.

Purpose: Introduce the concept of ergonomics.
Emphasis: Ergonomics is defined as the interaction between the worker, the task or job, and the environment. It is important to stress that the goal of ergonomics is adapting the workplace, rather than adapting the worker. Many people believe that ergonomics is just making the worker complete the job more safely through fitness training, such as stretching and strength training. For some people, body mechanics is their idea of ergonomics. These activities are important part of staying healthy and preventing injury but research has shown that body mechanics and fitness alone are not effective approaches to injury prevention. Improving the task or the work environment are the major goals of ergonomics.
Action Point: Explain the above point and solicit their opinions as to why this might be.

Prevention and Control

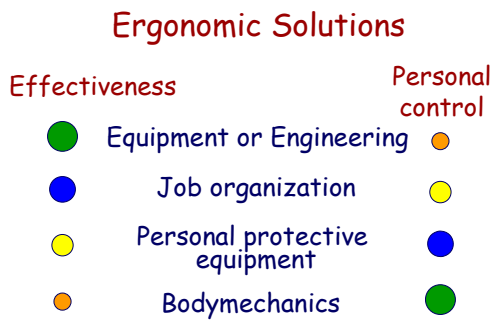
Line personnel think of great solutions!

- ✓ Set short term and long term goals
- ✓ Think outside the box – come up with many potential solutions
- ✓ Decide on the optimal solution by considering
  - ✓ Barriers
  - ✓ Costs
  - ✓ Amount of risk reduced

Purpose: Introduce prevention and control.
Emphasis: Once hazards have been identified, it is time to think about how to prevent or control the hazards. The ergonomics team should set short-term and long-term goals. These can be based on whether a solution might address a single problem or several problems. Sometimes smaller solutions make a big impact because of the frequency an activity is conducted. Longer-

term goals may solve bigger issues, but may consume many resources and may not be feasible in a short time period. Overall, when considering prevention and control management should think outside the box and come up with as many different solutions as you can, even when they do not sound practical initially. Sometimes, through the group process, a potential solution that initially sounds unlikely may evolve into a unique solution. Management must decide on the optimal solution by considering the barriers to implementing the solution, the cost and most importantly how much of the risk is reduced and in how many people. It is very easy to be resistant to thinking of any change, but think of what would be ideal and work from there on making it reasonable.

Action Point: Point out the picture and how innovative fire and EMS personnel are at solving problems.



Purpose: Introduce the concept of ergonomic solutions.

Emphasis: There is a hierarchy to ergonomic solutions. On the left side, there is the effectiveness of the solution in reducing or eliminating the injury risk. On the right side is the degree of personal control. These are inversely related; generally as personal control increases, the effectiveness decreases. The most effective solutions for risk reduction are equipment changes or engineering controls *(click the mouse to make it appear on screen)*. Changing to better designed equipment or redesigning the apparatus or station can reduce risk of injury. Ask the class if they can think of any examples. This may not be in a worker's personal control but as line personnel, they should have an equipment committee or another means to recommend equipment or design changes.

Next in the hierarchy is job organization *(click the mouse to make it appear on screen)*. Job organization has been discussed as a risk so coax the group to think of how the work protocols and schedules could be a solution. Workers have little personal control over this these aspects of work, but each worker can contribute to making the organization healthier by being invited to participate in job organization decisions.

Next on the list is personal protective equipment (PPE) *(click the mouse to make it appear on screen)*. Providing a protective barrier to protect joints or promote neutral posture is considered ergonomic personal protective equipment. Ask the class if they can think of any examples. Workers have some personal control over this solution since he/she would decide to purchase and use this equipment.

The least effective solution in reducing risk is body mechanics *(click the mouse to make it appear on screen)*. Body mechanics is using proper body alignment while working. Ask the class if they can think of any examples. The worker has most

personal control over this. When developing solutions, it is important to keep this hierarchy in mind for setting short-term and long-term goals.

Action Point: Prompt the class to think of examples of these after you describe each, you should have several in mind in case the class does not have examples. You can even add pictures of them. Some examples: *Equipment or engineering* - stair chair with tracks that can descend stairs, bariatric ambulance that uses a winch to pull a bariatric gurney up ramp into the medic unit. *Job organization* - making team lifts the standard work practice, and having enough staff on crew to have 4 people on an apparatus. *Personal protective equipment* - Kneepads for use in drills without live fire, lumbar rolls to promote neutral spine when sitting (in the vehicles, in the station). *Bodymechanics* - using appropriate lifting techniques (keeping spine neutral, load close, large base of support).

---

3) Ergonomics Training

- Part of an ergonomics program is to provide training to fire and EMS personnel
- Ergonomics training curriculum is free from Oregon OSHA. Modules include:
  - "Introduction to Ergonomics and Cumulative Trauma"
  - "Job Hazard Analysis"
  - "Developing and Implementing Ergonomic Solutions"
  - "Bodymechanics & Back Health"

18

Purpose: To emphasize the importance of training in an ergonomics program.

Emphasis: Ergonomics training is important in order for all the other elements of injury prevention to work. This training is part of a training curriculum provided by Oregon OSHA that has several modules available for departments to provide ergonomics training for line personnel.

Action Point: none.

---

4) Medical Management System

Preventative Measures:

- Regular medical exams
- Regular physical conditioning
- Periodic fitness/wellness evaluations
- Education/training

Reactive Measures:

- Early recognition and treatment
- Access to medical and rehabilitative care
- Alterative work
- Workers' compensation

Purpose: To discuss the role of a medical management system in an ergonomics program.

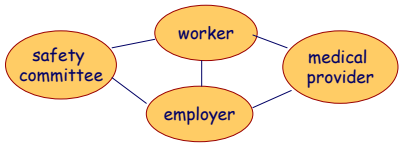
Emphasis: A medical management system can be divided into preventative and reactive. Point out what these are from the slide.

Action Point: Why is medical management system and important part of injury prevention? Since the nature of cumulative trauma disorders is over time, regular medical care is important for early detection of symptoms before it becomes an injury.

---

5) Injury Reporting System

- Define what constitutes a 'reportable injury'
  - Not reporting may lead to more serious injuries
  - Minor injury logs
  - Mechanism to report injuries
- Identify lines of responsibility



Purpose: To discuss important aspects of an injury reporting system for an ergonomics program.

Emphasis: Having a clear injury-reporting system serves multiple purposes. This can help workers understand that they should report and address early signs of cumulative trauma, before it becomes an acute or severe

injury. It also allows the department to identify where the high-risk jobs or activities are so that prevention and control measures can be developed. For example, many minor injuries go unreported, yet these can be the first indications of repetitive or cumulative trauma; of body regions that need attention in terms of muscle strengthening, toning or rehabilitation; or of job tasks that require modification to prevent future injury. Finally, a thorough injury-reporting system can establish communication lines between very important channels, the safety committee, medical providers, workers and command staff.

Action Point: Ask how well the injury reporting system in the department works and how thorough it is at capturing repetitive and cumulative trauma. What are the strong points? What could be improved?

Purpose: To discuss important aspects of reporting injuries.

Emphasis: When reporting injuries, it is important that personnel understand what they are reporting. With information about cumulative trauma and ergonomics, the reporting system may be able to better identify why the injuries are occurring. It is very important that the injury-reporting system is part of the feedback to the ergonomics program to better identify and address hazards, and to evaluate the ergonomic solutions.

Action Point: Ask whether these elements are currently in place. Is injury reporting handled efficiently in terms of identifying the ergonomic risks associated with the job and the injury?

Purpose: To discuss how to implement an ergonomics program.

Emphasis: Support for a program will require buy-in from line personnel at all levels, from the board of directors, and possibly from funding sources higher up the chain such as the city government. For those providing funding, this may mean making a convincing argument that ergonomics will save them more in reduced injury costs and enhanced productivity than it will cost. Accountants will need to show tables of figures in support of this.

Action Point: Start a discussion about how the department currently gains support for new programs. Could those same tactics be used for promoting ergonomics?

Commitment & Involvement

- Support from department, local government, community and line personnel essential
- Launch kick-off meeting by chief to explain program
- Establish ergonomics committee
- Establish lines of communication & responsibility
- Commit resources – time and money

23

Purpose: To talk about how to implement an ergonomics program

Emphasis: Emphasize that to implement a successful ergonomics program both command staff and line personnel are needed. Plan on having a kick-off meeting presided over by the chief to help win over government officials and community members. Establish clear lines of responsibility and communication that are understood by workers and management alike. Most importantly, there needs to be department commitment in terms of time and funding.

Action Point: Continue the discussion about gaining support from stakeholders.

Ergonomics Committee

- Set short-term and long-term goals
- Identify useful tools and resources
- Develop ergonomic awareness
- Identify & modify high risk activities via
  - Risk assessments
  - Surveys
  - Injury-records
- Make necessary changes to work environment

24

Purpose: To talk about how an ergonomic committee might start off.

Emphasis: The ergonomics committee may be part of the existing health and safety committee or a separate committee. Identify manuals and guide books that will assist in establishing your program. Promote ergonomic awareness through training. Then identify high-risk activities and make changes according the established long-term goals.

Action Point: Promote a discussion about the barriers to implementing an ergonomics program.

---

7) Evaluating Your Program

How do you know what is working?

- Statistics
  - Health
  - Program
  - General
- Cost / Benefit Analysis

Purpose: To talk about evaluating your program.

Emphasis: The department will not know whether the ergonomics program is working unless evaluation is planned from the start. Use statistics and cost/benefit analyses to quantify the program's effectiveness.

Action Point: none.

Statistics

Health: reduction in
- injury rate, severity
- costs (overhead, medical, worker's comp)
- time loss

Program: numbers of
- hazards identified
- solutions proposed
- solutions approved
- solutions implemented

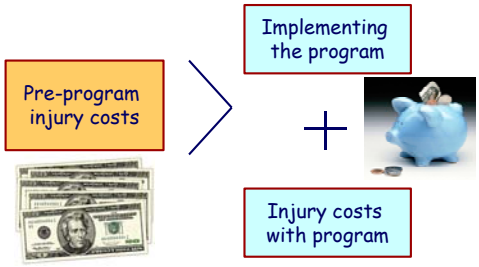
General: having
- appropriate equipment
- improved work environment
- improved work practices
- boosted morale
- healthier relations

Purpose: To give an example of what statistics might be important for a program evaluation.

Emphasis: The following types of statistics would give you an idea of how your program is working. It is important to set up tracking these types of items before you implement your program so that you have something to compare to when you do implement your program.

Action Point: Ask the class how they would be able to collect these types of statistics.

Cost/Benefit Analysis



Purpose: Talk about a cost/benefit analysis.
Emphasis: From medical management, define the ergonomic injuries for tracking the costs. Be sure you use the same time period for pre-injury and post-injury statistics and that you include the cost of implementing your program for the post-measurement.
Action Point: Point out that there is a nice table for doing a cost/benefit analysis in the FEMA ergonomics guide that the department could use as a guideline.

Ergonomic On-line Resources

FEMA has Fire and EMS Ergonomics:
search for "ergonomics" on www.fema.gov/

Elements of Ergonomics Programs – NIOSH
www.cdc.gov/niosh/homepage.html

Oregon OSHA
www.orosha.org/consult/ergonomic/ergonomics.htm

Federal OSHA
www.osha.gov/SLTC/ergonomics/index.html

28

Purpose: Provide on-line resources for ergonomic programs.
Emphasis: Training and information can come from a variety of sources. These websites have free and valuable ergonomics information. There is even free ergonomics information specific to fire and EMS from FEMA.
Action Point: Suggest they look up these websites and see what is available for their department.

Conclusions

- Cumulative trauma occurs over time
- Applying ergonomics = injury prevention = $$ saved
- An ergonomics program is a comprehensive approach at applying ergonomics
- Command staff are integral to a successful ergonomics program

Purpose: Summarize the talk.
Emphasis: Bring home the main points.
Action Point: none.

Questions and Evaluation

Thank you for your attention

Purpose: Allow questions not asked during the talk.
Emphasis: To solicit feedback. This will help you to know what other modules should be taught or how the training can be improved.
Action Point: Field questions and have the class fill out evaluation forms.

Ergonomics for Fire and EMS Departments

Command Staff Ergonomics

University of Oregon
Labor Education and Research Center

This material has been made possible by a grant from the Oregon Occupational Safety and Health Division, Department of Consumer and Business Services

LABOREGON
LERC

UNIVERSITY OF OREGON

Today's Workshop

Will provide information on:

- Cumulative Trauma
- Risk factors for musculoskeletal injury
- Elements of an ergonomics program
- Information resources for developing an ergonomics program in your department

Fire and EMS Work

Requires workers to:

- Always be prepared
- Respond quickly
- Think and react quickly
- Not always be in control of schedule
- Work in hazardous situations

Physically & Emotionally Demanding

Cost of Injury

- 31.4 % of firefighter injuries due to overexertion
- Overexertion is due to pushing, pulling, holding, carrying, wielding or throwing objects
- Per claim, average workers' compensation cost of ***ALL*** injuries to firefighters = $5168
- Per claim, workers' compensation average cost for overexertion = $9715
- Of this $9715, only $3458 was for direct medical costs

Avoidable Injuries

Acute injuries

- Happen *immediately*
- Can become chronic
- Re-injury possible

Chronic injuries

- Pain or symptoms lasting more than a month

Cumulative trauma

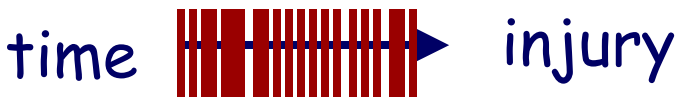
- Happens *over time*

Cumulative Trauma Cycle

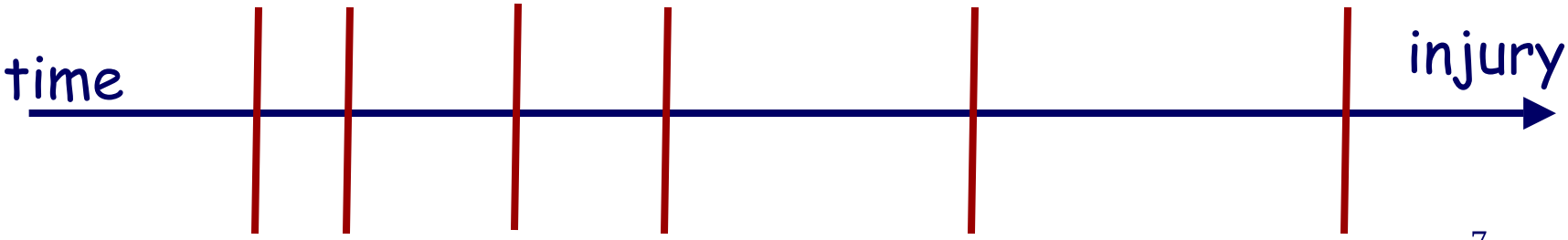
Repetitive Motions

Same posture or motions again and again

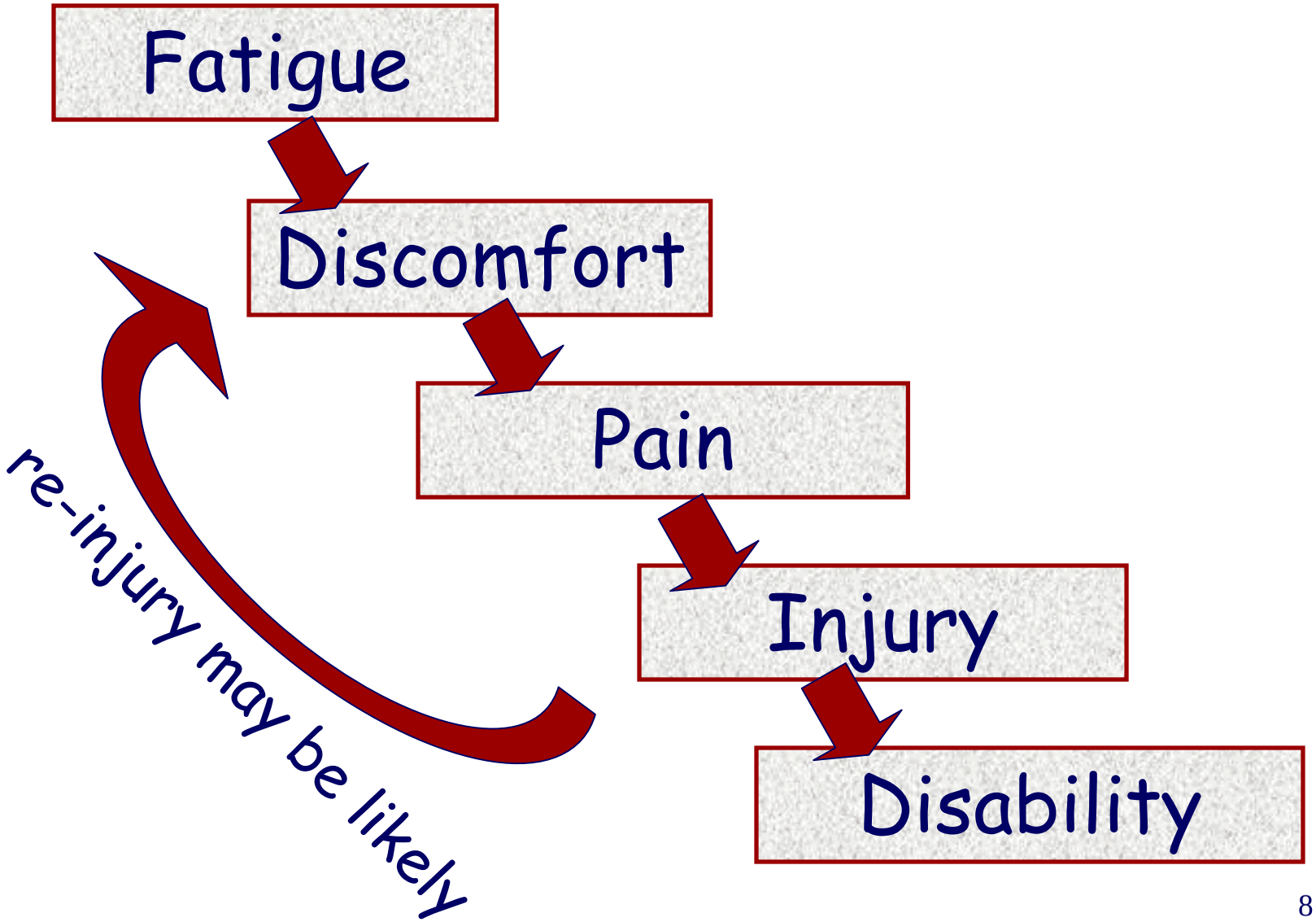
- Repetitive motion can be very frequent over short period of time



- Cumulative trauma can be less frequent but repeated over time

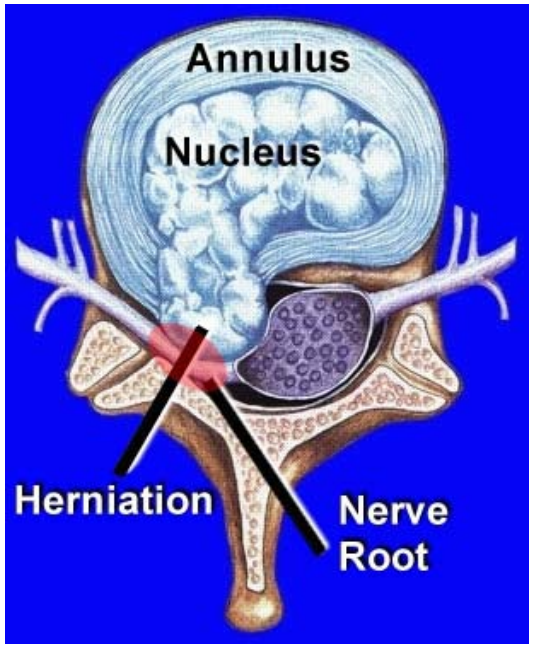


Break the Injury Cycle



Disc Herniations

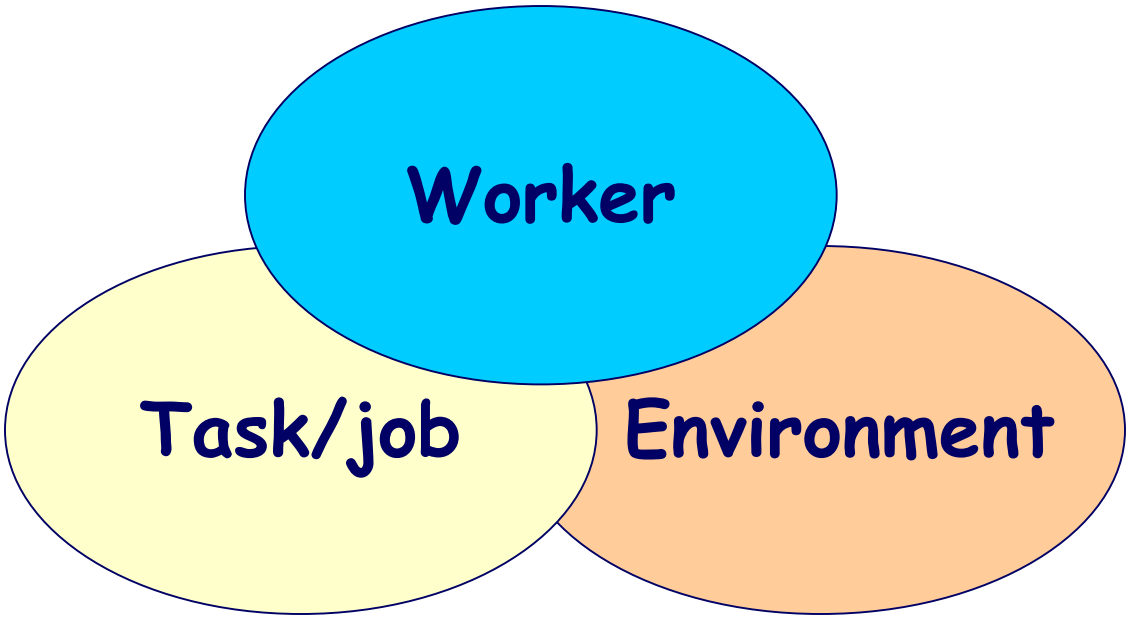
- Disc damage is frequently the result of cumulative, repetitive trauma as well as overexertion



- Outer disc fibers repeatedly tear and heal as a result of repetitive overloading

- The disc weakens overtime (years) leading to herniation of the nucleus, causing back and leg pain, and numbness

What is Ergonomics?

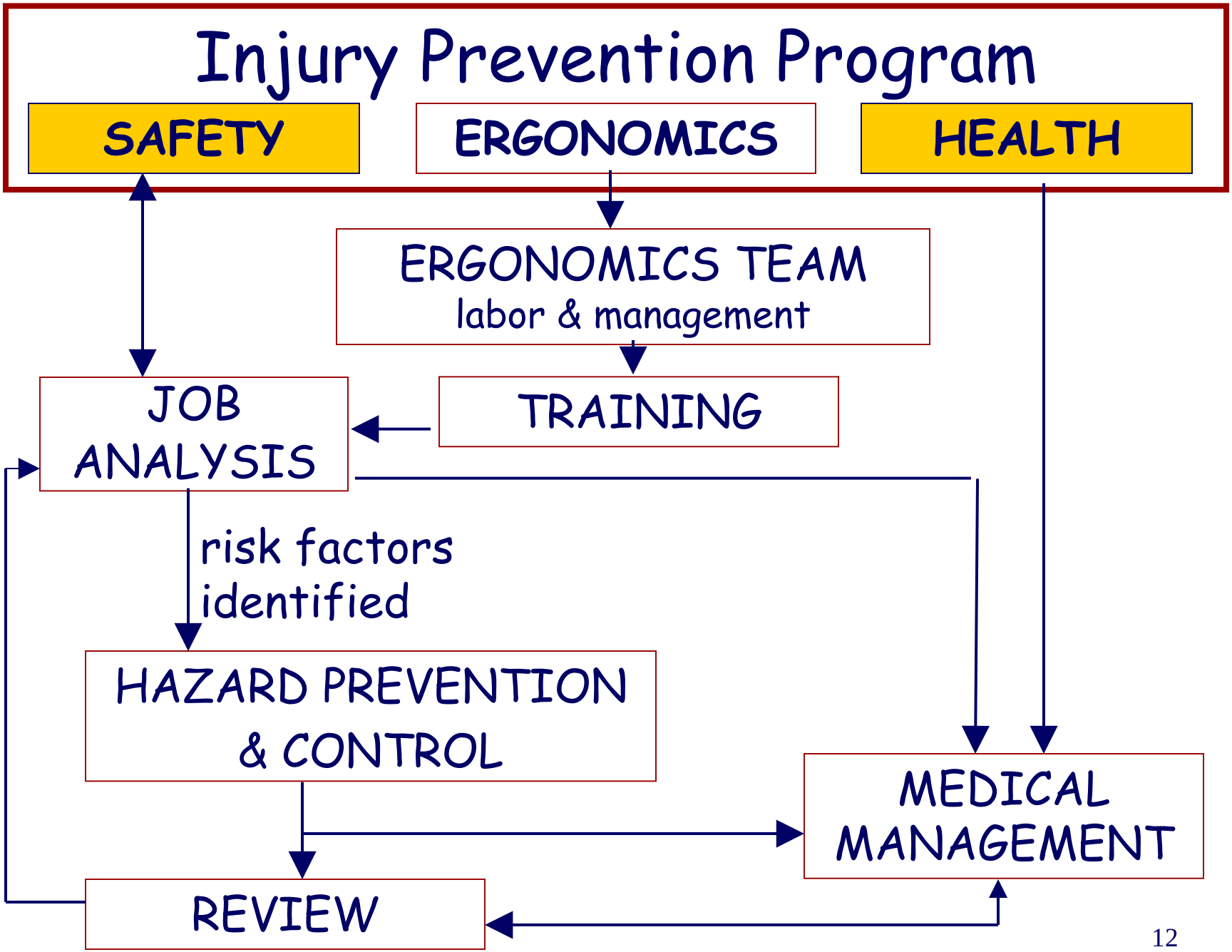


The goal of ergonomics is to design the job to fit the worker, NOT fit the worker to the job.

Musculoskeletal Risk Factors

- ✓Excessive force/weight (pulling, pushing or lifting)
- ✓Awkward postures
- ✓Prolonged postures
- ✓Repetition
- ✓Temperature extremes

Risk magnitude is increased by
time, intensity, or combining factors


Injury Prevention Program
SAFETY
ERGONOMICS
HEALTH
ERGONOMICS TEAM
labor & management
JOB ANALYSIS
TRAINING
risk factors identified
HAZARD PREVENTION & CONTROL
MEDICAL MANAGEMENT
REVIEW

Ergonomics Program Elements

1) Assessment of musculoskeletal hazards
2) Prevention and control of musculoskeletal hazards
3) Training
4) A medical management system
5) Procedures for reporting injuries
6) A plan for the implementation of the program
7) Methods for evaluating the program

1) Assessment of Hazards

- A hazard analysis breaks a job down into elements which can be described and measured
- It allows the inherent risk to be quantified
- It identifies the conditions within a job that contribute to risk
- It is performed by person with ergonomics training
  - Safety committee members
  - Line personnel

When to do a Hazard Assessment

Identify jobs where:

- Work-related injuries have occurred previously
- Frequent severe or non-severe injuries occur
- Past injuries result in work restrictions
- Workers leave because of inability to perform the physical requirements of job
- Sustainable quality performance difficult
- Worker complaints of unresolving pain or fatigue

Prevention and Control

Line personnel think of great solutions!

- ✓ Set short term and long term goals
- ✓ Think outside the box – come up with many potential solutions
- ✓ Decide on the optimal solution by considering
  - ✓ Barriers
  - ✓ Costs
  - ✓ Amount of risk reduced

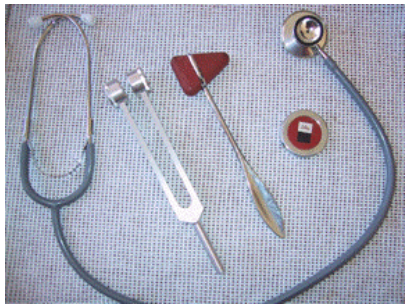
Ergonomic Solutions

Effectiveness		Personal control
	Equipment or Engineering	
	Job organization	
	Personal protective equipment	
	Bodymechanics	

3) Ergonomics Training

- Part of an ergonomics program is to provide training to fire and EMS personnel
- Ergonomics training curriculum is free from Oregon OSHA. Modules include:
  - "Introduction to Ergonomics and Cumulative Trauma"
  - "Job Hazard Analysis"
  - "Developing and Implementing Ergonomic Solutions"
  - "Bodymechanics & Back Health"

4) Medical Management System



Preventive Measures:

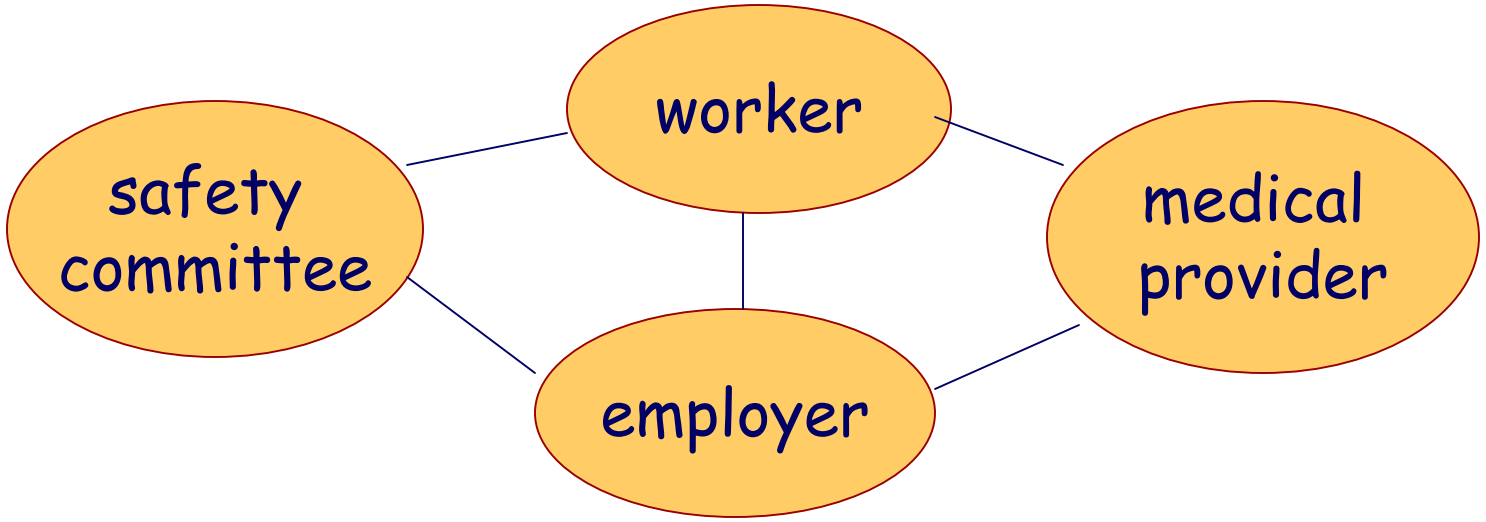
- Regular medical exams
- Regular physical conditioning
- Periodic fitness/wellness evaluations
- Education/training

Reactive Measures:

- Early recognition and treatment
- Access to medical and rehabilitative care
- Alterative work
- Workers' compensation

5) Injury Reporting System

- Define what constitutes a 'reportable injury'
  - Not reporting may lead to more serious injuries
  - Minor injury logs
  - Mechanism to report injuries
- Identify lines of responsibility



Reporting Injuries

- Train personnel
  - Ergonomics
  - Record keeping
- Record keeping
  - Clearly identify injury cause
  - Differentiate between acute and repetitive
- Follow-up
  - Feedback into the ergonomics program
  - Identify and address hazard

6) Implementing Your Program

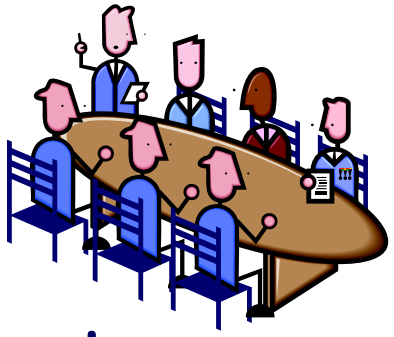
Gaining Support

- Part of existing safety and health program
- Management commitment
- Worker involvement
- Union involvement
- Awareness and education

Commitment & Involvement

- Support from department, local government, community and line personnel essential
- Launch kick-off meeting by chief to explain program
- Establish ergonomics committee
- Establish lines of communication & responsibility
- Commit resources – time and money

Ergonomics Committee



- Set short-term and long-term goals
- Identify useful tools and resources
- Develop ergonomic awareness
- Identify & modify high risk activities via
  - Risk assessments
  - Surveys
  - Injury-records
- Make necessary changes to work environment

7) Evaluating Your Program

How do you know what is working?

- Statistics
  - Health
  - Program
  - General
- Cost / Benefit Analysis

Statistics

Health: reduction in

- injury rate, severity
- costs (overhead, medical, worker's comp)
- time loss

Program: numbers of

- hazards identified
- solutions proposed
- solutions approved
- solutions implemented

General: having

- appropriate equipment
- improved work environment
- improved work practices
- boosted morale
- healthier relations

Cost/Benefit Analysis

Pre-program injury costs

Implementing the program

+

Injury costs with program

Ergonomic Resources

FEMA: Fire and EMS Ergonomics
search for "ergonomics" on www.fema.gov/

National Institute for Occupational Safety and Health:
Elements of Ergonomics Programs &
Guide to Evaluating the Effectiveness of Strategies for Preventing Work Injuries
www.cdc.gov/niosh/homepage.html

Oregon OSHA
www.orosha.org/consult/ergonomic/ergonomics.htm

Federal OSHA
www.osha.gov/SLTC/ergonomics/index.html

Conclusions

- Cumulative trauma occurs over time
- Applying ergonomics = injury prevention = $$ saved
- An ergonomics program is a comprehensive approach at applying ergonomics
- Command staff are integral to a successful ergonomics program

Questions and Evaluation

Thank you for your attention

Glossary

Anatomical Position: an erect standing position with the arms at the side and palms turned forward.

Anthropometry: the study of physical dimensions in people, including measurement of human body characteristics such as size, breadth, girth, and distance between anatomical points.

Arthritis: inflammation of joint or joints.

Awkward Posture: deviation from the ideal working posture. For example, working with the body flexed at the waist where there is loss of the lumbar lordosis, or working with the wrists flexed or the hands above shoulder level, reaching behind, twisting, forward or backward bending and pinching.

Axial Skeleton: refers to all bones that forms the upright axis of body, e.g. skull, hyoid, vertebral column.

Biomechanics: the study of forces and their effects on the human body. Biomechanics uses mechanical principles to analyze human movement.

Bursa: small bag filled with fluid, which reduces friction between moving structures. There are many bursa throughout the body, commonly irritated bursa are in the shoulder and knee.

Bursitis: a compression of the bursa between the tendons and bones of the shoulder.

Carpal tunnel: channel on the palmar side of the wrist formed by the irregular small bones of the wrist and a tough ligament that stretches across it. Through the carpal tunnel pass the flexor tendons of the fingers, the median nerve, and some blood vessels.

Carpal tunnel syndrome (CTS): a compression of the median nerve as it passes through the carpal tunnel in the heel of the hand.

Carpals: the wrist bones, collectively.

Cervical: the first seven vertebrae of the spine under the cranium.

Chronic low back pain: general soreness and fatigue of the low back; pain is usually constant, and it accompanies most activities.

Compression: a loading mode in which equal and opposite loads are applied to the surface of a structure, resulting in shortening and widening a structure; for example, the force experienced by the spine during lifting.

Constriction: binding, squeezing, or shrinking of blood vessels so the circulation is reduced.

Control measure: a method of reducing worker exposure to risk factors. Specific methods include redesign of equipment or workstations, modifying work practices, and changing the organization of work.

Cumulative trauma disorder: musculoskeletal or neurological symptoms caused by repetitive and forceful movements that occur over time.

De Quervain's disease: occurs when the sheath around the tendon leading to the thumb becomes inflamed.

Digital neuritis: compression of the nerves, which serve the fingers.

Discs: structures between adjacent vertebrae that act as shock absorbers and facilitate movement. Discs consist of an inner gelatinous core called the nucleus pulposus and tough outer fibers called the annulus fibrosis.

Epicondylitis: inflammation of the epicondyle of a long bone, most commonly a technical term for "tennis elbow".

Ergonomics: the scientific study of human work. The term comes from the Greek words "ergos" meaning work, and "nomos," meaning natural laws of. Ergonomics considers the physical and mental capabilities and limits of the worker as he or she interacts with tools, equipment, work methods, tasks, and the working environment.

Ergonomics program: a systematic method (similar to an accident-prevention or quality-improvement program) used to evaluate, prevent, and manage work-related musculoskeletal disorders. The four elements of a typical ergonomics program are worksite analysis, hazard prevention and control, medical management, and training and education.

Ergonomics team: members in the workplace ergonomics program responsible for the identifying and correcting musculoskeletal hazards.

Fatigue: a condition that results when the body cannot provide enough energy for the muscles to perform a task.

Fatigue fracture: a fracture typically produced by either low repetition of high loads or high repetition of relatively normal loads.

Force: the amount of physical effort a person uses to do a task.

Fulcrum: the axis around which a lever pivots. For example, when lifting a patient the fulcrum for the patient handler tends to be the lumbar spine.

Hazard prevention and control: eliminating or minimizing the hazards identified in the worksite analysis. This is accomplished by changing the jobs, workstations, tools or environment to fit the worker. Hazard prevention and control is an element of the ergonomics program.

Incidence rate: the rate at which *new* injuries and illnesses occur for a given job, production line, work area, department or the company.

Job analysis: a safety and health review that addresses work-related musculoskeletal disorders. It is a structured way of identifying jobs and workstations that may contain musculoskeletal hazards, the risk factors that pose the hazards, and the causes of the risk factors. Job analysis is an element of the ergonomics program.

Job design: the distribution of job duties over a work shift. Jobs should be designed to reduce stresses to the body and decrease risk of injury.

Kinematics: biomechanical analysis of movement focusing on position, velocity and acceleration.

Kinetics: biomechanical analysis of movement focusing on forces applied.

Kyphosis: convex curvature of the spine that exists in the thoracic region.

Ligament: connective tissue attaching bone to bone.

Lordosis: concave curvature of the spine that exists in the cervical and lumbar regions.

Medical management: the effective use of available health-care resources to prevent or manage work-related musculoskeletal disorders. Medical management is an element of the ergonomics program.

Musculoskeletal disorders (MSD): illnesses and injuries that affect one or more parts of the musculoskeletal system. Generally refers to cumulative trauma disorders.

Musculoskeletal system: the soft tissue and bones in the body. The parts of the musculoskeletal system are bones, muscles, tendons, ligaments, cartilage, nerves, discs, and blood vessels.

Myositis: inflammation of a muscle.

Neutral posture: comfortable working posture that reduces the risk of musculoskeletal disorders. The joints are naturally aligned with elbows at the side of the body and wrists straight. Generally neutral posture is the same as anatomical position.

Physiology: the science that deals with the normal function of the living organism and its parts.

Prevalence: the number of *total* cases of a health problem in a population.

Range of motion: the normal range of translation and rotation of a joint for each of its degrees of freedom.

Records review: reviewing company records to identify patterns of injuries (or potential injuries) to help you find the jobs and workstations that may contain musculoskeletal hazards.

Recovery time: time period between exertions in which work is light or suspended so that body tissues can recover.

Repetition: the number of occurrences of a particular motion in a given time. Repetition is a risk factor of musculoskeletal injury. The severity of risk depends on the frequency of repetition, speed of the movement or action, the number of muscle groups involved, and the associated force.

Risk factors: an aspect of a job that defines the worker's chance of getting a work-related musculoskeletal disorder. Risk factors are repetition, force, awkward posture, prolonged postures, direct pressure, vibration, and combinations of factors.

Sprain: injury due to acute or cumulative trauma of a ligament.

Static loading: physical effort or posture that is held and requires muscle contraction for more than a short time. As muscles remain contracted, the blood flow to the muscles is reduced.

Strain: injury due to acute or cumulative trauma to a muscle.

Synovia: membranes lining the inside of joint capsule and moving surfaces of joints. They secrete the synovial fluid, which lubricates joints.

Tendonitis: inflammation of the tendon inside the sheath.

Tendon: connective tissue attaching muscle to bone.

Thoracic outlet syndrome: pinching or squeezing the nerves and blood vessels between the neck and shoulder.

Work-related musculoskeletal disorder: cumulative trauma injury to the muscles, tendons, ligaments, discs and other soft tissues.

Work practice controls: procedures for safe and proper work that are used to reduce the duration, frequency or severity of exposure to a hazard. They include work methods training, job rotation, and gradual introduction to work. Work practice controls are part of hazard prevention and control.

Resources for more ergonomics information

"Fire and EMS Ergonomics: A guide for Understanding and Implementing An Ergonomics Program in Your Department"

This guide is published by FEMA. Search for "ergonomics" on www.fema.gov/ and you can request a free copy for your department.

"Elements of Ergonomics Programs"

This guide is published by the National Institute for Occupational Safety and Health (NIOSH). DHHS Publication No. 97-117. This publication is free. Call 1-800-35-NIOSH or visit www.cdc.gov/niosh/ephome2.html .

To get more general information on ergonomics:

Ergoweb
www.ergoweb.com/resources

Federal Occupational Safety and Health Administration (OSHA)
www.osha.gov/SLTC/ergonomics/index.html

Oregon Occupational Safety and Health Administration (OR-OSHA)
www.orosha.org/consult/ergonomic/ergonomics.htm

Evaluation Form

1. How would you rate this class overall? Please circle one.

Excellent Very good Good Fair Poor

2. How effective were the teaching methods? Please circle one.

Excellent Very good Good Fair Poor

3. Was the information useful? Please circle one.

Extremely useful	Very useful	Useful	Somewhat useful	Not useful at all

4. How likely are you to use this information in your job? Please circle one.

Extremely likely	Very likely	Likely	Somewhat likely	Not likely at all

5. What would have made this class more useful or better?

6. Are there other topics in ergonomics that you would like training on? Please list.

7. Additional comments: (Please feel free to write on the back of this sheet)