Module 3: Hazard Identification & Prevention

❖ Lecture Objectives

This module defines hazards and risks and demonstrates how to identify and recognize workplace hazards; and presents general principles quantifying and for reducing risks.

What is a hazard?

An unsafe condition or practice that could cause an injury or illness to an employee.

What is exposure?

When someone is within the “danger zone.”

• Physical exposure. When the person is generally within arm’s length.
• Environmental exposure. Due to noise, hazardous atmospheres, temperature extremes. These hazards could affect everyone in the facility.

How does your perception about the severity of a hazard change with daily exposure to that hazard?

The more we’re exposed to a hazard without getting hurt, the more we trivialize the hazard.

What you see are merely the surface symptoms

Hazardous conditions and unsafe or inappropriate behaviors you see in the workplace are the observable symptoms or effects of deeper system root causes.
Surface symptoms:
- Are unique conditions or individual behaviors (you can point at a person or object)
- May exist or be performed by anyone, anytime, anywhere
- May directly cause or contribute to an incident or accident
- May be important clues revealing root causes

**Where do injuries come from?**

**Unpreventable acts.**

Only 2% of all workplace accidents are thought to be unpreventable. Heart attacks and other events that could not have been known by the employer are examples of unpreventable acts. Companies often try to place most of their injuries into this category. They justify these beliefs with such comments as: "He just lifted the box wrong and strained his back. What could we do?" Unfortunately, they are excuses for not looking into the "root cause" of the injury.

**What procedures do we use to detect and correct hazardous conditions?**

Inspection, observation, job hazard analysis, incident/accident analysis.

**System failure.**

Safety management system failures account for at least 98% of all workplace accidents. System failures refer to inadequate design or performance of safety programs that provide training, resources, enforcement, and supervision.
Types of Hazards in the Workplace

1. **Falls.** Lt. Chissov fell 22,000 feet and survived. Others who were not so lucky have died falling on a slippery floor. It's not how far you fall, it's how you land! The most common types of accidents are **falls to the same surface**, and **falls to below**. The severity of injury from a fall depends on three factors:
   1. velocity of an initial impact
   2. magnitude of deceleration - due to hardness of the surface
   3. orientation of the body on impact

2. **Impact.** Impacts resulting in **struck by** and **struck against** may cause serious accidents. The severity of injury from impacting objects depends on three factors:
   1. velocity of the impact
   2. characteristics of the object (size, hardness, shape etc.)
   3. body part impacted

3. **Mechanical.** If it's mechanical, and it moves, it's a hazard. There are as many hazards created by moving machine parts as there are types of machines. Mechanical hazards cause **caught-in, caught-on**, and **crush** accidents that can cut, crush, amputate, break bones, strain muscles, and even cause asphyxiation.

**Mechanical Hazard Motions**
1. Rotating 2. Reciprocating 3. Transverse

**Mechanical Hazard Actions**
4. **Vibration and Noise.** Tools, equipment, and machinery that vibrate at a low frequency can injury a part of the body or the whole body. However, the most common sound-induced injury is due to high frequency vibration. Low frequency vibration hazards exist in two primary categories:

1. **Segmental Vibration.** Exposure to equipment that vibrates at various frequencies can affect different parts of the body. For instance, the hands are most sensitive to vibrations at 30-40 cycles per second. Internal organs can be affected by vibrations as low as 4-10 cycles per second.

2. **Whole-Body Vibration.** Very low frequencies can affect the entire body. For instance, truck drivers experience continuous whole-body vibration as they travel. That's one reason truck driving is considered one of the most hazardous tasks for lower back injuries.

5. **Toxics.** Virtually all materials may be toxic to some extent. In the workplace, a material is toxic if a small quantity can cause an injurious effect, such as tissue damage, cancer, mutations. It's important to consider the routes of entry of toxic materials into the human body. There are four possible routes of entry:

1. **Inhalation.** Breathing in toxics is the most common and dangerous route.

2. **Ingestion.** Toxics enter through the gastrointestinal tract.

3. **Absorption.** Toxics pass through skin into the bloodstream.

4. **Injection.** Toxics may be injected into the body (needles, etc). The least common, yet most direct route of entry.

6. **Heat and Temperature.** Overexposure to heat and temperature extremes may result in a range of injuries from burns to frostbite. Temperature indicates the level of heat present. The second law of thermodynamics states that heat will flow from an area of higher temperature to one of lower temperature. Heat is produced as a result of chemical reaction, combustion, electrical current, mechanical motion and metabolism. Heat is transferred by:

- **Convection.** Heat is transferred by molecules moving through a fluid, gas or liquid.
- **Radiation.** Occurs when a body's temperature is above absolute zero.
- **Conduction.** Heat is transferred through a substance or between substances without physical movement of the substances itself.
7. Flammability/Fire. Fire may cause burn injuries. In order for combustion to take place, the fuel and oxidizer (oxygen) must be present in gaseous form. Flammable materials include:
- fuel solvents
- cleaning agents
- lubricants
- coatings
- chemicals
- refrigerants
- insecticides
- plastics
- hydraulic fluid
- vegetation
- wood/paper
- fabrics
- metals
- rubber products

8. Explosives. The results of an explosion may range from minor injury to major catastrophe (Space Shuttle Challenger). Instantaneous release of gas, heat, noise, light and over-pressure creates a wave front that damages anything in its path. About 2 billion pounds of explosives are used by industry annually in construction, mining, quarrying, and seismographic work. Many types of explosions may occur:
- chemicals
- solids
- gases
- dusts
- vapors
- equipment

9. Pressure Hazards. High and low pressure conditions in the workplace can result in injury. Standard atmospheric pressure is 14.7 pounds per square inch (psi). High pressure gas distribution lines are considered high-pressure when operating at 2 psi or higher. The American Society of Mechanical Engineers (ASME) rate boilers which operate at more than 15 psi as high-pressure. The pressure in full cylinders of compressed air, oxygen, or carbon dioxide are over 2000 psi! Examples of pressure hazards include:

- **Ruptured cylinders.** The thrust generated by gas flowing through a puncture or rupture of a cylinder can be 20 times greater than the weight of the cylinder and reach velocity of 50 feet per second in 1/10th of a second! The result: a missile.

- **Whipping hoses and lines.** Compressed air and water hoses can kill when end fittings become loose. Such hoses and lines should be restrained by weighting with sand bags at short intervals, chained, clamped, etc. Never try to grab a whipping hose or line: turn off the controlling valve.

- **Water hammer.** The effect caused by a sudden stop of liquid flow causing a shock wave (water hammer) that can cause a line rupture. Have you ever heard a pipe "clang"?
10. Electrical contact. Exposure to electrical current may cause injury or death.
The voltage is not so important as the amount of current. It doesn't take much current to kill. There are five principle categories of electrical hazards:

**Shock.** Electrical shock is a sudden and accidental stimulation of the body's nervous system by an electrical current. Look for bare conductors, insulation failures, buildup of static electricity, and faulty electrical equipment.

**Ignition of combustible (or explosive) material.** Ignition is usually caused by a spark, arc, or corona effect (ionized gas allows a current between conductors).

**Overheating.** High current creates high heat that can result in fires, equipment burnout and burns to employees.

**Electrical explosions.** Rapid overheating of circuit breakers, transformers, and other equipment may result in an explosion.

**Inadvertent activation of equipment.** Unexpected startup of equipment and machinery can injure and kill. That's why we have lockout/tagout procedures.

11. Ergonomics. Improper lifting, lowering, pushing, pulling, and twisting can cause strains and sprains. Ergonomics-related hazards are the most common source of injury in the workplace. About 45% of all claims are related to ergonomics! Ergonomics hazards exist in:

- The **worker** - physical/mental capability, preexisting conditions, etc.
- The **task** - work that includes high force, repetition, frequency and duration, and inappropriate posture, point of operation.
- The **environment** - noise, temperature, humidity, color, etc.

12. Biohazards. Exposure to plants, animals or their products that may be infectious, toxic or allergenic may cause illness and disease. People who work with animals, animal products or animal wasted have a greater risk of infection. Biohazard agents include:

- **Bacteria** - simple, one-celled organisms that may or may not be harmful.
- **Viruses** - organisms that depend on a host cell for development and reproduction.
- **Fungi** - may be small or large (mushroom) parasitic organisms growing in a living or dead plant or animal matter.
**Rickettsia** - rod-shaped microorganisms that are smaller than bacteria and depend on a host for development and reproduction. Microorganisms Transmitted by fleas, ticks and lice.

13. **Workplace Violence.** Workplace violence is any violent act that occurs in the workplace and creates a hostile work environment that affects employees’ physical or psychological well-being. A risk factor is a condition or circumstance that may increase the likelihood of violence occurring in a particular setting. Risk factors include:

- Employee contact with the public
- Exchanging money
- Selling/dispensing alcohol or drugs
- Delivering passengers, goods or services
- Mobile workplace (such as a taxicab or police cruiser)
- Exposure to unstable or volatile persons (such as in health care, social services)
- Employees working alone, late at night/early morning, or in small numbers
- Employees working in high-crime areas
- Employees guarding valuable property or possessions
- Employees working in community settings
- Employees deciding on benefits, or in some other way controlling a person’s future, well-being, or freedom (such as a government agency)

### Four Strategies to Identify and Analyze Hazards

1. **The Safety Inspection and Audit**

   Regular safety inspections and occasional audits are important in making sure the workplace remains free of hazards that could cause injury or illness.
   - The ***inspection*** examines conditions in the workplace to identify hazards. This is what the safety committee typically performs each quarter.
   - The ***audit*** evaluates the quality of program design and performance to better control hazards. This is what the safety committee needs to perform to ensure continuous improvement.
How to develop an effective inspection checklist

1. Determine applicable state safety & health rules for the workplace.

2. Review OSH Act and use those that apply to your workplace. Become familiar with the rules that, if violated, would result in serious physical harm or fatality.

2. Observation

It is important to overcome the inherent weakness in the walkaround inspection process by developing and using informal and formal observation procedures.

Informal Observation
Employees and managers can spot hazardous conditions and unsafe/inappropriate behaviors while they conduct their daily work tasks.

Formal Observation
Simple observation programs, plans and procedures can be successful tools for gathering and analyzing data to improve the safety management system. Employees are assigned to make observations and report results for statistical analysis.

3. The Job Hazard Analysis (JHA)

Although not required by OR-OSHA rules, the Job hazard analysis (also called a job safety analysis) is an excellent process that separates a job into its basic steps. Each step is then analyzed to identify actual and potential hazards. Once the hazards are known, safe job procedures are developed.

The JHA can be valuable in helping present on-the-job training (OJT). The JHA is also an opportunity for management to involve employees in developing safe work procedures.
4. The Incident/Accident Analysis

All non-injury incidents and injury accidents, no matter how minor should be analyzed to identify and control hazards.

• **Incident analysis** allows you to identify and control hazards before they cause an injury. It’s always smart business to carefully analyze non-injury incidents.

• **Accident analysis** is an effective tool for uncovering hazards that either were missed earlier or have managed to slip out of the controls planned for them. Both processes are most useful when done with the goal of discovering all of the underlying contributing root causes.

The two primary phases in the incident/accident analysis process

1. **Event analysis.** Analyze the event (near-miss, accident) to determine what happened. Identify the events that occurred prior to and including the injury event.

2. **Cause analysis.** Evaluate each event for direct and contributing surface causes. Surface causes are unique hazardous conditions and/or unsafe behaviors that may have directly caused or contributed to the incident or accident. Next, evaluate the root causes in the safety management system to determine if any failure in its design or performance may have contributed to the incident or accident. Ask if the system is failing to perform in one or more of these areas:

   • Training. Was training adequately designed, presented, and documented?
   • Resources. Were adequate physical resources and support provided?
   • Enforcement. Are safety policies and rules consistently enforced?
   • Supervision. Are supervisors identifying hazards before workers get hurt?
   • Leadership. Are supervisors and managers meeting obligations to workers?
The Hierarchy of Controls

To most effectively improve the safety and health management system, we need to anticipate potential hazards before they exist. Absent that, we need to control existing hazards when they've been identified. According to best practices there are two primary control strategies are used:
Control the hazard
Control exposure to the hazard

1. Controlling hazards by engineering the workplace

To "furnish a safe and healthful workplace," means to design the workplace so that tools, equipment, machinery, materials, and the work environment are free (if feasible) from hazards that could cause injury or illness. The most effective plan is to control the hazard because, after all, if you can get rid of the hazard, you don't have to control exposure to the hazard. We do this through sound engineering. There are two hazard control strategies:
• Eliminate the hazard
• Reduce the hazard
If hazard control strategies are not as effective as they need to be, you we may need to also use exposure control strategies.

2. Controlling exposures by managing work and workers

To "furnish work that is safe and healthful," means to design procedures and practices so that employees are free (if feasible) from exposure to hazards that could cause injury or illness. There are also two exposure control strategies:
• Eliminate the exposure
• Reduce the exposure

Engineering Controls - Eliminate or reduce hazards
These controls focus on the source of the hazard itself, unlike other types of controls that generally focus on the employee exposed to the hazard. The idea is engineer the work environment and the job itself to eliminate or reduce the hazards. Engineering controls use the following strategies to eliminate or reduce hazards:

**Substitution.** Substitute something that is not hazardous or is less hazardous. Examples include:
- Replacing defective tools, hazardous equipment and machinery
- Substituting toxic substances with non-toxic or less-toxic substances

**Design.** If feasible, design or redesign the facility, equipment, or process to remove the hazard and/or substitute something that is not hazardous or is less hazardous. Examples include:
- Redesigning tools, equipment, machinery and materials
- Redesigning a chemical process to use less toxic chemicals
- Designing workstations to be more ergonomically correct

**Enclosure.** If removal is not feasible, enclose the hazard to prevent exposure in normal operations. Examples include:
- Complete enclosure of moving parts of machinery
- Complete containment of toxic liquids or gases
- Complete containment of noise, heat, or pressure-producing processes

**Barriers.** Where complete enclosure is not feasible, establish barriers to prevent access to the hazard.
- Machine guarding, including electronic barriers
- Baffles used as noise-absorbing barriers

**Ventilation.** or local ventilation to reduce exposure to the hazard in normal operations. Examples include:
- Ventilation hoods in paint booths and laboratories
- Force air ventilation in confined spaces

**Management Controls – Eliminate or Reduce Exposure**
Management controls eliminate or reduce exposure to hazards through strategies such as changing work habits, improving sanitation and hygiene practices, or making other changes in the way the employee performs the job. The focus is on managing what employees do. There are three basic management control strategies to eliminate or reduce exposure to hazards:

**Practices.** Some of these practices are very general in their applicability. They include housekeeping activities such as:

- Using personal protective equipment (PPE).
- Placing warning signs that inform and restrict access
- Removing tripping, blocking, and slipping hazards
- Removing accumulated toxic dust on surfaces
- Wetting down surfaces to keep toxic dust out of the air

**Procedures.** These procedures apply to specific jobs in the workplace. Use the JHA to help develop procedures.

- Permit-required confined space entry procedures
- Lockout/Tagout procedures
- Fork-lift safety inspection procedures

**Schedules.** Measures aimed at reducing employee exposure to hazard by changing work schedules. Such measures include:

- Lengthened rest breaks
- Additional relief workers
- Exercise breaks to vary body motions
- Rotation of workers through different jobs

**Effective Maintenance Processes**

*What two general types of maintenance processes are needed?*

1. **Preventive maintenance** to make sure equipment and machinery operates safely and smoothly.
2. **Corrective maintenance** to make sure equipment and machinery gets back into safe operation quickly.
Module 3: Hazard identification and prevention

1. Define the term Hazard
2. Identify workplace hazards
3. Describe the hierarchy of Hazard control
4. Describe a classification of hazards as Class A, B and C giving examples in each case
5. Describe for any named work environment the five elements of hazard source concern, Hint use the acronym (PEMEP)
6. Describe the following hazards giving examples in each case:
   a. Physical
   b. Biological
   c. Ergonomic
   d. Chemical
7. For each of the following type of jobs identify the possible hazards and the hazard control method that may be employed:
   a. Welding
   b. Port work
   c. Hospital laboratory attendant
   d. Agriculture worker
   e. Office worker
   f. Mechanic
8. Identify different types of personal protective equipment and describe when they may be used.
9. Who is capable of inspection of person protective equipment (PPE)?
10. Why do you think that PPE is the last resort to protection against hazards?
11. List the methods used to identify hazards and correct hazardous conditions
12. Identify some general safety factors that may be employed to prevent workplace hazards and reduce risks
13. Define what is meant by a risk giving an example to illustrate your answer
14. Distinguish between a risk and a hazard
15. Identify the routes of entry into the body
16. What does the term WRULD stand for?
17. Give some examples of WRULD
18. Describe the two primary categories for low frequency vibrational hazards