

**Chapter 14**

**Workplace Safety and Health**

## **14 Introduction**

One of the important goals in the workplace is to provide a safe working environment for employees and visitors. Workplace injuries, both nonfatal and fatal, continued to pose significant challenges in the U.S., affecting various industries differently. Workplace injuries have enormous consequences on the worker, the worker's friends and family, productivity, medical needs, insurance claims, worker's compensation, and society. Here's an overview of the statistics and their societal costs:

### **14.1 Daily Workplace Injury and Fatality Statistics in the U.S.**

#### **14.1.1 Nonfatal Workplace Injuries**

On average, there are approximately 7,500 nonfatal workplace injuries each day in the U.S. This figure is derived from the 2.7 million nonfatal workplace injuries reported in 2022, assuming a standard 365-day year.

The U.S. Bureau of Labor Statistics (BLS) reported approximately 2.7 million nonfatal workplace injuries and illnesses in 2022, which translates to an incidence rate of 2.7 per 100 full-time equivalent (FTE) workers in private industry. Key industries with the highest numbers of nonfatal injuries included:

- Healthcare and Social Assistance: 453,200 injuries
- Retail Trade: 352,800 injuries
- Manufacturing: 334,500 injuries
- Transportation and Warehousing: 235,200 injuries
- Accommodation and Food Services: 182,500 injuries
- Construction: 162,500 injuries

Industries with the highest rates of nonfatal injuries per 100 FTE included Transportation and Warehousing and Agriculture, Forestry, Fishing, and Hunting, both at 4.3.

#### **14.1.2 Fatal Workplace Injuries**

The daily average for fatal workplace injuries is about 14 workers. This estimate comes from the total of 5,190 fatal workplace injuries reported in 2022.

In 2023, the BLS reported 5,190 fatal workplace injuries, representing an increase from previous years. Industries with the highest numbers of fatal injuries were:

- Construction: 1,008 fatalities
- Transportation and Warehousing: 804 fatalities
- Agriculture, Forestry, Fishing, and Hunting: 511 fatalities

### **14.1.3 Workplace Diseases**

Workplace diseases, which often result from long-term exposure to harmful substances, account for a significant number of deaths annually. According to the Occupational Safety and Health Administration (OSHA), about 95,000 workers die each year from diseases contracted on the job. This results in an average of approximately 260 deaths per day due to workplace diseases.

### **14.1.4 Costs to Society**

The National Safety Council (NSC) highlighted that the financial impact of workplace injuries is substantial. For instance, the average cost per work-related injury, including medical expenses and lost wages, was estimated at \$41,353. The most expensive injuries included:

- Amputation: \$118,837 per injury
- Fracture or Dislocation: \$60,934 per injury
- Burns: \$48,671 per injury

Motor vehicle accidents were the costliest type of work-related accident, averaging \$85,311 per incident.

## **14.2 Classification of an Industrial Accident**

An industrial accident is any unplanned, sudden event in an industrial setting that results in injury, illness, or damage. This can include accidents occurring in manufacturing plants, construction sites, mining operations, and other industrial environments. These accidents often involve machinery, hazardous materials, or physical tasks and can lead to both immediate and long-term consequences for workers and the workplace.

## **14.3 Objective of Workplace Safety**

The primary objective of workplace safety is to protect the health and well-being of employees by preventing accidents, injuries, and illnesses in the workplace. This involves:

- *Creating a Safe Working Environment:* Implementing safety protocols, guidelines,

and systems to minimize risks.

- *Compliance with Regulations:* Adhering to laws and standards set by organizations like OSHA (Occupational Safety and Health Administration) and other relevant authorities.
- *Employee Training and Education:* Providing workers with the knowledge and skills to perform their tasks safely.
- *Continuous Improvement:* Regularly reviewing and updating safety practices to adapt to new hazards and technological advancements.

## 14.4 Causes of Fatal and Nonfatal Injuries

### 14.4.1 Fatal Injuries

Common causes of fatal injuries in the workplace include:

1. *Falls:* Particularly in the construction industry, falls from heights are a leading cause of death.
2. *Struck by Object:* Being hit by moving, protruding, or falling objects.
3. *Electrocution:* Contact with live electrical wires or equipment.
4. *Caught in/between:* Accidents where workers are caught in machinery or crushed by objects.
5. *Transportation Incidents:* Vehicle-related collisions, often seen in transportation and warehousing sectors.
6. *Assaults and Violent Acts:* Tragic events sometimes occur in the workplace or on the workplace property (i.e., parking lots) due to organizational or personal conflicts.
7. *Fires and Explosions.* When combustible materials ignite.

### 14.4.2 Nonfatal Injuries

Common causes of nonfatal injuries include:

1. *Overexertion and Bodily Reaction:* Strains from lifting, pushing, or pulling objects.
2. *Slips, Trips, and Falls:* Falls on the same level due to wet floors or uneven surfaces.
3. *Contact with Objects and Equipment:* Being struck by or caught in equipment.
4. *Repetitive Motion Injuries:* Injuries due to repetitive tasks, such as carpal tunnel syndrome.
5. *Exposure to Harmful Substances:* Inhalation of toxic fumes or contact with hazardous chemicals.

## 14.5 Reasons for Industrial Accidents

Industrial accidents occur due to a variety of reasons, including:

1. *Human Error*: Mistakes made by workers due to lack of training, fatigue, or misjudgment.
2. *Unsafe Working Conditions*: Poorly maintained equipment, inadequate safety measures, or hazardous environments.
3. *Failure to Follow Safety Procedures*: Ignoring established safety protocols or bypassing safety devices.
4. *Mechanical Failures*: Equipment malfunctions or breakdowns due to poor maintenance or design flaws.
5. *Lack of Training and Supervision*: Inadequate training or insufficient oversight leading to improper handling of machinery or materials.
6. *Environmental Factors*: Adverse weather conditions, natural disasters, or other external factors, such as lighting, noise, temperature, and humidity, impacting safety.

## 14.6 Types of Human Error

Human error in industrial settings can be categorized into several types, each contributing to accidents in different ways:

1. *Skill-Based Errors*: These errors occur during routine tasks that require a high level of skill and familiarity. They can be further divided into:
  - Slips: Unintended actions, such as pressing the wrong button.
  - Lapses: Forgetting to perform an action, such as omitting a step in a procedure.
2. *Rule-Based Errors*: These occur when a worker misapplies a rule or procedure. They can happen due to:
  - Misinterpretation of Rules: Not understanding the rule correctly.
  - Application of Wrong Rules: Applying a rule that is not suitable for the situation.
3. *Knowledge-Based Errors*: These happen when a worker encounters a situation for which they have no pre-set rules or procedures and must rely on their knowledge and judgment. Errors can occur due to:
  - Insufficient Knowledge: Lack of necessary information to make the correct decision.
  - Incorrect Interpretation: Misunderstanding the situation due to incorrect or incomplete information.

## 14.7 Factors Affecting Accident Rates

Several factors influence accident rates in industrial settings, often interrelated and varying across different work environments:

### 1. *Organizational Factors:*

- Safety Culture: A workplace culture that prioritizes safety can significantly reduce accident rates.
- Training and Education: Adequate training on safety procedures and equipment usage helps prevent errors and accidents.
- Management Practices: Effective leadership and supervision ensure that safety protocols are followed.

### 2. *Environmental Factors:*

- Workplace Design: Ergonomic and well-designed workspaces can minimize physical strain and reduce the likelihood of accidents.
- Lighting and Noise Levels: Proper lighting and controlled noise levels help maintain focus and reduce errors.
- Housekeeping: Clean and organized workspaces prevent slips, trips, and falls.

### 3. *Human Factors:*

- Fatigue: Tired workers are more prone to making mistakes.
- Stress: High levels of stress can impair judgment and reaction times.
- Distraction: Distractions from the task at hand can lead to lapses in attention and subsequent errors.

### 4. *Technical Factors:*

- Equipment Maintenance: Regular maintenance and inspection of equipment prevent mechanical failures that could lead to accidents.
- Technology and Automation: Proper implementation and monitoring of technology can enhance safety, but poor design or misuse can introduce new risks.

### 5. *Procedural Factors:*

- Standard Operating Procedures (SOPs): Clear, well-documented procedures ensure consistency and reduce variability in task performance.
- Compliance with Regulations: Adhering to industry standards and legal requirements helps maintain a baseline of safety.

## 14.8 One-Time vs. Cumulative Trauma Disorders

### 14.8.1 One-Time Trauma Disorders

These disorders result from a single, acute incident causing immediate injury. Examples include:

- *Fractures*: Broken bones from a fall or collision.
- *Lacerations*: Deep cuts or tears in the skin or flesh.
- *Burns*: Damage to the skin or deeper tissues caused by heat, chemicals, or radiation.
- *Concussions*: Brain injuries caused by a blow to the head.

### 14.8.2 Cumulative Trauma Disorders (CTDs)

CTDs develop over time due to repetitive stress or strain on a particular part of the body. They are caused by repetitive motions, overuse, or maintaining awkward postures for prolonged periods. Common CTDs include:

- *Carpal Tunnel Syndrome*: Compression of the median nerve in the wrist, often from repetitive hand movements.
- *Tendinitis*: Inflammation of a tendon, commonly affecting the shoulders, elbows, or wrists.
- *Epicondylitis*: Also known as tennis elbow or golfer's elbow, involving inflammation of the tendons in the elbow.
- *Bursitis*: Inflammation of the bursae, small fluid-filled sacs that cushion the bones, tendons, and muscles near joints.
- *Rotator Cuff Injuries*: Damage to the muscles and tendons that stabilize the shoulder.

#### 14.8.2.1 Common Cumulative Trauma Disorders

1. *Carpal Tunnel Syndrome*: Affects the hands and wrists, commonly caused by repetitive tasks like typing or assembly line work.
2. *Tendinitis*: Commonly affects the shoulder, elbow, wrist, and knee due to repetitive motion or overuse.
3. *Epicondylitis (Tennis Elbow)*: Results from repetitive motion of the forearm and wrist.
4. *Bursitis*: Often affects the shoulders, elbows, and hips, resulting from repetitive pressure or movements.

5. *Trigger Finger*: A condition where a finger gets stuck in a bent position, often due to repetitive gripping actions.

## 14.9 Occupational Diseases

Occupational diseases are illnesses that occur as a direct result of workplace activities or exposures. Common occupational diseases include:

- *Asbestosis*: Caused by inhalation of asbestos fibers, leading to lung damage.
- *Silicosis*: A lung disease caused by inhaling silica dust.
- *Hearing Loss*: Resulting from prolonged exposure, sometimes years, to loud noise.
- *Dermatitis*: Skin inflammation caused by exposure to irritants or allergens.
- *Lead Poisoning*: Caused by exposure to lead in the workplace, affecting multiple body systems.
- *Occupational Asthma*: Triggered by inhaling fumes, gases, dust, or other substances at work.
- *Mesothelioma*: A type of cancer linked to asbestos exposure.

## 14.10 Occupational Safety and Health (OSH) Act of 1970

The OSH Act of 1970 is a landmark law in the United States aimed at ensuring worker safety and health. Key features include:

1. *Establishment of OSHA*: The Occupational Safety and Health Administration (OSHA) was created to enforce workplace safety and health standards.
2. *Employer Responsibilities*: Employers are required to provide a safe working environment free from recognized hazards that can cause death or serious physical harm.
3. *Safety Standards*: OSHA sets and enforces safety standards, conducts inspections, and issues citations and fines for non-compliance.
4. *Worker Rights*: Workers have the right to a safe workplace, to receive training about hazards, to review records of work-related injuries and illnesses, and to file complaints without fear of retaliation.
5. *Research and Training*: The National Institute for Occupational Safety and Health (NIOSH) was established to conduct research and provide training on occupational safety and health.

### 14.10.1 Objectives of Workers' Compensation Laws

Workers' compensation laws are designed to provide financial and medical benefits to



employees who are injured or become ill due to their job. The primary objectives of these laws include:

1. *Provide Prompt and Fair Compensation:* Ensuring that injured workers receive timely and fair compensation for work-related injuries or illnesses without the need for lengthy litigation.
2. *Medical Care and Rehabilitation:* Covering the cost of medical treatment and rehabilitation necessary for the injured worker to recover and return to work.
3. *Income Replacement:* Offering wage replacement benefits to compensate for lost income while the worker is unable to work.
4. *Permanent Disability Benefits:* Providing compensation for workers who suffer permanent disabilities resulting from their injuries.
5. *Survivor Benefits:* Offering financial support to dependents of workers who die due to work-related injuries or illnesses.
6. *Encourage Workplace Safety:* Incentivizing employers to maintain safe working environments to reduce the incidence of workplace injuries and illnesses.

#### **14.10.2 Conditions to Receive Workers' Compensation Benefits**

To qualify for workers' compensation benefits, certain conditions must be met. These conditions vary by jurisdiction but generally include:

1. *Employment Status:* The injured individual must be an employee of the company at the time of the injury. Independent contractors and volunteers may not be eligible, although some states provide exceptions.
2. *Work-Related Injury or Illness:* The injury or illness must arise out of and in the course of employment. This means it must occur while the employee is performing job-related duties.
3. *Notification of Injury:* The employee must report the injury or illness to the employer within a specified time frame, which varies by state but is typically within 30 days.
4. *Medical Documentation:* The employee must provide medical documentation that supports the claim, showing that the injury or illness is work-related.
5. *Filing a Claim:* The employee must file a workers' compensation claim with the relevant state agency or workers' compensation board within a certain period, usually within one to two years from the date of the injury or diagnosis of the illness.
6. *Cooperation with Medical Treatment:* The employee must follow prescribed medical treatments and attend necessary medical evaluations as required by the workers' compensation process.

### 14.10.3 Coverage Under the OSH Act

The Occupational Safety and Health (OSH) Act of 1970 applies to most private sector employers and their employees, as well as some public sector employers and employees. However, there are specific categories of workers who are and are not covered under the OSH Act:

#### 14.10.3.1 Who is Covered by the OSH Act

1. *Private Sector Workers:* Most employees in private industries, including manufacturing, construction, agriculture, maritime, and general industry sectors.
2. *State and Local Government Workers:* In states with OSHA-approved state plans, state and local government employees are covered. State plans must be at least as effective as the federal OSHA program.
3. *Federal Government Employees:* Federal agencies must have safety and health programs that meet OSHA standards, although federal employees are not subject to OSHA enforcement.

#### 14.10.3.2 Who is Not Covered by the OSH Act

1. *Self-Employed Workers:* Individuals who are self-employed are not covered by the OSH Act.
2. *Family Farms:* Farms that employ only immediate family members are exempt from OSHA coverage.
3. *State and Local Government Workers (in states without OSHA-approved plans):* Employees in state and local governments in states that do not have OSHA-approved state plans are not covered.
4. *Workers Protected by Other Federal Agencies:* Certain workers are protected by other federal laws, such as miners (protected by the Mine Safety and Health Administration), and those working in the nuclear industry (protected by the Department of Energy).

### 14.11 Types of Recordable Cases

Under OSHA regulations, employers must keep records of work-related injuries and illnesses. These records help identify workplace hazards and improve safety. The following are types of recordable cases along with the criteria:

### 14.11.1 Recordable Case Criteria

1. *Death*: Any work-related fatality.
2. *Days Away from Work*: Any work-related injury or illness that results in days away from work.
3. *Restricted Work or Job Transfer*: Any work-related injury or illness that results in restricted work or a job transfer.
4. *Medical Treatment Beyond First Aid*: Any work-related injury or illness requiring medical treatment beyond first aid.
5. *Loss of Consciousness*: Any work-related injury or illness resulting in loss of consciousness.
6. *Significant Diagnosed Injury or Illness*: Any work-related injury or illness diagnosed by a physician or other licensed healthcare professional that is significant even if it does not result in death, days away from work, restricted work, or medical treatment beyond first aid. Examples include cancer, chronic irreversible diseases, a fractured or cracked bone, or a punctured eardrum.

### 14.11.2 Specific Criteria for Certain Conditions

1. *Needlestick Injuries*: Injuries from needlesticks or cuts from sharp objects contaminated with another person's blood or other potentially infectious material.
2. *Medical Removal*: Cases where an employee is medically removed under the medical surveillance requirements of an OSHA standard.
3. *Hearing Loss*: Work-related hearing loss when an employee's hearing test (audiogram) reveals that their hearing level has worsened by an average of 10 decibels (dB) or more in either ear at 2000, 3000, and 4000 hertz (Hz), and their total hearing level is 25 dB or more above audiometric zero in the same ear(s).
4. *Tuberculosis*: Cases where an employee is exposed to someone with a known case of active tuberculosis, and subsequently develops a tuberculosis infection.

## 14.12 Common Safety and Health Metrics Used in Industry

Industries use a variety of safety and health metrics to monitor and improve workplace safety. These metrics help organizations identify trends, assess the effectiveness of safety programs, and implement corrective actions. Some of the most common metrics include:

1. Incidence Rate
2. Severity Rate
3. Average Severity

#### 4. Average Days Away from Work

Each metric is defined with an example provided as follows:

##### 14.12.1. Incidence Rate (IR)

The incidence rate measures the number of new cases of work-related injuries and illnesses occurring in a given period relative to the total number of hours worked by employees. It is usually expressed per 100 full-time workers per year. The incidence rate formula is given by Eq. 14.1.

$$IR = \left( \frac{\text{No. of recordable injuries and illnesses} \times 200,000}{\text{Total number of job exposure hours}} \right) \quad (14.1)$$

The constant, 200,000, represents 100 employees each working an average of 2,000 hours per year (i.e., 50 weeks x 40 hrs/week = 200,000 hrs/yr).

##### Example 1. Incidence Rate

If a company has 10 recordable injuries and illnesses (or recordable cases) in a year and employees worked a total of 400,000 job exposure hours, the incidence rate would be:

$$IR = \left( \frac{10 \text{ recordable cases} \times 200,000}{400,000 \text{ job exposure hours}} \right) = 5$$

∴ This means that, on average, there are 5 incidents per 100 full-time workers per year.

##### 14.12.2. Severity Rate (SR)

The severity rate measures the seriousness of work-related injuries and illnesses by calculating the total number of lost workdays due to these incidents per 100 full-time workers per year. The severity rate formula is given by Eq. 14.2.

$$SR = \left( \frac{\text{Total number of lost workdays} \times 200,000}{\text{Total number of job exposure hours}} \right) \quad (14.2)$$

### Example 2. Severity Rate

If a company has a total of 150 lost workdays due to injuries and illnesses and employees worked a total of 400,000 hours, the severity rate would be:

$$SR = \left( \frac{150 \text{ lost workdays} \times 200,000}{400,000 \text{ job exposure hours}} \right) = 75$$

∴ This means that, on average, there are 75 lost workdays per 100 full-time workers per year.

### 14.12.3. Average Severity (AS)

Average Severity measures the average number of lost workdays per recordable injury or illness (or recordable case). The average severity formula is given by Eq. 14.3.

$$AS = \left( \frac{\text{Total number of lost workdays}}{\text{No. of recordable cases}} \right) \quad (14.3)$$

### Example 3. Average Severity

If a company has 10 recordable injuries and illnesses resulting in 150 lost workdays. The average severity formula is given by Eq. 14.3. The average severity would be:

$$AS = \left( \frac{150 \text{ lost workdays}}{10 \text{ recordable cases}} \right) = 15 \text{ lost workdays/recordable case}$$

∴ This means that, on average, each injury or illness results in 15 days away from work.

### 14.4.4. Average Days Away from Work (ADAW)

This metric measures the average number of days an employee is away from work due to a work-related injury or illness. The average days away from work formula is given by Eq. 14.4. The average days away from work would be:

$$ADAW = \left( \frac{\text{Total number of lost workdays}}{\text{No. of cases involving lost workdays}} \right) \quad (14.4)$$

### Example 4. Average Days Away from Work

If a company has 5 cases with days away from work totaling 75 days, the average days away from work would be:

$$ADAW = \left( \frac{75 \text{ workdays}}{5 \text{ cases involving lost workdays}} \right) = 15$$

∴ This means that, on average, each case involving lost workdays results in 15 days away from work.

### 14.13 Summary

Workplace safety and health are crucial for protecting employees, reducing economic losses, and ensuring legal compliance. Injuries and fatalities have broad implications beyond direct costs, affecting productivity, employee morale, and overall societal well-being. Improved safety measures, stricter enforcement of regulations, and better training programs are essential to reduce these incidents and their associated costs. This chapter highlights the critical importance of workplace safety measures and disease prevention strategies. Improving safety protocols, enhancing worker training, and enforcing regulations can help reduce these numbers, thereby saving lives and reducing the financial burden on society. By prioritizing safety, businesses can improve productivity, reduce costs, and enhance their reputation while fulfilling their ethical responsibilities.

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