Ergonomics and Risk Factor Awareness

PART 1

Introduction

Musculoskeletal Injuries

Risk Factors
Ergonomics and Risk Factor Awareness

PART 1

Suggested Discussion Points:

Why is your company doing this training?

Handouts / Tools / Reference Materials:

Objectives

• To gain an understanding of:
  – What is ergonomics
  – How cumulative trauma disorders develop
  – Ergonomic risk factors
  – Controlling risk factors
• To gain an understanding of how ergonomics applies to your job

Suggested Discussion Points:

• There are principles and theories in ergonomics just like any other science
• Cumulative trauma disorders or musculoskeletal disorders (also referred to as “MSDs”)
• Risk factors that can impact the musculoskeletal system and result in MSDs
• Steps to identify and control risk factors
• Applying ergonomics to make your job safer
Ergonomics - What is it?

Most people look like this...

Some designers must think that people look like this...

Suggested Discussion Points:

- Some tools, equipment, and machines are not designed to accommodate the typical user. Few machines are designed for individual differences. This forces individuals to use awkward positions, such as bending and reaching.
- This “one size fits all” method of designing is opposite to the viewpoint of ergonomics.
- Applying the science of ergonomics considers the variety of end users at the beginning of the design process.
- In this example, the lathe was designed for a person who looks like the man in the bottom picture. The designer should have considered the end user’s anthropometry (body measurements) before designing the lathe.

Handouts / Tools / Reference Materials:

Canadian Centre for Occupational Health and Safety: Work-related musculoskeletal disorders.
http://www.ccohs.ca/oshanswers/diseases/rmirsi.html
**Ergonomics is...**

- Scientific study of human interaction with the work environment
- Considers physical and mental capabilities of workers as they interact with tools, equipment, work methods, tasks, and working environment
- Goal – to reduce work related injuries by adapting work to fit people

**Suggested Discussion Points:**

- Ergonomics is the systematic and scientific study of the worker’s interaction with his/her work environment. Job safety analyses (JSAs) are a very systematic way to break down a job to discover safety issues. In ergonomics, we break down tasks to identify risk factors that can be minimized to reduce cumulative injuries.
- Ergonomics considers differences in people when designing job tasks.
- Applying ergonomics seeks to put “people first” and considers how the work can be better designed to accommodate the user, reduce injury risk, and improve the quality of worklife.

**Handouts / Tools / Reference Materials:**

The Ergonomics Society (U.K.): What is ergonomics?
http://www.ergonomics.org.uk/section.php?s=1

Oregon OSHA: Introduction to ergonomics – cumulative trauma disorders.
http://www.cbs.state.or.us/external/oshad/educate/training/pages/201disorders.html
Suggested Discussion Points:

- Just because something is advertised as “ergonomic” does not mean it will reduce risk. How people use the tool is very important.
- For example, demonstrate an inline and pistol grip screw driver (demonstration pictures below).
- For example, you can adjust ergonomic chairs incorrectly. A chair may have all of the features needed to provide a good seated posture, but unless you know how to adjust it and the proper postures, it may not be used correctly.

Demos / Stories / Examples:

This example shows that even if a tool is well designed, it can be used the wrong way and will not reduce risk to the user.

Ask for a volunteer from the group and hand him or her the inline/pistol grip screwdriver. Then using a book, notebook, or sheet of paper, simulate a work surface. Hold the book/notebook/paper at approximately waist level of the volunteer with the book/notebook/paper parallel to the floor, as shown in Figures 1 and 2. Ask the employee to adjust the screwdriver (or choose either an inline or a pistol-grip style) to perform the task of placing a screw into the provided “work surface”
using the most appropriate method. Figure 2 is the appropriate way, removing most of the deviation from the wrist and lowering the shoulder.

![Figure 1.—Poor posture.](#) ![Figure 2.—Good posture.](#)

Now, rotate the book/notebook/paper so that it is perpendicular to the floor, as shown in Figures 3, 4, and 5. Ask the volunteer to perform the same task on this “work surface.” Both Figures 3 and 4 show a poor posture, whereas Figure 5 is an example of an appropriate way to use this tool for a vertical surface at this height.

![Figure 3.—Poor posture.](#) ![Figure 4.—Poor posture.](#) ![Figure 5.—Good posture.](#)
Props/Materials Needed:

- Screwdriver with combination pistol/inline grips
- Notebook or other object to simulate working surface

Handouts / Tools / Reference Materials:

International Labour Organization. Your health and safety at work: ergonomics. Refer to section D: Hand tools and controls.  
http://www.itcilo.it/english/actraw/telean/osh/ergo/ergonomi.htm
Suggested Discussion Points:

Example of using ergonomics to solve a problem

Demos / Stories / Examples:

Problem: At one mine, employees are required to chock their vehicles whenever they are parked on the mine property. This means that some employees have to chock their vehicles several times a day. Because the two chock blocks are connected with a rope, performing this task results in excessive stooping and bending. Other issues occur during muddy or wet conditions.

Have the groups share their solution ideas.

Props/Materials Needed:

Two chock blocks
What one company did...

Demos / Stories / Examples:

Solution: A handle fabricated with conduit was attached to the two chock blocks by the Field Maintenance Department. This modification allowed employees to place the chock blocks in front and behind the tire and to pick the chock blocks off the ground with little or no stooping. The handle also helped alleviate issues that occur during unfavorable weather conditions.
Suggested Discussion Points:

Another example of using ergonomics to solve a problem.

Demos / Stories / Examples:

Problem: Swinging a standard sledgehammer to carry out a task can be very strenuous on the body. With the Slide Sledge, using a heavy and awkward sledge hammer to exert a force is no longer necessary. The Slide Sledge is able to deliver a powerful payload of impact with minimal effort from the employee.

Have the groups come up with more examples of how ergonomics has been used to solve problems, possibly from firsthand experience.

Props/Materials Needed:

Sledgehammer
Suggested Discussion Points:

Applying ergonomics can lead to many benefits to the employee, including:

- Staying healthy as you get older
- Enjoying leisure time activities
- Reducing discomfort
- Reducing fatigue
- Enhancing quality of life
- Making your job safer
- Designing jobs for the next generation of workers – your children
- Improved quality of work
- Increased efficiency by working smarter – less wear and tear on the body
- Preventing musculoskeletal injuries

Demos / Stories / Examples:

1. Instead of telling them the benefits, ask the participants to offer benefits that they think would occur from applying ergonomics. Make a list on a flip chart, white board, or chalkboard. Then give them the list from the Suggested Discussion Points above.
2. An alternative for audience participation is to follow the format for the “Family Feud” TV game show. Divide the class into two groups: “Family A” and “Family B.” Use a coin toss to decide which family goes first. Each family then takes turns until all of the benefits are identified. **Hints:** To control the time used to answer the question, set a time limit for each “family” to respond and/or limit the number of benefits that need to be identified to four or five.

**Props/Materials Needed:**

- Flip chart, white board, or chalkboard
- Coin

**Handouts / Tools / Reference Materials:**

Suggested Discussion Points:

Although applying ergonomics can lead to many benefits, many companies do not consider ergonomics for various reasons. These reasons are considered barriers, which could include:

- Lack of resources (staff, time, money)
- Lack of knowledge or expertise
- Attitudes toward ergonomics
- Safety culture
- Lack of a regulation
- Lack of commitment on all levels (top management to employees)

Demos / Stories / Examples:

1. Instead of giving them the list of barriers, ask the participants to name barriers to implementing ergonomics in the workplace. Make a list on a flip chart, white board, or chalkboard.

2. An alternative for audience participation is to follow the format for the “Family Feud” TV game show. Divide the class into two groups: “Family A” and “Family B.” Use a coin toss to decide which family goes first. Each family then takes turns until all of the barriers are
identified. *Hints:* To control the time used to answer the question, set a time limit for each “family” to respond and/or limit the number of barriers that need to be identified to three or four.

**Props/Materials Needed:**

- Flip chart, white board, or chalkboard
- Coin
Suggested Discussion Points:

When an ergonomic approach is not used, musculoskeletal disorders (MSDs) may develop.

This section will include information on:

- How MSDs are different from acute injuries
- Examples of MSDs
- How MSDs may develop

**NOTE:** Other terms for MSDs are cumulative trauma disorders (CTDs) or musculoskeletal injuries (MSIs). All three terms are interchangeable for purposes of this training. Companies may choose the term consistent within their organization.
Suggested Discussion Points:

It usually takes an injury to draw attention to a problem. Reactive means that the main effort to reduce injury risk is after an injury has occurred. Efforts are focused on preventing future injuries, not on the current injury.

Reacting to injuries that have occurred does have value because of the cumulative nature of MSDs. Other workers may be developing an MSD, and action taken may be useful in preventing MSDs for these workers. However, with a reactive approach, one can sometimes wrongly assume that no injuries means no problems, when it really means that the injuries have not yet occurred because of the cumulative nature of MSDs.

Demos / Stories / Examples:

What would happen if you did not provide preventive maintenance for your equipment?

As an example:

- A Monday morning quarterback cannot do anything to prevent the losing outcome of Sunday’s game; or
- Shutting the barn door after the horse has left the barn will not prevent the horse from leaving the barn.
Suggested Discussion Points:

Concentrate on the importance of being proactive versus solely reactive. Being proactive can be described as PM (preventive maintenance) for people.

Proactive means we avoid waiting for the injuries to occur and we keep an eye on risk factors connected to specific work tasks that can lead to signs, symptoms, and eventually injury.

To do this, trainees must understand:

- What musculoskeletal injuries are
- How musculoskeletal injuries progress
- Signals (signs and symptoms) that tell you when an injury might occur
- How to prevent them from happening

These will be presented in this portion of the training.

Demos/Stories/Examples:

Participants probably will be able to relate to obesity, high cholesterol, and high blood pressure as risk factors for heart disease.
Work-Related Injuries

• **Acute injuries** –
  – Occur instantly
  – Examples: fractures, cuts, bruises

• **Cumulative injuries** –
  – Develop gradually
  – Examples: sprains/strains, herniated discs, tendonitis, carpal tunnel syndrome

Suggested Discussion Points:

• **Acute injuries** occur instantaneously. Types of acute injuries include fractures, cuts, and bruises. People are more familiar with acute injuries. These injuries can affect any part of the body, including internal organs.

• **Cumulative injuries** occur gradually over time with varying degrees of signs and symptoms, indicating that something is wrong. Some examples include herniated discs, tendonitis, carpal tunnel syndrome, and sprains/strains. These injuries affect muscles, nerves, tendons, ligaments, and blood vessels.

**NOTE:** Some types of injuries can be either acute or cumulative depending on the precipitating event. For example, a sprain/strain can be cumulative if the exposure is highly repetitive and involves submaximal forceful exertions, or it can be acute if the precipitating event is a single overexertion exceeding the maximum capability of the worker.

Demos/Stories/Examples:

Scenario: A person is smoking a cigarette by a gas pump.
Question: What is the risk?
Answer(s):

A. Acute injury: explosion and tripping hazard
B. Cumulative illness: lung cancer

It is common for risky situations to have both an acute and a cumulative risk associated.
What type of injury?

Acute
or
Cumulative

Suggested Discussion Points:

- Reinforce the differences between acute and cumulative.
- Sometimes it is difficult to differentiate between the two types of injuries.

Demos/Stories/Examples:

Hand out the list of injury scenarios and ask the participants to determine which injuries are acute or cumulative. This exercise can be done by individual participants or by separating the participants into teams. One team can do the odd-numbered scenarios, while the other team does the even-number scenarios.

Handouts/Tools/Reference Materials:

Acute and Cumulative Injury Handout

Suggested answers to the injury scenarios:

Musculoskeletal Disorders

- **Median number of lost work days**
  - 5 days for all workers with injuries
  - 25 days for workers with MSDs
- **Average cost per injury**
  - $824 for all other cases
  - $8,070 for an MSD
- **MSDs tend to have**
  - Longer durations
  - Longer treatment time
  - Greater work disability

Suggested Discussion Points:

MSDs differ from other type of injuries in many ways.

- Lost workdays are greater for MSDs.
- MSDs cost more than other injuries.
- MSDs take longer to get better and require more treatment.
- MSDs increase a person’s risk for reinjury. Once you have an MSD, the risk for the same injury is higher, especially if the first injury was not properly treated, the recovery time was not adequate, and/or the root cause of the problem was not addressed.

Sources of data shown in slide:

Case Study – Back Injuries Can be Serious

Supervisor suffered back injury helping a worker move sheet metal in January 1978

- Original injury - $1000 medical costs and no lost time
- Recurrence in 1992 cost $18,000
- Surgery/comp in 1993 cost $81,000 and resulted in permanent partial disability
- Additional costs of $55,000 in 2001 alone

By 2002, this 1978 back injury cost over $517,000!

Original injury cost data did not appear to warrant investment . . . until you consider future costs.

What about costs to the employee?

Suggested Discussion Points:

- High costs of MSDs
- A back injury is a good predictor for a future injury – should implement an intervention or job improvement to prevent future back injuries

Demos / Stories / Examples:

This example can be replaced with your own example if you have the cost data. The example shown in the slide is an actual case that happened at a U.S. Navy facility. The injury cost was $517,000 by the year 2002.

Ask participants to think about the human cost to this type of situation. Ask them to give examples of what the worker would be experiencing, such as:

- Pain
- Time involved with rehabilitation
- Unable to participate in leisure time activities
- Reduced wages
- Loss of function

Source of data presented in slide: Barbara Wright, Ergonomics Program Manager, Naval Aviation Depot (NADEP), Jacksonville, FL 32223; phone: 904–542–3539; e-mail: Wrightbl@navair.navy.mil.
Targeting Signs

Injury

Signs
decreased grip strength
loss of muscle function
decreased range of motion
decreased nerve conduction speed
change in skin color
deformity
swelling

Slide Pointers:

• Must click mouse to reveal the “signs” ring. If you are making this interactive, stop here to have participation.
• Must click mouse to reveal the examples of “signs.”

Suggested Discussion Points:

Signs are objective findings (the change can be measured and/or observed) that include:

• Decreased grip strength
• Loss of muscle function
• Decreased range of motion
• Decreased nerve conduction speed
• Change in skin color when exposed to cold or vibration
• Deformity
• Swelling

In some cases, signs can be reversed, but not always.
Demos / Stories / Examples:

To emphasize what signs are, demonstrate decreased range of motion. Two examples affecting the shoulder and elbow joints include:

- Stand with your arm at your side. Raise your arm outward to the side as far as you can. Then repeat, but only raise your arm as high as your shoulder.
- Stand with your arm at your side with your palm facing forward. Raise your forearm as far as you can. Then repeat, but only raise your forearm so that it is parallel to the ground.

Ask the participants what they could not do either at home or at work if their range of motion were decreased as shown in the demonstration.

Ask the participants for examples of other signs and what they could not do as a result of that sign either at home or at work, such as:

- Decreased grip strength – not being able to hold a large milk bottle with one hand
- Decreased grip strength – not being able to open a bottle with a screw cap or even opening a door by turning a door knob
- Loss of muscle function – not being able to lift your child into a car seat
- Loss of muscle function – not being able to get dressed or to feed yourself
Slide Pointers:

- Must click mouse to reveal the “symptoms” ring.
- Must click mouse to reveal the examples of “symptoms.”

Suggested Discussion Points:

- Symptoms are more subjective in nature and include pain, fatigue, numbness, or tingling sensations.
- Any one or combination of these may be an early indicator that there is a problem. Symptoms that are ignored may progress to signs. The key is to recognize symptoms early before they progress to a sign or injury.
- Symptoms can be treated – are reversible.
- Failure to seek early treatment can result in chronic pain or permanent disability.
- It is important to know that symptoms may occur at any time, not just while you are working. Symptoms may be experienced while sleeping, watching TV, or in a cold environment.

Demos/Stories/Examples:

For instance, symptoms for carpal tunnel syndrome often occur at night.
Cumulative Injury Progression

Slide Pointers:

- Must click mouse to reveal each step of the progression. This will give you time to talk about each step.

Suggested Discussion Points:

- One possible progression for a cumulative injury starts with symptoms, such as fatigue or stiffness, then progresses to periodic pain and then continuous pain, and finally results in a loss of function.
- The sooner the exposure is reduced or eliminated, the better the chance of avoiding permanent injury.
- Preventing the progression of a cumulative injury by elimination of risk factors is ideal.
- The longer one waits to get treatment, the longer it usually takes to get better. In addition, once loss of function occurs, you may never regain full function.

Demos/Stories/Examples:

Ask participants if they can share any experiences with MSDs or cumulative disorders. Ask them to describe the progression of an MSD and to describe how long it took to get better.
Suggested Discussion Points:

- The vertebrae are the bones of the spine.
- Vertebrae provide support and protection to the spinal cord.
- Between each vertebra is a disc. The disc is a large, round ligament that connects the vertebrae together.
- The disc serves as a shock absorber.

Demos / Stories / Examples:

*Video: Click on the vertebrae to start the video, and then click it again to stop the video when you are done. To move to the next slide, make sure your pointer is no longer on the picture. This will allow the presentation to advance.* The disc is subjected to different types of stress as we use our backs each day. The disc generally acts as a shock absorber. Bending over results in compression of the disc and will cause the disc to bulge. Twisting and bending together is perhaps the greatest stress on the parts of the spine, especially the disc.

*Marshmallow Demo:* To demonstrate how the discs behave between the vertebrae, give each participant two vanilla wafers and a large/jumbo marshmallow. Have them place the marshmallow between the two vanilla wafers and squeeze the two vanilla wafers together causing the marshmallow to bulge outside of the vanilla wafer “sandwich.” The marshmallow represents a
spinal disc and its ability to compress and expand. Vanilla wafers represent two vertebrae and their ability to protect the disc. The nature of the disc (marshmallow) allows us to be able to bend and twist.

**Props/Materials Needed:**

- Vanilla wafers (two per participant)
- Large fresh marshmallows (one per participant)

**Handouts / Tools / Reference Materials:**

Suggested Discussion Points:

- Degeneration occurs when wear and tear causes deterioration of the disc—small tears occur in the ligament. Over time, the tears may become bigger and longer (like when your favorite jeans get old and begin to fray).
- Repeated lifting, combined with bending and twisting, may lead to injury and degeneration of the disc.

Demos / Stories / Examples:

*Video:* Click on the vertebrae to start the video, and then click it again to stop the video when you are done. To move to the next slide, make sure your pointer is no longer on the picture. This will allow the presentation to advance. When the disc degenerates, pain receptors in the outer region are activated and a person can experience back pain. In addition, if the tears in the disc reach the outer layers, the center of the disc can protrude through the tears and push against the spinal nerves and cause severe pain. When this condition occurs, it is called a herniated disc.
*Paper Clip:* Pass out one paper clip per individual, and ask him/her to straighten the paper clip. Once the paper clips are unfolded and more or less straight, have the participants bend it back and forth at the same point, counting how many bends it takes to break the paper clip. Have the participants share the number of bends required to break the paper clip.

*Soda Pop Can:* Have the participants press down on the top of an empty soda pop can. No matter how hard the can is pressed, it will not collapse. Now have them gently press on the side of the can with one finger to cause a dent, and then press down on the top of the can. The can will compress off to one side.

The discussion point that should be addressed with these examples is that the same principle applies to the human back—the more you bend it, the weaker it becomes. Also, this example highlights that everyone’s breaking point is different, which makes it difficult to define how many times it is safe to bend over and lift something or what weight is a safe weight to lift. It varies from person to person, just like the number of bends varied to break the paper clip.

**Props/Materials Needed:**

- Paper clips (enough for one per participant)
- Empty soda pop can with no indentations

**Handouts / Tools / Reference Materials:**

**Suggested Discussion Points:**

This slide shows the same spine 20 years apart. This is an example of the type and level of degeneration that can occur. Note the extensive level of degeneration of the disc and the bone.

Although the specific cause of this degeneration is not important, it is important to know that its progress can be delayed. While some degeneration occurs with aging, its progress may be accelerated by heavy physical work, vibration exposure, smoking, and genetics.

Applying ergonomics will reduce the stress experienced by the body and will minimize the degree of degeneration from exposures to risk factors. Ergonomics promotes healthy aging so you can have a higher quality of living.

**Handouts / Tools / Reference Materials:**

Anatomical models illustrating normal spines and spines with degeneration are available from [www.backtalksystems.com](http://www.backtalksystems.com).
Suggested Discussion Points:

- The carpal bones in the wrist and the transverse carpal ligament form a “tunnel” in the wrist.
- The space in the tunnel is fixed and it cannot be expanded.
- The median nerve and the tendons that move the fingers pass through this tunnel.

Handouts / Tools / Reference Materials:

Suggested Discussion Points:

- The median nerve (yellow) and flexor tendons (white) pass through the carpal tunnel opening.
- The sheath (blue), or tenosynovium, that covers the tendons is very slippery and allows the tendons to glide against each other as the hand is used to grasp objects.
- Any condition that irritates the tendons, such as repeatedly bending the wrist and applying force, can result in swelling and thickening of the sheath.
- Inflammation of tendons and the sheath can cause discomfort or tendonitis.
- The swelling of the sheath reduces the space in the carpal tunnel.

If this condition gets to a point where increased swelling and pressure squeezes the median nerve against the ligament, carpal tunnel syndrome develops. This can result in numbness, tingling, and pain in the hand(s). Surgical releases are commonly performed to reduce the pressure, but scar tissue formed from the surgery can actually reduce the size of the tunnel. If the person goes back to the same working conditions, symptoms are likely to recur. Symptoms are often most acute while sleeping, since blood pressure is reduced. Advanced cases may result in permanent weakness and clumsiness of the hand.
Demos / Stories / Examples:

Ask the participants to rub their hands together and ask them what they feel. The heat that occurs is due to friction. Think about your hands as the tendons in your wrist passing through the carpal tunnel. This internal heat generated by the tendons rubbing against each other can lead to inflammation and pain.

Video: Click on the tendon picture with the black background to start the video, and then click it again to stop the video when you are done. To move to the next slide, make sure your pointer is no longer on the picture. This will allow the presentation to advance. The sheath (blue) that covers the tendons is very slippery and allows the tendons to glide against each other as the hand is used to grasp objects.

Handouts / Tools / Reference Materials:

**Suggested Discussion Points:**

- Trigger finger affects the movement of the tendons as they bend the fingers to form a fist.
- The tendons that move the fingers are held in place on the bones by a series of narrow ligaments. These ligaments form an arch or tunnel on the surface of the bone for the tendon to run through along the bone.
- When trigger finger occurs, the constant irritation from the tendon repeatedly sliding through the tunnel causes the tendon to swell in this area and form a nodule.
- Repeated trauma from pistol-gripped power tools or long hours grasping a steering wheel can cause trigger finger.

The symptoms of trigger finger include pain and a clicking sensation when the finger is bent. Tenderness usually occurs over the area of the nodule. The clicking sensation occurs when the nodule moves through the tunnel. If the nodule becomes too large, it may pass under the ligament and then not be able to return. If the nodule cannot move back through the tunnel, the finger will be locked in a flexed trigger finger position.
# MSDs vs. Heart Disease

<table>
<thead>
<tr>
<th>Disease (Injury)</th>
<th>Heart Disease</th>
<th>MSDs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Signs</strong></td>
<td>Artery blockage</td>
<td>Loss of muscle function/decreased range of motion</td>
</tr>
<tr>
<td><strong>Symptoms</strong></td>
<td>Shortness of breath/chest pain/arm pain</td>
<td>Pain/numbness/fatigue/tingling</td>
</tr>
<tr>
<td><strong>Risk Factors</strong></td>
<td>High blood pressure/smoking/no physical activity/age/male/race/high cholesterol/high triglycerides</td>
<td>Excessive force/poor posture/repetition</td>
</tr>
<tr>
<td><strong>Root Cause</strong></td>
<td>Lifestyle/Genetics</td>
<td>Object weight/workstation design/position of work piece</td>
</tr>
</tbody>
</table>

*Address root causes to improve health!*

## Suggested Discussion Points:

- MSDs develop over time similar to other types of diseases, such as heart disease.
  - MSDs and heart disease have signs and symptoms.
  - MSDs and heart disease have risk factors and root causes.
- MSDs are not like some diseases that progress even if the exposure stops. MSDs can be reversed if the exposure is reduced and permanent damage has not already occurred.

## Demos / Stories / Examples:

Ask participants to name other diseases that would be similar to MSDs.

Examples: diabetes, arthritis, silicosis.
Take Action!

As soon as you are aware of early warning signals

Report Your Concerns

Early action may prevent loss of function and serious injury!

Suggested Discussion Points:

- Do not assume that fatigue or discomfort is just “part of the job.”
- It is important to learn to recognize early warning signals and take action.
- Discuss the reporting procedure used by your organization, i.e., report to supervisor, ergonomics committee, safety director, etc.

Demos / Stories / Examples:

Ask participants about the right procedure for their site.
Suggested Discussion Points:

- Risk factor exposures may result in discomfort or an MSD.
- In addition to looking for and eliminating safety hazards, such as an unstable ladder or an oil spill on the floor, it is vital to identify and control risk factors.
Risk Factor Effects

Are hard to predict, they depend on:

- **Who** is doing the work
- **How many** risk factors there are
- **How much** there is of each risk factor
- **How** the work is done
- **How often** the work is done

Suggested Discussion Points:

- Exposure to risk factors may have some effect on workers.
- Effects of risk factors depend on:
  - Who?
  - How many?
  - How much of each risk factor?
  - How often the exposure occurs (days per week and times per day)?
  - How the work is done (tools, techniques used, or work station layout)?
- Early effects of risk factors are more likely if:
  - A worker is exposed to extreme levels.
  - Multiple risk factors are in play, e.g., bending and twisting while lifting.
  - A worker has a preexisting weakness due to heredity or a previous injury or illness.
Musculoskeletal Disorder
Risk Factors

Four Main Risk Factors

1. Forceful Work - A lot of physical effort
2. Poor Posture - Poor positioning of the body
3. Repetitive Work - Doing the same movements many times
4. Vibration Exposure - Two types: hand-arm and whole body

Suggested Discussion Points:

- Much research has been done to identify risk factors that result in MSDs.
- The four main musculoskeletal injury risk factors that are found in mining environments are:
  - Force
  - Posture
  - Repetition
  - Vibration

Handouts / Tools / Reference Materials:

Examples of Forceful Work

- Heavy lifting
- Carrying heavy objects
- Forceful pushing or pulling
- Forceful gripping
- Shoveling damp or heavy materials

Suggested Discussion Points:

- Examples: Heavy lifting or carrying, forceful pushing or pulling, forceful gripping, and shoveling
- The actual force needed to do a job depends on many factors, such as: the task being performed, weight and shape of objects being handled, type of grip being used, and ability to get a good grip.
- Strength is a function of body position. The amount of force that one can produce by the body will depend on the body position and the specific muscles being used. For example, if you are lifting an object at knee height versus shoulder height, a person could lift a heavier object at their knees using the leg muscles than at their shoulders using the shoulder/arm muscles.

Demos/Stories/Examples:

*Video: Click on the picture to start the video, and then click it again to stop the video when you are done. To move to the next slide, make sure your pointer is no longer on the picture. This will allow the presentation to advance. A quality control technician is obtaining a sample from a railcar. This is done several times during the shift. Play the video and ask the participants to identify the risk factors they observe. The risk factors shown in this video include shoveling, forceful pulling, heavy lifting, and carrying.*
Examples of Poor Posture

- Trunk bent over more than 20 degrees
- Twisting the trunk or head
- Elbows above shoulders
- Extended forward reaches
- Reaching behind the body
- Extreme wrist bending
- Pinch grips
- Kneeling or squatting
- Static position

Suggested Discussion Points:

- It is common for workers to use postures that put stress on their bodies.
- Elbows above shoulders, extended forward reaches, trunk bending, extreme wrist bending, pinch grips, and kneeling or squatting are poor postures often seen in the work environment.
- Because work is dynamic, several different safe postures should be used throughout the work shift.

Demos / Stories / Examples:

Video: Click on the picture to start the video, and then click it again to stop the video when you are done. To move to the next slide, make sure your pointer is no longer on the picture. This will allow the presentation to advance. This worker is welding. Awkward postures shown in the video include static posture, reaching with arm, and twisted and bent neck. This worker is wearing a powered air-purifying respirator.
Demonstrate examples of some of the poor postures (see pictures below demonstrating poor postures):

- Raise your hands and elbows above your shoulders and demonstrate using the power tool (screwdriver) from the earlier slide.
- Bend your wrist in extreme flexion and extension.
- Pick up a binder using a pinch grip.

Ask participants what they think is a safe posture. A good rule of thumb is to work with your joints at about the midpoint of their range of motion. Demonstrate a neutral posture for the wrist and arm.

- The wrist is straight—no wrinkles should be visible.
- The arm should be bent about 90° at the elbow.
Demonstration of the differences between pinch and power grip strengths: Ask for two volunteers. Obtain maximum strength levels for both types of grips using a dynamometer. Record results on a white board or flip chart. Ask for two more volunteers and obtain their maximum power and pinch grips. Record the results. Discuss the differences between power and pinch grips. The pinch grip should be around 20% of the power grip. Ask the participants: if they had a choice, which grip they would use? Tasks should be designed to use power grips and not pinch grips.

Two sources for dynamometers include:

The Human Solution
12417 River Bend, Suite 12
Austin, TX  78732
Phone:  1–800–531–3746
http://www.thehumansolution.com/dynamometers.html

Nexgen
6600 Trans Canada Highway
Suite 750
Pointe Claire (Montreal), Quebec
CANADA   H9R 4S2
Phone:  514–685–8593
http://www.nexgenergo.com/medical/baseline1.html
Examples of Repetitive Work

- Using equipment controls
- Machine paced assembly tasks
- Packing or unpacking items
- Computer keyboarding
- Manning a store checkout line

Suggested Discussion Points:

- Highly repetitive motions are repeated every few seconds or minutes.
- Using equipment controls, machine-paced assembly tasks, packing or unpacking items, computer keyboarding, and working at a store checkout line are commonly repetitious jobs.
- Some parts of the body are more likely to be affected by repetitive motion than others, e.g., the wrist, elbow, and shoulder.
- Repetition is more critical as a risk factor when combined with another risk factor, such as force or awkward posture. An example would be using a sledgehammer. Using it once would not generally be a problem, but using it many times could result in fatigue and possibly an injury.

Demos / Stories / Examples:

Video: Click on the picture to start the video, and then click it again to stop the video when you are done. To move to the next slide, make sure your pointer is no longer on the picture. This will allow the presentation to advance. This worker is operating a surface drill. He manipulates the levers and switches throughout the shift. Also, note the awkward postures: forward reach and twisted neck.
Handouts / Tools / Reference Materials:

Ergonomics – high repetition.
Examples of Vibration Exposure

- Whole Body - Sitting or standing on vibrating surfaces (includes jolting and jarring)
- Hand-Arm - Using vibrating tools

Suggested Discussion Points:

- Hand-arm and whole-body vibration are the primary forms of vibration exposure.
- Commonly used power tools like sanders and drills have moderate hand-arm vibration levels.
- Tools like impact wrenches and jackhammers have high hand-arm vibration levels.
- Whole-body vibration is often caused from riding in mobile equipment like haul trucks or forklifts.

Short-term effects of too much hand-arm vibration are reduced blood flow and loss of ability to feel things that are cold, hot, rough, or sharp.

Exposure to whole-body vibration may also cause headaches, nausea, and back problems.

How can we protect ourselves from hand-arm vibration?
Demos / Stories / Examples:

*Video*: Click on the picture to start the video, and then click it again to stop the video when you are done. To move to the next slide, make sure your pointer is no longer on the picture. *This will allow the presentation to advance.* This is a video of mechanic using a grinder. This is an example of moderate arm-hand vibration.

Also, you could ask how we could protect ourselves from hand-arm vibration. Answers may include antivibration gloves, properly setting the torque, and selecting the proper tool for the job.

Handouts / Tools / Reference Materials:

Other Risk Factors

- Environmental Factors - temperature/humidity/altitude
- Contact Stress – sharp edges
- Pressure Points
- Torque Reaction

Suggested Discussion Points:

There are other risk factors that occur at mining sites. They include:

- Pressure points
- Contact stress (sharp edges on desk/table tops)
- Environmental conditions: heat stress, cold stress, high humidity, altitude
- Restricted spaces: working under vehicles

This worker is working under a vehicle in a restricted working space.

Demos / Stories / Examples:

Ask the participants to identify the risk factors observed in the photo: restricted space, perhaps pressure points, lying on back.
Compounding Risk Factors

Higher Priority!

More than one risk factor present

Reducing any one of the risk factors will significantly reduce the probability of injury.

Suggested Discussion Points:

- An MSD is more likely to occur if the exposure involves multiple risk factors.
- Reducing the exposure to some of the risk factors will significantly reduce the chance of developing an MSD.

Demos / Stories / Examples:

Ask the participants for examples of multiple risk factor exposures they have seen.

- Lifting and twisting the trunk of the body
- Operating a heavy power tool with a bent wrist
- Operating a joystick with a bent wrist
- Reaching above your head while holding a tool

Video: Click on the picture to start the video, and then click it again to stop the video when you are done. To move to the next slide, make sure your pointer is no longer on the picture. This will allow the presentation to advance. Play the video and ask the participant to identify the risk factors observed.
These workers are rebuilding a crusher and need to remove the springs. Risk factors observed include forceful exertions, forceful gripping, impacts from the hammer, repetition, and working above shoulder level.
Homework

- Identify tasks that you do or other workers do that have exposures to risk factors.
- Complete a concern card for each task - Describe the task and risk factors. Indicate if you have any discomfort.
- Try to complete at least 2 concern cards.
- Bring your cards to the next session.

RISK FACTOR REPORT CARD

1. Work Area / Job Title: __________________________
2. Describe task: ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________

3. Check all risk factors that apply:
   □ Poor Posture  □ Forceful Gripping
   □ Repetitive Work □ Heavy Lifting/Carrying
   □ Vibrating Tools  □ Bouncing/Jarring
   □ Static Posture  □ Heavy Shoveling
   □ WB Vibration  □ Forceful Push/Pull
   □ Other risk factors: _______________________

4. Place X on affected areas.

5. Comments/suggestions: ______________________________________________________
                           ______________________________________________________

6. Plant/Mine Name: ______________________

Suggested Discussion Points:

- The homework gives the participants practice at identifying risk factors associated with their jobs.
- Discuss how to complete the card. Use an example of a completed card.

Handouts / Tools / Reference Materials:

- Risk Factor Report Card
- Example of a completed Risk Factor Report Card

*If you choose not to do the homework assignment, delete this slide from the presentation.*
Provide date and time for the second session.

Tell participants the topics that will be covered during the second session:

- Review risk factors
- Learn:
  - Why risk factors occur (root causes)
  - How to control risk factors
- Practice:
  - Identifying risk factors
  - Improving jobs