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## Prevention of Workplace Injuries and Illnesses

Ida Mutai  
imutai@murraystate.edu

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PREVENTION OF WORKPLACE INJURIES AND ILLNESSES

By  
Ida Jepkemoi Mutai

Project submitted in partial fulfillment of the  
requirements for the  
Bachelor of Integrated Studies Degree

Murray State University  
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**FIELD OF STUDY  
PROJECT APPROVAL**

I hereby recommend that the project prepared under my supervision by

\_\_\_\_\_.

entitled \_\_\_\_\_, be

accepted in partial fulfillment of the requirements for the degree of

\_\_\_\_\_.

\_\_\_\_\_  
BIS 437 Senior Project Faculty Adviser Signature

\_\_\_\_\_  
BIS 437 Instructor Signature

### **Abstract**

The purpose of this project is to explain ways of preventing injuries and illnesses in the workplace. Safety and health have been major focus in most workplaces because many injuries occur every day. Activities carried out in the workplace can cause direct exposure to physical, or chemical stressors that can lead to acute illnesses or later chronic illnesses if countermeasures were not implemented by employers and no one is monitoring what the employees are exposed to. There are various ways of preventing these injuries including implementing some techniques in the workplace. It is the work of the employer to ensure that every employee who comes to work in the morning must go home with all the fingers and toes. According to the General Duty Clause the worker should be protected. It is the employee's duty to follow the regulations of the workplace in order to be safe at the end of the day. This project will focus on the identification of health and safety hazards within the workplace. Emphasis will be placed on the identification of measures to protect workers from harm.

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## **Introduction**

Activities carried out in the workplace may directly expose employees to physical or chemical stressors that could cause acute illnesses or later chronic illnesses if preventative safety measures are not implemented. Recovery time from workplace injuries and illnesses could take weeks or months. There were approximately 2.8 million non-fatal workplace injuries and illnesses reported by private employers in 2017 as reported by the U.S Bureau of Labor Statistics (2018). Employers are responsible for implementing and monitoring measures that limit employees to potentially harmful situations. There are various ways of preventing workplace injuries. While the employer is responsible for establishing sound safety practices it is the employee who is responsible for following the safety policy.

The Occupational Safety and Health Act of 1970 (OSHA) was passed in the United States to prevent workers from being harmed at work (Health Hazard in Construction, 2012), the General Duty Clause is simple and comprehensive. The General Duty Clause explains that each employer shall “furnish to each of his employees’ employment and a place of employment which is free from recognized hazards that are causing or likely to cause death or serious physical harm to his employees” (Robbins, 1998, p. 331). The General Duty clause is the main source of citations given out due to unsafe conditions at work. This act protects employees from being put into risky environments by their employers. Before the General Duty Clause was established, workers were exposed to hazardous materials known or unknown because employers were not required to have workplace safety rules in place. Since the General Duty Clause employers have established clear safety guidelines designed to prevent or mitigate employee exposure to workplace hazards. These efforts have shown the employers committed to ensuring that the workers are in a safe environment at all times. Workplace safety inspections affected injury rates

and other outcomes. There was a 9.4 % decline in injury rates and a 26% reduction in injury cost (Levine, Toffel, & Johnson, 2012).

Citations are issued when an employer fails to keep the workplace safe from hazardous materials. An employer has to ensure that the workplace is free from hazards before workers start working. When the employer fails to do so citations are given out. Also, citations are given out when the hazard was recognized and it was clear that the employer knew about it and they ignored it. When the hazard was going to cause death or harm to the worker is another reason citation are given out. Lastly, citations are given out if the hazard recognized was feasible and there was a method to correct it but no action was taken by the employer (Health Hazard in Construction, 2012, p. 18)

Identifying health and safety hazards is the first step in protecting workers from harm. Workers should be protected from potential risks at the workplace by using appropriate safety controls. Workers should also be aware of the existence of potentially hazardous materials in their work environment. For example, exposure to hazardous material like lead should be monitored in the workplace. In cases when workers are exposed to lead without the implementation of the appropriate safety measures, the employer is violating the law. Asbestos exposure is another common hazardous material worker in old buildings encounter. Because asbestos may break down and be released into the air. Even if the workers are not being exposed to it directly, they are at risk and have a right to know. For instance, rubbing or scratching of floor surfaces can expose asbestos to workers without their knowledge. The asbestos breaks down and becomes airborne. Then unknowingly, a janitor fixing the floor or sweeping up dust is exposed to potentially harmful material. Employees have a right to know of potential harm.

Employees also have the right to know and understand the potential consequences associated with exposure.

Educating workers is the key to making sure that no injuries and illnesses are going to occur. Educating them on the basics before they start working will prepare them mentally and physically to work. Free training should be offered before they start work because this will motivate them and training reveals promising results (Mortensen et al., 2014). The purpose of this paper is to identify health and safety hazards in the workplace. After identifying them, I will explain ways of reducing these hazards from happening. Eliminating all hazards from the workplace is impossible. Trying our best to reduce these hazards is the main goal here.

### **Training Workers**

Health and safety training are a widely used intervention for preventing injury and illness at work (Forst et al., 2013). The best way to give workers training is by a training program with the presence of the machines they are going to be using at the workplace. Allowing them to train hands-on will increase their confidence. This event will allow them to feel how it is and since most people learn with tangible materials (VanRy, 2019). It can be a time-intensive because you train one person at a time depending on the machines or items you will use at the workplace you have access to for training, however, it is the best to use when you have enough resources to offer training in large quantities. Saving time will come in handy when the resources are limited. The more employees gain new skills and knowledge, workplace training also allows organizations to develop a new and better process to increase productivity (Films Media Group, 2011).

Role-playing is another method of employee training (VanRy, 2019). This is the point where a scenario is given to an employee and they are asked to work through it they will have to



consider different points of view and think as they work. This event can be challenging at times, but the workers have a chance to take their time as they go through the training. Allowing group discussions and team activities is also another method of training whereby you give training a group of employees at once who have a common activity in the ground. This method is always best used when the task is challenging, and it needs a collaborative approach to tackle the issue. eLearning is another method of training which is the digital way of learning (VanRy, 2019). Videos, tests, and sometimes courses are delivered online and it is the employees' responsibility to watch the videos, do the tests and come back to work ready to apply what they learned online with real-life situations at work. eLearning has both advantages and disadvantages but so long as the foundation and directions are well set by the leader, it will be easier for the learners to learn easily without struggle (VanRy, 2019).

To reduce fatalities, partnerships with community-based organizations should be established to reach those people who are unfortunate to reduce injuries among the local workers (Forst et al. 2013). These partnerships created awareness of workplace hazards and self-efficacy among workers who were not aware of workplace injuries and illnesses. Training effectiveness has been studied in a variety of sectors, including construction. Providing work leaders who will be team leaders is the best route to take if there are new workers who need training. The leader should be someone who has been in the workplace for long with more experience.

From 29 CFR 1926.21 (b) employers have training requirements they should be responsible for (OSHA, 2019). "The employer should avail himself to the health and safety training programs the Secretary (OSHA) provides" (OSHA, 2019, p.56). Using the available opportunity or the resources provided is the best practice to do. By using these resources, it will

show that you are making use of the things present around you. This will show a good picture of the employer and the employees to the authority.

The employer must instruct each employee on how to recognize and avoid unsafe conditions within the workplace (OSHA, 2019, p.56). Giving heads up to the employee so that they know when the unsafe condition is within the workplace will help them avoid. The main focus at the workplace is to avoid injuries and illness from occurring then the best way to do it is training employees on how to recognize these hazards when they occur and the way to identify them. If the employees are using respirators and they can smell something abnormal then the best action to do is keep the respirator on as they escape the room. Keeping the respirator will reduce the number of hazardous materials being inhaled when they are escaping the room. Also, showing the employees the emergency system where it is located in the next step to do. Orienting them around the workplace will be helpful during an emergency because if they know where the alarm system is one of them will turn it on if it did not go off automatic to alert the other employees to escape the room.

Employees should be instructed on how to handle poisonous, caustic, and other harmful substances within the workplace. The employer should train them on how to handle these harmful substances when they are working with them. The personal hygiene needed should be maintained to avoid contaminating these hazardous materials. Most hazardous materials are mixed with something like water that can be flammable or they can produce a poisonous gas that we do not need at work. Employees should be aware that their hands should be clean, and they should be dry and not sweaty because sweat can drip onto these substances and that is what we do not need. The employers should instruct the employees on the personal protective clothing

they need to use when they are handling different poisonous materials. (OSHA, 2019, p.56). Chemicals are handled differently, depending on its physical, chemical, and biological state.

In a job site where harmful plants are found, Employees who are working there should be aware of the hazards that may occur and ways of avoiding injuries while working. They should be trained on how to avoid these injuries from happening (OSHA, 2019, p.56). Also, they should be taught how to handle the injuries if they occur at any point since injuries occur sometimes. The first aid procedures they should follow should be within a reachable place so that they can refer to it if they forget a step or some part. Employees should know where the first aid kit is located at the workplace to help them avoid blood loss if there was a cut before they get to the hospital. The first aid kit should contain some instruments which are only needed during an emergency.

First aid kits should be available in every workplace where the hospital is not in the same work environment. This will be used during emergencies before the workers get to the hospital to get some immediate care. Someone should be trained in the workplace on how to use these first aid kit. The person should be willing to learn how to use it and to give care to the affected workers. Most first aid kits contain an automated electronic defibrillator (AED). From 29 CFR 1926.50, the first aid kit must be placed in a waterproof container and must be checked by the employer every week to ensure that everything is replaced on time. Each package in the container should be sealed (Health Hazard in Construction, 2012, p. 24). Also, in areas where 911 is not available phone numbers for the physicians, an ambulance should be posted so that during an emergency the people who are within can get access to it easily. Lastly, when there is an emergency concerning injurious corrosive materials with the eyes, suitable facilities for flushing the eyes must be provided within the workplace. This should be available at all times

and should be checked regularly to ensure that they are still good to be used (Health Hazard in Construction, 2012, p. 24).

All employees who enter into confined space should be instructed as to the nature of the hazards involved (OSHA, 2019, p.57). Employees should understand that a confined has limited entry and it is not suitable for human beings. Those who go there are well trained and they know what chemicals are associated with that space. The workers who go in should be well dressed and equipped with the right apparatus. Confined space contains harmful dust or gases and the employee should be aware of the nature of these harmful dust and gases. Employees who handle flammable gases, liquids, or gases should be aware of the safe handling requirements they should attain before handling these materials (OSHA, 2019, p.56). It is good to know how to handle a chemical before going into the environment which is full of unsuitable gases and they can react or explode any minute. Knowing how to handle it is the best practice because you will know the next action to take if these occur.

### **Safety and Health Hazard Identification**

A hazard is the potential and probability of being exposed to a physical agent or a chemical agent that is harmful at a certain level of concentration. An uncontrolled environmental factor workplace may increase the hazard probability. It can cause health effects or damage as well. To prevent workplace injury and illness, first, the health hazard should be identified by assessing the workplace environment and potential exposure to any harmful conditions. As a safety professional, you should conduct a workplace assessment and make sure that the workers are not exposed to any hazardous materials or any harmful conditions and if they are exposed to any harmful substance they should determine if they are affecting the workers' health. There are various ways of identifying health hazards in the workplace. Safety is a state of being safe and

protected from or against an injury, harm, danger, or risk (Canadian Centre for Occupational Health and Safety [CCOHS]. 2019).

Hazard identification is a way of anticipating, recognizing, and evaluation a situation to determine if it can cause harm or it can pose any danger to the people, environment, organizations like property or even loss of equipment. Risk assessment is the general term used to describe all processes of hazard identification. Hazard identification can be conducted when a new procedure is being designed before an activity is carried out, when activities are been done, during annual or weekly or monthly inspections, and after incidences such as when an injury occurs or when a worker reports a near-miss event (CCOHS, 2019). Making sure that all hazards have been identified and determined as the main goal when carrying out this process because the main goal is preventing future incidences and locating past incidents and injuries.

Anticipating is a way of predicting what might happen in the future and be able to come up with ideas on how to handle if a risk ever happens. It also includes a way of handling what has occurred before and what measures were carried out at that time. Looking at the techniques and measures that were used in the previous hazard is very important because you identified what worked the most for that organization, and what needs to be improved. It is like a strategy when setting new measures which will turn out to be updated measures in most cases. A good example is if you are working with a fertilizer industry, it is good to know the physical, chemical, biological, state of the materials in a building. This helps in pointing out the hazards that might occur without straining or waiting for the hazard to occur to act of pointing out what can be the hazards.

Recognizing hazards is also the same as identifying hazards. After the organization's materials are known the best way to point out hazards in that setting. In general industry, for

example, there are various ways of anticipating what will happen. The use of Job Safety Analysis (JSA) is one of the ways and this is an advantage whereby looking at the step by step walkthrough of a job and what hazards may present themselves and anticipate them beforehand. Job safety analysis is a process used by safety professionals and supervisors to review job methods and uncover hazards (Plog, 2012, p. 740).

Job safety analysis advantages are established in different ways which include giving training to individuals in a safe environment with efficient procedures. When accidents occur during the training process the procedures are reviewed to ensure that no procedure was being missed or skipped. Following all the steps helps in making sure that hazards that could occur due to human error are minimized from occurring thus eliminating them from happening in the workplace (Plog, 2012, p. 740). Making changes before the hazard happens is the best way to protect the employees who might be the first people to be affected. Retraining of workers can be done through preparations that are made for safety and health observations. (Plog, 2012, p. 740). A worker who has been in the field for long can be given a duty one time to go around checking what other workers are doing and they can pinpoint any mistakes workers are doing wrong. After those workers are supposed to be retrained from the beginning. JSA focuses on the relationship between the worker, the job, the machines used, and the condition of the work environment in which the sources of hazards will originate from (Health Hazard in Construction, 2012). When an analysis is conducted the questions, which are always asked are about the chemicals or materials which are being used. The state of chemicals, either gases, solids, liquids, or vapor. The cause of the hazard that occurred if it was through the noise, vibrations, or radiation (Health Hazard in Construction, 2012, p.13).

The use of OSHA 300 logs is the second way of predicting what will happen in an organization which helps in dissecting the rates and averages of the hazards which have mostly occurred in the past and it helps to figure out what the common issues are. These statistics are of more importance because you can see if they have been decreasing or increasing and it is easy to work with digits in a big organization. These trends are always the best to refer to when need be. It is important to visit the past data of that organization to see the pattern in which hazards have been occurring and things that may reoccur.

Evaluation is the last way of identifying hazards. "Evaluation is a decision-making process resulting in an opinion on the degree of health hazard" (Plog, 2012, p. 27). Evaluation helps save money and time in an organization by seeing if the hazards have been determined and correct control measures have been implemented and they are the best to work with when a hazard occurs without any complication. There are very many reasons for evaluation in an organization. Knowing the level of risk that might occur is the first step toward the recognition of hazards in the workplace. The next step is recognizing the raw materials being used and the impurities that are released and can cause harm to anyone within the workplace. Implementing controls to be on the safe side if hazards occur is the second step to take. If hazards occur it is important to know what steps to take to avoid the hazard from occurring again. Problem-solving as quickly as possible, figuring out what is there and what is not there, and preventing fines from the government or other safety organizations are the next steps to take (Plog, 2012, p. 488). Lastly focusing on staying below the limits which can cause damage like fire ignition through the exposure of certain chemicals to the air among others.

Exposure to workplace hazards for certain time leads to occupational disease and occupational medicine should be implemented to cure the disease that has occurred in concern

with the maintenance of health in the workplace (Plog, 2012 p. 748). An occupational disease is a health condition that occurs as a result of work-related activity. The work can cause acute or chronic conditions depending on the level of exposure to the stressor, the type of occupation and the physical, or chemical properties of the stressor. For example, janitors are a good example of people who will suffer both acutely and chronically depending on how they handle the chemicals they use to clean and if they follow instructions when mixing liquids in the correct amount required concentration levels.

Acute conditions occur and affect an individual over a short period mainly a few days or weeks. It is onset and severe. A good example of this condition is sudden headaches accompanied by weakness. From Plog 2012, “The health effects of chemical exposure are considered acute when it appears within a short time following exposure, mainly hours, and the health effects are relatively short-lived” (p. 128). Chronic conditions persist for a long period mainly months or even years and the signs and symptoms are not onset they develop over a long period. Plog (2012) referred to chronic exposure to “continued or repeated exposure over a prolonged period, usually years” (p.129). The symptoms develop slowly and may worsen over an extended period. A good example is lung disease like asbestos which is characterized by scarring in the lungs, which leads to long-term breathing problems. Occupational medicine includes the prevention and treatment of diseases and injuries that occur at the workplace. Occupational medicine also focuses on reducing the exposure as well as reducing the time the workers will take breaks when they are not feeling well, these make sure that the workers bond well among themselves when they are at work with their employers. (Plog, 2012)

The occupational health nurse delivers all the health care services to workers when they complain about being sick when they think it is related to workplace exposure to stressors.



Occupational nurses are known for promoting good health on workers by offering lessons on how to stay safe and out of illness during times when there are breakouts and such. They are also known for protecting the workers by ensuring that when they need immunizations, for example, they get them at the right time. Nurses also restore the workers' health within a safe and healthy work environment when they are not feeling well, they are the immediate people the workers visit, and they give them medications if need be (Plog, 2012, p. 760).

These occupational nurses also act as a connecting link in determining the employers' ability to work after promoting, protecting and restoring their health conditions to normal (Plog, 2012, p. 760). The key knowledge of health nurses includes proper communication with the workers, offering to teach them where necessary, offering direct care skills if the workers are not able to depend on themselves they help as much as they can, and giving counseling advice to workers if they speak out about what they are going through. Nurses are known to be good listeners and they are known to be among those people who perform multiple roles in one position or career.

The occupational medicine physician has a major role in preventing occupational illness from occurring and restoring the workers' health within a safe workplace and also in determining the work-relatedness of disease. Even though in most cases it is hard to determine the occupational disease and the nonoccupational disease, the health professional provides information about the operations and what is going on in the workplace to the medical department (Plog, 2012) This will help in making a complete and reasonable decision whether the disease is work-related or not.

There are preventive measures which if carried out these conditions will be eliminated in the workplace. We will discuss this later as the main point so I will not go into details but just

give a brief introduction to it. These measures include; avoiding the irritants in the surrounding air by removing the cause in the facility completely or by substituting it with a better medium that does not pose risks to the workers, and the use of personal protective equipment by workers when working.

### **Ways of Identifying Injuries and Illnesses**

In the workplace, there are many ways to identify injuries and illnesses that will occur. This is why employers are working every day to ensure that their workers are not experiencing these by either exposure or due to their working conditions. Ergonomic assessment, monitoring the workplace, ensuring that the workplace is free from contaminants, not exceeding the limits required, biohazards, and toxicology are some of the ways used to assess and identify the illnesses and injuries that are likely to occur in an industry. Technology is widely used in the twenty-first century when designing objects because it is easy and more modified without using a lot of time figuring out what the best object is.

Ergonomics is the study of humans' efficiency in their working environment with the appropriate design of products to fit the worker and not the other way around (Plog, 2012, p.364-365). To ensure that the worker is not hurt during work or to ensure that the worker is not experiencing uncomfortable issues while working the products in this case the machines, chairs, table, among other things they use while working are well designed to fit the worker. This is why there are different designs of products in the market that fits everybody. Ergonomics in the work environment play a big role because it eliminates discomfort while working and the risk of workers getting an injury. Human beings widely perform different occupational tasks in their everyday lives. To avoid overloading, overworking, underloading, underworking these tasks

should be matched with human capabilities or with their energy level to avoid damaging of muscles, tendons, or reducing the performance capacity.

Ergonomics affects every human being whether they realize it or not. Ergonomics impacts anything we do at home, at work, or any place in between. Ergonomics is human-oriented meaning it is workers friendly and its main focus is workers. It provides a friendly environment to anyone who is around the industry for example. Consideration should be given for various shapes, sizes, and skills of people in the work environment. Ergonomics is about making it easy for whatever you are designing to be used without experiencing injuries or illnesses. This can be achieved by using five aspects of ergonomics which are: safety, comfort, productivity, and aesthetics.

Safety is the design you decide to use is safe to use and it will not cause any discomfort or harm to the worker. Comfort designs are comfortable to use without having difficulty seeing the surroundings or hearing what is going on in the background. Ease is how a design can be easily used. Productivity refers to performance done by the designed object to increase productivity. Aesthetics is the way we perceive an object by the way it looks, feels, smells and even tastes. In a work environment, we want a seat that is adjustable for both tall and short people. When a seat is so short the tall people will suffer because they will not have space for their legs and this will lead to some injuries, and when the chair is so tall the short people will struggle getting on top of it, this will lead to them falling when they are trying to climb in the chair.

Ergonomics are classified as physical, cognitive and organizational ergonomics. Plog (2012) explained that:

Physical ergonomics is more of human anatomical, physiological, biomechanical, and anthropometric characteristics as they relate to physical activity. Examples of physical ergonomics include our working postures, the way we handle materials, moving around the workplace repetitively, work-related musculoskeletal disorders, how the workplace layout is presented, safety, and health. (p.364)

Cognitive ergonomics is about the way we reason, think, how we respond and perceive things. We apply this when making decisions, applying the skills we have mastered already at the workplace, when using computers, training as this can relate to human-system design, and how we handle work stress. Organizational ergonomics includes the way sociotechnical systems are optimized. These include communication among workers or people around the workplace, the way the workplace is designed, working together as a team, cooperating while working, the way working times are designed to fit in everybody's schedule, quality management, and telework (Plog, 2012, p. 364).

Ergonomics have a great impact on the workplace. With the use of ergonomics, there is the reduction of injuries. Reduction of injuries is achieved when there is a good design for machine guards. Machine guards' systems create a safe work environment by protecting both the workers and the machine. Machine guards are easy to install when the correct procedure is followed, and they are affordable too. Also, reduction of injuries is achieved through designing of slip when the resistant surfaces are created. These resistant surfaces will protect the worker from falling. Floors can be made resistant by creating texture in concrete by broom finish which will make the skid-resistant surface, applying the anti-slip coating, combining grit additives with sealers which provide a layer to concrete floors, using non-slip tapes or installing rubber mats (What is Ergonomics?, 2019).

Ergonomics also prevent fatigue. This can be achieved by using proper lighting if the worker is using computers in the workplace. Lighting that is too dim or bright can lead to strain which can cause headaches, neck pain, and eye problems. To avoid this the correct lighting level should be used when using a computer and make sure a bright background is avoided. Using lights with yellow tone is better for your eyes. Encourage workers to blink regularly and close your eyes once in a while to avoid eye strain (What is Ergonomics?, 2019). The best way to avoid eye strain is by providing a picture like 20 feet away from every computer station that workers can focus on and this helps them not be focused on their computers for so long without taking breaks. Encouraging workers to keep moving regularly while at work helps your body positioning. Sitting for so long in the same position and your head or neck is in the same position will make you tired, and your body exhausted. Alternating part of your day at work with sitting and standing that way while walking you get to do some light stretches for every minute every hour. Using anti-fatigue mats provides perfect cushioning to the workers' feet if they stand for long at work. Making sure that your feet are touching the floor when you are seated and not dangling.

Getting adjustable chairs for both tall or short people is the key here. Also, positioning the chair properly and maintaining desk efficiency helps reduce fatigue at work. When sitting on a chair and a table, make sure that the chair is not away from the mouse and the keyboard that way you will not be stretching your arms to get to the mouse and the keyboard, keeping the mouse and the keyboard close to each other prevents excessive reaching which leads to shoulders and arms strains. Lastly is keeping the arms close when using the keyboard and the mouse that way you will avoid the strain of neck, shoulders, arms, and elbows (The Advantages of Ergonomics, 2019). Typing when your elbows are bent about a 90-degree angle, with the weight

of your arms supported is the best way to reduce tiredness. Getting chairs with armrests is what most offices are applying now because this has reduced fatigue among the workers. If the job involves receiving phones all day long encourage the workers to use a headset instead of trying to hold the phone between their neck and shoulder while trying to multitask. This will help the worker's neck to be straight almost all the time and neck and shoulders problems will be avoided.

Ergonomics helps prevent musculoskeletal disorders when the tasks being carried out by workers have been evaluated to determine strain levels and retrain the workers on how to perform it in the correct way to avoid further musculoskeletal disorders from occurring (The Advantages of Ergonomics, 2019). This is also achieved by evaluating the work station layout and removing any material that is probably to cause any disorder if the workers use it and installing the modified models which have been proven that they do not cause musculoskeletal disorders to workers if they use it correctly. Evaluative all the repetitive activities that might cause musculoskeletal disorders is the other way of ensuring that these disorders are avoided by ensuring that these repetitive activities are either done correctly or limiting the time the workers do this activity by ensuring that job rotations are started that way the workers get to do different jobs at work and they stay healthy.

A proper lifting technique in the workplace is the key. Workers lift, lower, push, pull, and carry loads either heavy or light in the workplace day in day out. Material handling has been considered as one of the causes of injury in a workplace because it involves, stretching, bending, moving, reaching, or straightening our hands or legs even if they are the lightest materials. It does not matter if the materials are boxes or metals, lifted daily or once in a while but all that matters are if the form of picking them and delivering from one place to another is correct. Safe

and efficient material handling should involve, offering training to those workers who handle the materials before they load, unload, and packing them at the desired place. Proper lifting techniques should be the first step to training because without proper techniques injuries will occur as the process is going on (The Advantages of Ergonomics, 2019).

The use of labels in the workplace helps to improve safety as well as efficiency and proper organization. These labels should be clearly labeled and should be appropriate. If you are labeling containers for example with hazardous chemicals inside, it is important to let the workers know what kind of hazardous materials they are dealing with. Hazardous materials can mean anything from every worker's perspective, and it does not have to be put in certain words. As long as it can cause harm to anything around it when it spills if it was a liquid, then that is a hazardous material. Hazardous material does not cause the same harm to an object or human beings. Some hazardous materials corrode, burn, and irritate the skin. Materially affect the skin differently and when workers come into contact with it they should know what to do as first aid (Plog, 2012, p. 405).

Labeling products should be a priority because they are more accurate and tells the immediate information of the products around the workplace (Plog, 2012, p. 405). Primary container labeling involves containers like bags, boxes, barrels, and drums that you receive from the manufacturer, the label should include all the six labeling elements (Globally Harmonized Systems (GHS) Labeling Requirements, 2012). On the other hand, secondary container labeling is smaller than primary containers and sometimes they can be transferred from primary containers to these small containers like spray bottles, or jugs (Globally Harmonized Systems (GHS) Labeling Requirements, 2012). Transferring to smaller spray bottles can be done under some conditions to reduce accidents when using these chemicals like using some sprays where

they should not be used at should be avoided. The conditions are that the materials being used within the work shift of the worker who is in that shift. This is done because when the worker is done, they should clean the small bottles and ensure that whatever was in there was used in the right place. The worker should also be in the whole shift so that they can monitor the use of those chemicals or use it themselves without letting someone from another shift use the chemicals where it should not. Lastly, the container should be within the work area of the worker who prepared it so that the worker can use it to complete their task. This reduces the chances of confusion and the occurrence of injuries. These labeling elements include the product name, supplier information, standardized hazard statement, pictogram, precautionary statement, and a signal word. The product name is the product name and its chemical name (Globally Harmonized Systems (GHS) Labeling Requirements, 2012). Supplier information which includes the company's name of the manufacturer of the products. It also includes the address and phone number which can be used if the user needs to know more of the product and they can call them or send them an email concerning whatever they need to ask or know.

A standardized hazard statement is the explanation of the nature of the hazard a chemical could cause especially when it comes into contact with the body. These statements include words like, it can cause serious eye damage, it is toxic if swallowed, toxic to aquatic life if exposed to their habitat, can be a carcinogen, and may cause allergies or asthma signs and symptoms if inhaled (Globally Harmonized Systems (GHS) Labeling Requirements, 2012).

A pictogram. These are pictures or graphics used to give information about the potential hazards of a chemical. Pictograms inform us at the time that the chemicals we are using might cause harm to the people, or environment within. The correct labeled pictograms are in the shape of a diamond, with a red border, and white background. The images inside should be drawn in a



black color or ink. Pictograms are used internationally and this is why they are all presented the same way (Globally Harmonized Systems (GHS) Labeling Requirements, 2012). There are more than nine pictograms mostly used in products to explain what hazards it can cause. These pictograms include, exploding bomb which represent explosive materials, flame which represent flammable if it comes into contact with fire or water depending on the product, the flame over circle which represent oxidizing meaning it can cause flame if there is presence of oxygen, corrosion pictogram which means it can cause corrosion to the skin or the surface if it spills over, the dead tree and fish pictogram representing hazardous to the environment and the water bodies as well as the animals leaving inside the water, the exclamation mark which represent health hazard or hazardous to the ozone layer, the health hazard which represents a serious health hazard and lastly the gas cylinder which represent gas under pressure. All these pictograms have either health hazards or physical hazards encountering each pictogram and its meaning. The table below shows the physical hazards and health hazards from hazardous materials that might be present in the workplace (Globally Harmonized Systems (GHS) Labeling Requirements, 2012).

A precautionary statement. These are the phrases or statements that explain in detail the measures that should be taken to minimize or prevent the negative effects when exposed to a hazardous substance either when using it or after it is disposed of. (Globally Harmonized Systems (GHS) Labeling Requirements, 2012). Precautionary can be divided into prevention, response, storage, and disposal. Prevention can be a statement like wear eye protection, storage can be something like a store in a cold dry place, and disposal can be avoided release to the environment.

Signal words provide a direct or immediate warning to individual reading. Words like ‘Danger’ and ‘Warning’ are used to represent the severity of the hazard. If the severity of the chemical is high ‘Danger’ is always used and if the severity of the chemical is less ‘Warning’ is used (Globally Harmonized Systems (GHS) Labeling Requirements, 2012).

Labels should be clear and read with no difficulty (Plog, 2012, p. 405). The environment should be put into consideration when making these labels too because if the environment or the building is full of the big machine which continuously vibrates it is good to get labels or placards which are a little bit bigger with some spacing, and the style of letters should be put in consideration too. The words used to write these labels should be familiar to the workers depending on their level of education because it is not of any importance to use labels with very hard vocabulary (Plog, 2012, p. 405). Workers will get confused and might do a different thing thinking it meant the other words. To avoid confusion among workers the labels should be placed on the correct containers or very near to the items they identify. Labels should be placed horizontally to easily read and quickly understand as you read from left to right. If abbreviations should be used, then they should be selected cautiously to avoid confusion (Plog, 2012, p. 405).

Generally, labels and placards are important because they make it easy for workers who can read to use their eyes and common sense when they are dealing with certain chemicals with enough training before they start working in a place. When these labels are followed correctly there will be no injuries hence no illnesses accompanied by chemical use at work. If the worker knows what they are doing and an accident happens like spilling, they will apply the correct measure to handle the spill showing how important these labels are by just following what it states. Labels help you identify the more hazardous chemicals from the less hazardous materials.

Toxicology is the science that studies harmful, or toxic, properties of the substance (Plog, 2012, p.123). The side effects of being exposed to chemical substances daily to some substances may be hazardous or not hazardous knowingly or unknowingly. These chemical substances can cause toxic effects on the human body system. The toxic effects can be reversible or irreversible depending on the concentration of chemicals a worker is exposed to. Chemical substances can cause harm to the body if the substance comes into contact with our bodies and they can be transported through our nose with inhalation, coming into contact with the skin and its absorbed through the mouth by ingestion, or through the absorption through our eye's thin membranes.

Chemicals always cause harm after being exposed to small quantities of chemicals over a long period. This happens because the symptoms do not appear till the body cannot tolerate anymore the concentration in the body and that way the worker starts complaining. It is good to monitor the working all the time to detect if there are any chemicals or unwanted hazardous chemicals in the air workers breath in and out all the time. This is where the industrial toxicologist comes in and their work is to specify how much is too much for the workers who are working in a particular environment depending on the hazardous chemical they are exposed to. The importance of identifying the toxins in our working environment is to reduce workplace injuries and illnesses which occur from being exposed to them (OSHA, 2019).

When a substance has reached a certain concentration in the body then the effects are seen and this is how chemical toxicity is compared with other chemical agents. Chemicals can cause chemical injury which can be local or systemic. Local injury is an injury that occurs to only one part of the body where the chemicals were in contact with the tissue whereas, systemic injury affects all parts of the body because the agent managed to pass through the blood vessels and the blood travels all over the body resulting to injury of various parts of internal organs. It is

important to identify how these substances have been entering the body to stop the toxicity or the hazards they will cause. The routes of entry include; inhalation, absorption, ingestion, and injection. Different substances enter the body with different routes and sometimes a substance can enter the body through more than one route of exposure (OSHA, 2012).

**Inhalation.** This is a major route of exposure in industries since any airborne substance can be inhaled. Airborne contaminants depend on their state which can be particulate dust, fumes, smoke, mists, gases, vapors, or aerosols. Injuries occur if you breathe in toxic substances. Inhalation injuries depend on what you inhaled in as well as how long you inhaled. Sometimes inhaling smoke from fires depends if it is hot heat or cold heat so the nature of the smoke matters too (Plog, 2012, p.125). This is because the respiratory system is made up of the upper respiratory system and the lower respiratory system. Small molecules settle in the alveoli which are in the lower respiratory system while large specks of dust are trapped by the cilia present in your nose. The more duration of exposure to chemicals you get the higher the toxicity in your body which was absorbed through the respiratory route (Plog, 2012, p.125).

**Absorption** is through direct contact with the skin. When a substance comes into contact with the skin, the skin acts as a protective barrier. If the substance is stronger it irritates the skin and it paves its way to reach the bloodstream through the blood vessels (Plog, 2012, p.125). Temperatures affect the rate of absorption and when it is warm, the rate of absorption through the skin is high because the skin pores are open and the blood flow rate is high. When it is cold the blood vessels constrict and the skin pores are closed hence if the substance comes in contact with the skin, the rate of absorption is slow. The skin thickness also determines the rate of the absorption rate. Depending on the location of the skin that came into contact with the substance. The palm is probably to absorb slower than the skin of the abdomen.

Ingestion by eating or drinking. In most cases in industries, the ingestion of chemicals is not common. This does not mean that the workers are not exposed to it at all but when workers eat their food within an environment where there is pollution or the presence of hazardous materials. These materials can settle on their food in the form of dust. Dust is invisible to the naked eye but when it lands on the food they can be ingested indirectly. Workers who smoke do not take any measures of cleaning their hands before touching a cigarette. The contaminated hands will deposit the hazardous substances on the cigarette and when they light the cigarette the substance starts burning and sometimes can be consumed in the form of gases. Absorption through ingestion is low because the stomach contains acids that help in digestion and it breaks down these substances and sometimes they are excreted as waste products. The stomach has a lot of characteristics that help with digestion (Plog, 2012, p.125).

Injection barely happens in industries because most workplaces do not work with needles. The injection can be done directly into the bloodstream, skin, or through the muscle by a needle. Injection occurs when a sharp object goes through the skin. It may allow germs to get entry into the body. This does not happen frequently and if this one happens at any point workers are always advised to avoid it because of the spread of bloodborne pathogens. The effects of exposure to air contaminants include irritation and allergies. When irritation occurs, there can be inflammation of the tissues. This inflammation may affect the eyes, nose lining, and the mouth at times (Plog, 2012, p.129). An example of injection is when a nail goes through a shoe of the worker and it had rust on it, this will cause some infection if not treated carefully. The main reason workers are encouraged to wear boots to work or shoes with a heavy sole is to protect them. Especially when their work involves a place where rusted nails can be found on the floor unknowingly.

Workers should be aware of the irritants within the workplace which can occur as a result of accidents of mixing one chemical with another. Some irritants are odorless and some have a pungent smell. The ones with a pungent smell can be easily determined by workers while working. It is always advisable to tell the workers to leave the workplace as soon as they smell these chemicals. If they are not sure of the chemical it is advisable to switch off the main inlet of any gases and leave the place as they seek emergency help. Irritants like ammonia gas have a pungent smell and can easily be determined. Ammonia irritates the throat and nose if inhaled for long (Plog, 2012, p.129).

### **Separating the Worker from the Risk Using Hierarchy of Controls**

A Hierarchy of Control is a model used in industries mainly to minimize to the lowest levels or eliminate exposure of workers to hazards and this is the goal of all safety professionals. This model is a widely accepted system by a lot of safety organizations (Occupational Safety and Health Administration [OSHA], 2019). Some controls are more effective than others and therefore the hazards in the hierarchy of controls are in the order of decreasing effectiveness. The top one is the most effective and as you go down the effectiveness decreases. Elimination and substitution are the two main control methods that should be applied when a hazard occurs. These two are the most effective as well since they are the top in the hierarchy of control model.

Employers have a greater task of selecting the control methods that are most feasible, effective and permanent. Elimination is on top and it is the most effective method. Elimination is defined as a way of physically removing all the serious hazards from the workplace that could potentially cause or likely to cause physical harm or death immediately when you meet them (OSHA, 2019). Elimination is the best way to remove a hazard and it is the first step an employer should take with the help of a safety professional because the workers won't meet with the

stressor since it is permanently removed out of the workplace. Elimination of hazardous materials as well will make the workplace free of hazardous situations that may occur due to errors easily made by human beings because the stressor will not be found in the workplace.

Other methods of control can be so expensive when it reaches an extent OSHA cites you if you go against their regulations in the workplace and this makes elimination and substitution a little bit cheaper and you have removed the hazard from the workplace and nobody will be harmed in the process of working. Elimination can cost more for an existing process, where major changes in the machines and methods of installing them is a requirement. According to McComb (2016), "Elimination and substitution do not cost the employer extra money in most cases because the hazard is being eliminated or substituted with similar material. There may be some extra cost involved, such as substituted with a similar material" (p. 12).

Substituting a material with a better one that does not pose hazards to the workers it can cost the employer some extra amount, but it is worth than putting your workers under hazardous or harmful environment. This is the best way to avoid extra charges from the fine the government will give you if you go against their laws (Plog, 2012, p. 580).

A good example of elimination is if the workers are supposed to work in high heights this can be easily eliminated and they can move the piece they are working on the ground level where it will not pose anyone to the risk of fall, this is an example of elimination that will not cost anything to the employer. (Plog, 2012). It is good to eliminate the risk before it causes harm to the workers around or anybody who will be within the area. Another example of elimination is if the equipment they already installed is producing a lot of noise that might affect workers' ears over some time, and they realize it before all the procedure is done. Removing the equipment completely from the place will be conducive for everybody around the place. If elimination does

not work, it is best to use the next step to figure out how to fix the problem or to avoid facing problems in the future of going against laws and regulations. Prevention is always better than cure and since elimination did not work out the best practice to take is a substitution.

Substitution is replacing the hazard with a safe control or with a less hazardous material available in the market at that moment (OSHA, 2019). Substitution can be either changing the process or changing the material being used depending on the best method which will protect the people around the most from any hazardous materials which lead to illnesses and injuries. Before deciding which material should be substituted with another, as an industrial hygienist you should exercise extreme caution because your decision will determine if what you choose will protect the workers the most or you chose a chemical which was worse than the previously used one. Also, the industrial hygienist decision ensures that the hazards which have never occurred or the ones which we have not experienced yet will not occur.

The importance of replacing hazardous materials with less hazardous material is because we care more about the workers and everybody who is staying within the surroundings of the industry for example (OSHA 2019). The people or the neighbors who were staying near the plant should have cared for before anything else, the rivers near the place should care as well because this is a habitat for some animals and we do not want to evade them or migrate them to another place or put them in danger in any way. Our priority is to care about every living organism within the place. The trees and plants near the place should be cared for to avoid deforestation which will affect the air and the surroundings. On the other hand, the importance of substitution is to improve the quality and reduce the cost of production but since we are not focusing on quality and cost of production I won't talk more about this importance.



Plog (2012) gave an example of process substitution if a painting company has been using spray painting method to paint as to complete their daily jobs, and if some studies are carried out to determine how much concentration of paint is in air and it is found to be above what OSHA or EPA regulations allow the workers to be exposed to in an 8 hour time-weighted average, then the best method to avoid these contamination and exposure taking place to workers is to replace the way of painting if that is the only spray in town which works best for them. So, using brush painting or dipping will be the best method to paint here because the number of contaminants in the air will cause some toxicity leading to workplace illnesses which we do not want to happen to our workers, plants, and animals around the contaminated air.

Plog (2012) gave an example of material substitution as the following:

Replacement of white lead in paint pigments by zinc, barium, or titanium oxides; the use of phosphorus in matchmaking; shot blasting instead of sandblasting; and substitution of calcium silicates and mineral wool for asbestos as an insulating material. Recently, new bismuth-containing alloys have replaced lead in the making of brass and bronze alloys. This substitution not only minimizes health concerns due to employee exposures to lead, but it also reduces the overall cost of OSHA and EPA compliance. (p.580)

A good reason for using alloys is that alloys lower the melting and boiling temperatures of metal, and hence the lowest level of energy is needed to melt the metals and put them together. This, on the other hand, saves the resources present in the environment. "Substitution of less hazardous materials or process equipment may be the least expensive method of controlling many occupational health hazards and this is becoming more important from the environmental health and community air pollution perspective as well" (Plog, 2012, p.520).

If the environmental health organizations have proved that this is the best method to do as a first step to avoid putting hazardous materials to the environment and this leads to the pollution which affects the workers. The support from the community air pollution is a positive impact on us as it shows that it is supported and accepted by the people and organizations around us. If elimination and substitution did not work for your workplace, the best option to do is go to the next control and apply it if it works best for that company and it is engineering control (OSHA, 2019).

Engineering control is a way of isolating people/workers from the hazard/ hazardous material in the workplace. Engineering controls protect the workers by removing hazardous conditions or by putting a barrier between the worker and the hazard because our main focus is to protect the worker from any injuries or illnesses that may result from being exposed to any hazards in the workplace. More than one engineering control can be applied at a time especially when the hazardous material being released are not being eliminated by one method, then the best way to handle this is by applying more than one control method to make sure that none of the hazards are being exposed to the workers (OSHA, 2019).

The importance of engineering control in the workplace is reducing the pollution of the environment. This is achieved because, in the process of protecting the worker from those stressors, the air released to the outside is clean and hence less air pollution. This will not put the ozone at risk because no chemicals have been released into the air. It also helps the company by reducing the amount of money they use to buy the products being used because some of them are renewable and this will be a great impact to the company, even though I am focusing on the workers' health I will put this one out here as an adding factor from the use of engineering controls. Also, these engineering controls reduce exposure to the workers, and they will be

complying with health and safety regulations and exposure limits. No one wants OSHA to cite them as a company because it costs a lot of money and sometimes the closure of the workplace, so the best method to avoid that is by complying to the laws and making sure that no chemicals or hazardous materials are exposed to the workers in any way (OSHA, 2019).

Preventing Illness and Injury in the Workplace (n.d). describes engineering control as more reliable. Engineering control provides the most effective protection compared to personal protective clothing or equipment. Engineering control provides complete control to the workers from being exposed to the hazardous materials around the workplace because of its reliability and consistent performance. Engineering control provides time protection because it does not depend on human labor, once it is installed it is done with proper installation. Even if the time it is meant to be effective will come to the end it is still working for a long period, like ten or more years before the next upgrade or model is in the market.

On the other hand, engineering control has some disadvantages. Preventing Illness and Injury in the Workplace (n.d). describes that engineering controls are less subject to human error they can fail. For example, if a ventilation system will come to an abrupt stop or fail then the hazardous gases will be released to the working environment and this will expose workers to them hence leading to illness which was not accounted for. To avoid this, it is good to have another alternative of protecting the workers if engineering controls fail when not planned and the required respirators should be present at all times to be used during such emergencies.

Sometimes, these engineering controls are not convenient or fully feasible when they are not fully developed as described from Preventing Illness and Injury in the Workplace (n.d). When the engineering controls are not feasible then the best thing to be developed on is personal protective methods. This will protect the employees as much as needed before engineering

controls are fully fixed. The cost of engineering control can be higher compared to a well-designed personal protective clothing program. Cost sometimes is the principal objection of requiring engineering controls because people have the belief that the engineering control costs are infeasible to a firm or an industry in general. Employers should be given an option to choose which method mostly protects the workers maximumly, but the problem is that if they are given this option without the laws they will all focus on the cost and take the cheapest route and will not focus on the workers' health. (“Preventing Illness and Injury in the Workplace,” n.d).

Administrative control is the way a change is brought to the workplace and the way people are working if elimination, substitution, engineering controls are not working to reduce workplace hazards which workers can experience when they are working. Examples of administrative controls include job rotation, reducing the time the workers work under certain exposure depending on the hazard, applying appropriate work practices, proper maintenance, and proper training to reduce the duration of exposure, frequency per worker and severity of exposure to hazardous materials (Plog, 2012, p. 585).

### **Make Use of Personal Protective Equipment**

Personal protective equipment is “equipment worn to minimize exposure to hazards that cause serious workplace injuries and illnesses” (Occupational Safety and Health Administration [OSHA], 2019). This is always referred to as PPE. Gloves, respirators, protective hearing devices, hard hats, shoes, and full-body suits are examples of personal protective equipment. Proper use of personal protective equipment should be ensured to reduce injuries and illnesses from occurring. Personal protective equipment should be used when elimination, substitution, engineering controls, and administrative controls did not work or apply for a specific work. Personal protective equipment is always the least effective in the hierarchy of controls. It should

be the last control applied when the other controls are not feasible and effective (Temporary Worker Initiative, 2015). Hazard assessment is always conducted to make a final decision whether personal protective equipment is needed to protect the workers from injuries.

To ensure that there is the proper use of personal protective equipment, OSHA requires the employer to provide adequate personal protective equipment. Employers are the ones who are responsible for providing training to the workers on how to use the equipment (Temporary Worker Initiative, 2015). The equipment which should not be defective and be in good condition. The equipment should be clean before with a reliable fashion. The workers should be comfortable while using protective equipment, so the employer should ensure that the equipment fits well. The equipment should be comfortable with the worker. Workers have different facial shapes and sizes, this should be considered before giving employer equipment (OSHA, 2019). Comfortable equipment will encourage the worker to work. If it is not comfortable it might not perform its job because the worker will be trying to move it around the face if it was a respirator.

Where personal protective equipment should be used, a personal protective equipment program should be established. This program should address the hazards present; the selection, maintenance, and use of personal protective equipment, training of employees, and monitoring of the program to ensure are ongoing effectively (Health Hazard in Construction, 2012). Employers should train the workers on how to use the equipment. Personal protective equipment is different depending on the workplace so the worker should be taught how to use the equipment. Some equipment is easy to use and some are complicated. Either way, training should be done before using it. The worker should be aware of the equipment they should use depending on the situation they are in. If they are entering a building full of chemicals should put on respirators and sometimes full bodysuits. The workers should know how to put on, adjust, and take the

equipment off. When putting them on it is good to know step by step so that all the zips will be well zipped and no leakage of air should be coming in when we do not need any hence ineffective. When removing we do not want to break the zips. It is advisable to remove it properly. This will keep the equipment clean and they can be reused more than one time (Health Hazard in Construction, 2012).

The limitations of the equipment used should be clear. This will help the workers use more than one equipment if one equipment cannot protect the worker fully. Proper care of the equipment should be well known so that after using the equipment is cleaned well and kept in the proper place. If there is a specific way of disposing of it, the workers should be told so that they will dispose of it in the correct place to avoid injuries or illnesses from occurring. Proper maintenance of the equipment should be done, like the use of goggles, they should be kept in a small bag after cleaning them. Also, they should be hung in a place where it is free from dust.

Before protective materials are chosen, some factors need to be evaluated. First the chemical resistance of the material. This is determined if a strong chemical can breakthrough or permeates through the material. If a chemical break through the material then it cannot be suitable for all situations but some situations (OSHA,2019). This is why we have different equipment for different materials. The next factor is flammability. Does the material catch fire? If yes, then it can be used in some different environments and not in some. The strength and durability of the equipment. Everyone wants equipment which lasts for long and it is strong to protect the worker from exposure at all times. The flexibility of the material and overall integrity is the next factor. The shelf life is another factor. This is how long the material takes to decompose or break down. In most cases, we need a material with a long shelf life so that we do not end up buying every year to update with the new equipment in store. Decontamination and

disposal are the last two factors. This is how the equipment is cleaned and disposed of (Health Hazard in Construction, 2012).

With a few exemptions, OSHA requires employers to provide personal protective equipment to the workers. This is because the employers are the ones who know the environment well and if the work environment puts the worker underexposure of hazardous materials then they should provide prevention methods too. The workers are not required to provide their protective equipment. The employer should also ensure that they provide the correct protective equipment. The worker should also pay for the replacement of the personal protective equipment. The exempted time of paying for it is when the worker lost or intentionally damage it. The employer should not provide personal protective equipment if the worker will use it for everyday activities at home. Like shirts, normal work boots, and prescription glasses (Health Hazard in Construction, 2012).

A few personal protective equipment includes respirators, hearing protectors, gloves, and protective clothing. The use of respirators limits the occupational diseases which occur due to breathing air contaminated with harmful dusts, fogs, fumes, gases, smoke, sprays, and vapor. Respirators prevent contamination (OSHA, 2019). Respirators protect the worker from hazardous materials in the air which are breathable. These hazardous materials can cause serious injuries to the body mainly the breathing system. hazardous materials can cause cancer, lung disease, death, and sometimes it can cause problems with the liver and kidneys. It is advisable to put on a respirator when you enter an area with hazardous particles in the air. Particles in the air depend on their properties. Some particles cannot be seen or smelled. The only way of avoiding the worker from inhaling these dangerous particles is by providing them with the respiratory

apparatus. If the worker is unsure whether a respirator is needed or not, the best thing to do is ask a supervisor.

Before implementing respirators in the workplace, a written respiratory program should be established. OSHA standard (29 CFR 1910.134) requires that this program be established and the procedures to be followed in every workplace where exposure can be available. “The employer should consult American National Standards as well as OSHA regulations” (Plog, 2012, p. 65). Before developing a written respiratory program, written-specific procedures should be implemented to suit the employer’s workplace. These procedures will explain more about the reasons for the use of respirators. The employer will have these copies available for employees to read when they want to. These procedures will state where the respirators will be brought from, and the manufacturer of the respirators. The worksite procedures should explain in detail how the respiratory program will be implemented in the workplace. These details will include, the person who will do respirators fit testing, when fit testing is done, and how often it should be done. By doing fit testing it will be a way of protecting the worker by checking if respirators are the best (Plog, 2012, p. 650). Respirator use in emergencies can be done through the worksite-specific respirators program. The type of respirators needed and the number of respirators should be stated clearly depending on the number of workers and the size of the workplace. Maintenance of these respirators should be accessible to the workers so that when they are done using it the correct measures are carried out.

Medical evaluations of respirator wearers are the other program element that should be considered. Depending on the workplace, the type of respirators used should be approved for some workers by a licensed healthcare professional. Some respirator restricts breathing, depending on the size, the weight, and some other factors. The health conditions of the worker



can limit the use of any type of respirator. It is good to identify these workers and provide them with special care when they are in the workplace so that no one will be disadvantaged. A medical evaluation is always done to determine the worker's health by using a respirator without experiencing any problems. The medical evaluation should be done before the worker is fit tested. Taking a medical evaluation will also determine the present condition of the worker and this sets the baseline of the worker's history when they first started working in a specific workplace. A medical evaluation is done by providing a questionnaire to the individual with questions about his or her history about the use of respirators. If a worker had some problems with the use of respirators, a medical follow up will be organized. This follow up will be used as an indicator of where the main cause started. And the worker will be given exemptions of not using any kind of respirators. A specific respirator should be provided so long as it protects the worker from the exposure of any hazardous materials (Plog, 2012, p. 651).

Medical evaluations are needed annually if the workers complain about signs and symptoms caused by the use of the respirator. If the worker started using the respiratory and then they got sick or they experienced problems with breathing for example. An annual medical evaluation will be needed in this case to prove that the problems were caused by the use of respirators. If a physician orders that a medical evaluation should be taken again then the employer should not hesitate but go ahead and give the employee a chance to have another medical evaluation done. This is called a reevaluation. Lastly, if a change occurs from the workplace then a medical evaluation will be required. The change of work can be the change in temperature in the workplace, or the change of machines being used produces hazardous particles at a different rate. Sometimes the physician can do medical evaluations based on his knowledge of the importance of doing it at different times. For example, if a worker has

difficulty breathing and after some time, the problem disappears then a physician might order for one depending on his observations (Plog, 2012, p. 651).

Respirator fit is another respiratory protection program. The worker should be provided with a respirator that fits well. The employer should provide respirators. To ensure that the respirator fits properly, a fit test should be done by every worker. Workers have different face shapes and sizes. Respirators' use is to prevent the worker from inhaling harmful atmosphere, so a seal check needs to be done by the worker to make sure that the air within does not leak inside through the sides of the respirator (Plog, 2012, p. 651). A seal check is a way of checking that the respirator is properly adjusted to the face. Instructions on how to do the seal check are different depending on the respirator. Most manufacturers provide a label on the side of the respirator or they send a respirator with a pamphlet with instructions on how to perform it. The instructions are clearly understood and easy to follow. The respiratory selection step provides the worker with the most comfortable respirator. The difference in the face shapes of women and men, respirator companies manufacture respirators with different sizes and models.

There are two methods of fit testing. Qualitative fit testing and quantitative fit testing. Qualitative fit testing relies on the response of the worker. It is a pass or fails the test. This test is good to use a harmless substance at first before going to a hazardous space. When the wearer detects the substance, it is a full indication that the respirator does not protect as needed because the seal test has not been achieved. If the wearer does not detect the substance then the seal test is achieved and the respirator fits very well. It can protect the worker fully when they are in a hazardous environment. When the qualitative test is performed the wearer should perform facial exercises to test the facepiece-to-face seal by pressing the facepiece respirator to the face. Breathing in and out is the best way to achieve this test because you will be breathing in the

atmospheric air (Plog, 2012, p. 680). An advantage of using this type of respirators is that they are cheaper and the employer can purchase many at a time and then train the workers on how to test them before using. The disadvantages of using this are that the wearer cannot put them on well during an emergency and they will be exposed to the hazardous materials in the atmosphere. Also, the workers can lie if they keep testing it and they cannot achieve to get the one fitting they can just take any size and assume that they will make it work. Workers' exposure will happen with this type of respirator because it depends on subjective opinion.

The quantitative respiratory test measures the actual amount of hazardous materials that can go through the respirator when the wearer is breathing normally. This is calculated and the result is a fit factor. Plog (2012) defined fit factor as “the ratio of the outside concentration to the concentration inside the respirator facepiece” p. 681. This is the accurate respirator to use but the problem with it is that it is more expensive than qualitative respirators. It does not depend on subjective responses. For example, if the environment contains 500 parts per million (ppm) of spray and the air within the mask contains 5 parts per million of the substance then the fit factor will be 100. The higher the fit factor the better the respirator.

Respirators needed in the workplace should be NIOSH-approved. This ensures that all the respirators are of the right type depending on the hazardous materials present in the workplace. Respirators are classified into two types. These types are described based on their capabilities and limitations when they are in use. Air-purifying respirators (APR), and atmosphere-supplying respirators (Plog, 2012, p. 657). Air-purifying respirators (APR) clean the air you breathe in by removing the harmful substances that are present in the atmosphere. Ambient air passes through the air-purifying respirator and the air is cleaned. These respirators are not suitable to be used in places where there is less oxygen. Ambient air is the normal air

within the atmosphere. There are two common types of air-purifying respirators. Particulate removing respirators and gas and vapor removing respirators. Particulate removing respirators filter out dust, fibers, fumes, and mists but they do not protect from gases and oxygen deficiency. They contain filters that filter the air. These filters depend on the model of the respirator. Some can be disposed of and changed and some are built-in and once they are done they can be disposed of (Plog, 2012, p. 657). Both particulates removing respirators and gas and vapor removing respirators have a tight-fitting facepiece. This facepiece helps protect the worker from breathing in contaminated air in the atmosphere. There are two categories of the facepiece. Half facepiece and full-facepiece. Half face-piece covers the face from the nose to the chin while full face-piece covers the whole face including the nose and the chin.

Respirators have a maximum use concentration that protects the worker by measuring the atmospheric concentration of the hazardous materials. The maximum use concentrations ensure that the employee has been protected to the maximum level when wearing a respirator. The environment in which a worker is working should have a maximum of twenty percent of oxygen. The worker does not need to be exposed to an environment that is oxygen deficient. An environment with an oxygen level below nineteen-point five percent is considered an oxygen-deficient environment (OSHA, 2019). Lack of oxygen can be dangerous to the worker and it causes immediate collapse. When the oxygen is less within the breathing zone, the red blood cells will not transport enough oxygen to the other parts of the body. This affects the functioning of the workers' breathing system and body functioning. When the worker collapses and the level of oxygen continue depreciating in the body, the cells start wearing off and no longer performs its work. The worker gets unconscious, the eyes turn blue, and experiences an increased breathing rate. Fainting, nausea and vomiting follows, the worker becomes unoriented after

sometimes and then collapses. Within eight minutes after collapsing, the patient undergoes a comma within forty seconds and then death (Respirator Protection eTool, 2019).

Before using air-purifying respirators it is important to know the chemicals within the work environment. Since air-purifying respirators depend on the air that surrounds workers, it is good to be aware of the chemical. If you don't know what kind of chemical it is, the environment is treated as immediately dangerous to life and health. Until someone proves the type of chemicals present (OSHA, 2019). Knowing the concentration of the chemical is also important. This will help the worker determine the reactions that might be going on. It will be easy to use the correct respirator hence protecting the worker. Air-purifying respirators are lightweight and this is why most workers prefer wearing this. It is easy to maintain, and inspect it. It does not require supplied air to use this, it does not take extra equipment to use.

The use of air-purifying respirators has limitations like other protective equipment. They have different contaminant cartridges that use chemical filters (Respirator Protection eTool, 2019). These cartridges are labeled according to colors and the color represents the type of contaminant within the facility. If the workplace is a big company it will be hard to manage and keep track since different workers will be wearing respirators with different cartridges depending on the facility they are working. This is why training is important to employees. It is important to let them know the importance of protective equipment they are provided with. Training them on the proper equipment is the key. Communication is difficult with the use of air-purifying respirators. It is very hard to understand what other workers are trying to say. It is hard to use an air-purifying respirator under immediate danger to life and health environment. Air-purifying respirator does not have a filter system that can handle an immediate danger to life and health environment. Lastly, air-purifying respirators are not suitable to be used for emergencies. If there

is an emergency and it needs a quick response air-purifying respirator should not be an option for use (Respirator Protection eTool, 2019).

Air-purifying respirators cartridges need to be changed. Part of the training to the new employee or the existing employees is teaching them when to change their cartridges. It is hard for a safety professional or an employer to keep up with everyone's cartridges. It is easy to teach them to do it alone. After teaching them, providing vending machines at the workplace is the best step to take. These vending machines will contain each type of cartridges, and every time they want to change their cartridges they can go ahead and change it than waiting for them to be given. Doing an annual fit test, it is the best time to do a change of cartridges to remind those workers who did forget to change theirs on time (OSHA,2019). When odor or taste is present inside the respirator it is a clear indication that dirt has been accumulating for so long including sweats. When breathing becomes difficult, then the cartridge needs to be changed to increase its effectiveness. Air-purifying respirators with the life service indicator beside it will indicate that the cartridge is full. Then that is the correct time to change it (Respirator Protection eTool, 2019).

Atmosphere-supplying respirators provide a respirable atmosphere to the wearer, independent from the ambient air (Plog, 2012, p. 667). They supply the worker with air from an outside source. These respirators provide maximum protection to the worker when exposed to hazardous particles. Atmosphere-supplying respirators can be through a negative pressure supplied air system or a positive air pressure supplies air system. A negative pressure supplied air system means that the worker sucks the air out of the tank they have in their bodies. Naturally we as human beings we suck air from the environment to our bodies. There is a constant flow of air in that mask. Positive air pressure supplies air system is where airline suppliers and air are

flowing through the filter all the time. Atmosphere-supplying respirators fall into three groups: air-supplied respirators, self-contained breathing apparatus (SCBA), and combination respirators (Plog, 2012, p. 667). Air-supplied respirators use a hose to deliver clean and safe air. Self-contained breathing apparatus (SCBA) consists of a wearable, clean air supply pack within the human body. Combination respirators have a self-contained air supply that is used when primary air supply fails. The greatest benefit of using a self-contained breathing apparatus is that it can be used for any type of contaminant or exposure level. It doesn't matter how hazardous the material is or how big it is. The supplied respirators are suitable for any chemical. In a room full of unknown chemicals its environment is treated as an immediate danger to life and health (IDLH). In an atmosphere with immediate danger to life and health, a worker needs to escape immediately from the area. A self-contained breathing apparatus allows the worker to escape at any time because the worker will use the oxygen they are carrying which is attached to their waist.

The limitations of using a supplied-air respirator are that the movements are limited. Self-contained breathing apparatus are heavy. The worker cannot go down to their knees when the chemicals are on low levels. The workers are encouraged not to submerge their legs in the chemicals. They are also very restrictive to movements. Self-contained breathing apparatus is time restrictive and twenty minutes is the limited time the workers are encouraged to be within a hazardous situation because of their health and safety (Respirator Protection eTool, 2019).

Hearing protectors is another example of protective equipment in the workplace. Exposing workers to loud noises can cause permanent hearing loss. Hearing loss is preventable. According to The Center for Disease Control (CDC), "they estimated that about 22 million are exposed to potentially damaging noise at work each year" (Occupational noise exposure, 2019, p. 2). Knowing the workplace noise levels is important. If you raise your voice to a person 3 feet

away from you at the workplace then the probability of being exposed to more than 85 decibels is high. Noise dosimeters and sound level meters are commonly used to measure noise levels at the workplace. Short term exposure to workers can cause slight damage to the ears. Permanent damage loss may not be the case but the worker will experience uncomfortable in the ears. Itching of the ears is the major signs or early symptoms of hearing problems. Pressure in the ears is the other problem, also ringing of the ears can be a symptom workers experience when they are exposed to noise for a short period. Workers who are exposed to noise for a few minutes every day might experience hearing loss after some time. Damage keeps accumulating and at the long run permanent damage of the ears is achieved. This damage is irreversible but surgeries and hearing aid can be used. It is important to monitor noise levels in the workplace. To avoid hearing loss the use of hearing protection equipment is advised (Occupational noise exposure, 2019).

“OSHA sets legal limits on noise exposure in the workplace” (Occupational noise exposure, 2019, p. 2). According to OSHA, workers are supposed to be protected through a hearing conservation program. This hearing conservation program ensures that workers are not exposed to more than 85 decibels in a 9- hour time-weighted average. OSHA uses a criterion whereby if 5 decibels are added to the limit which is 85 decibels then the time exposed to the worker should be cut into half. Every time the noise is increased by 5 decibels then the time exposure is cut in half. When the exposure level reaches 85- decibels then hearing protectors are needed. The employer should provide protective equipment and it should be used to reduce sound levels. Before getting to a decision of providing the protective equipment other feasible engineering controls shall be utilized (Occupational noise exposure, 2019). When 85 decibels are reached, it is considered the action level. The National Institute for Occupational Safety and



Health (NIOSH) recommended that all workers should be exposed to noise below 85 decibels in a time-weighted average of 8 hours. This will help reduce the exposure and the chances of putting the workers into a dangerous situation of making them lose their hearing capability.

When workers are being exposed to loud noises produced by machines, hearing protection is needed. Protecting workers is the main focus in the workplace. There is various hearing equipment that is commonly used in the workplace. Earplugs and earmuffs are the types of hearing protectors available (Canadian Centre for Occupational Health and Safety [CCOHS], 2019). Workers have a choice of hearing protectors depending on the level of noise produced in the workplace. If the worker is comfortable then, they will have the option of not using the hearing protectors. When choosing protective equipment, it is important to consider the job being done in the workplace. If the job produces loud noise then the type of protective equipment is different from the one for a job with low noise. Selecting equipment that provides adequate protection is the other factor to consider. This depends on the noise being released by the machines being used.

Comfortability at the workplace is another factor the employer should consider while purchasing the equipment. This will make it easy for workers to work around the workplace with no difficulties. Considering the environment is the other factor. The working environment is different because of the activities going on. Some places are warm, cold, or humid. The hearing protectors chosen should be appropriate for the temperature in the workplace. Lastly, hearing protectors should provide adequate communication and hearing needs. Workers need to hear alarms in case of emergency with the presence of hearing equipment in their ears. Earplugs are inserted to the ear canal while the earmuffs are held by a headband, and it contains a soft ear cushioning material that fits around the ear. The ear muffs contain a hard-outer cup. Earmuffs

also protect the ears from cold apart from the main use which is noise (CCOHS, 2019). Noise reduction rating (NRR) is a method that accurately determines the effectiveness of a person wearing a hearing protector. Manufacturers always provide the NRR value of the earplugs or earmuffs (Goldthwaite, 2019).

NRR values are a more accurate method to determine the exposure of a worker who is wearing a hearing protective equipment. Depending on the heavy machinery and equipment that produce loud noises, the protection of workers is determined using NRR. NRR is always determined by subtracting seven from the NRR which is always given in decibels. Then, divide the result by two. Lastly, subtract the answer from the original noise exposure levels in decibels (Goldthwaite, 2019). The values of NRR always range from 0 to approximately 30. A higher value means that there is a greater amount of protection to the worker. The least number means that the worker is protected but the equipment in use may not be the best and some loud noise is being exposed to the worker indirectly.

Earplugs and earmuffs have both disadvantages and advantages. Earplugs can be disposed of or reused depending on the worker and the job. If the worker is going on a break, they can come back and reuse but if they are going home on Friday and coming back to the workplace on Monday then it is good to dispose and use new ones on Monday. They are easy to use and cheaper. Earplugs can be worn in a wet or a humid environment with no difficulty. To achieve maximum protection workers should insert them properly and in a clean way to prevent infection of the ears. Earmuffs are well designed and the headband fits most heads. This is an advantage because the workers will not take time looking for the one which fits them but they adjust the ones they have to fit their head. Since they are big enough they are not easily misplaced and they can be reused for a long time. Earmuffs are made of a cushion inside and a

hard outer-cup which does not soak in a humid environment. When it's raining they don't get wet either and the workers who have sensitive ears to dirt can wear them without fear of ear infections. Also, the supervisor can easily see them from a distance during the inspection (OSHA, 2019).

The disadvantage of using earplugs is that some do not provide maximum protection and they cannot withstand more than 105 decibels. Earplugs are small and this can make it difficult for the supervisor to inspect if the workers wear them correctly when they are working without bothering them. They need more time to fit. The worker should not put them in when in a rush because they should be put correctly for maximum protection. Earplugs may irritate the ear canal because they are meant to fit in the ear canal which causes ear infection to the worker. Earmuffs, on the other hand, are more uncomfortable in hot and humid areas. Workers cannot use these in a confined space. If the worker is wearing glasses these may interfere with wearing them. It will not provide maximum hearing protection to the worker because the glasses break the seal between the skin and the ear muffs increasing chances of exposure (OSHA, 2019).

To protect the worker maximumly they should know how to care for the protective devices provided. They should be able to check their protective devices for wear and tear regularly. This will reduce the chances of putting in hearing devices which will not provide full protection. Workers should ask for their devices replaced if they are no longer pliable. They should know how to properly clean the device to reduce the chances of putting dirt to their ear canals which are the main cause of infections. Caring for these devices will maintain the protection level and it will be effective when they are using them. When cleaning the earmuffs, it is important to ensure that the muffs are not wet. When the devices are exposed to excess moisture they should replace the cushions after work and they should keep them in a dry place.

Since hearing devices are different depending on the manufacturers, employers should train their workers on how to clean, and store these devices. Other protective equipment like gloves and protective clothing should be used in the workplace accordingly. Protecting the worker from experiencing injuries and illness in the workplace is the focus (OSHA, 2019).

### **Conclusion**

Protecting workers from injuries and illnesses is achieved by identifying health and safety hazards that may occur. Employers are responsible for implementing and monitoring measures that limit employees from potentially harmful hazards. Prevention of workplace injuries can be achieved by offering training to workers. Training should include the training programs they should follow and the importance of these training programs. Employees should be trained on how to recognize and avoid unsafe conditions in the workplace.

Employers and employees should act as a team to determine ways of identifying injuries and illnesses. Use of ergonomic assessment, monitoring the workplace, ensuring that the workplace is free from contaminants, not exceeding the required limits, and toxicology helps in identifying workplace injuries and illnesses. Separating workers from risks using the hierarchy of controls is another way of preventing workplace injuries and illnesses. Some of these controls eliminate the cause of injury and illness. Some controls just prevent the illness or injury from getting worse.

In conclusion, using personal protective equipment in the workplace prevents injuries and illnesses. The use of protective clothing depends on the settings of the work and exposure levels of hazardous materials. Workers have the right to be protected by the employers according to the General Duty Clause. If the worker is not protected then OSHA gives out the citation to the

facility. “From 29 CFR 1910.119(3)(v), the penalties range from \$0 to \$70,000 per item” (Dreux Esq., (2005). These citations are characterized as “serious” or “willful”.

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