Occupational Skin Exposures and Effects

WHAT HEALTHCARE PROFESSIONALS NEED TO KNOW
THIS IS A 4 HOUR COURSE

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This course was developed to help expand the knowledge of healthcare professionals with respect to the subject of occupational skin exposures and effects. The information in this course has been derived from various professional sources.

It is the responsibility of the healthcare professional to determine which principles and theories contained herein are appropriate with respect to his/her personal limitations and scope of practice.

The information in this course has been carefully researched and is generally accepted as factual at the time of publication. The Institute for Advanced Therapeutics, Inc. disclaims responsibility for any contradictory data prior to the publication of the next revision of this course.

*The images used at the beginning of each chapter were obtained from Microsoft Office Clip Art.
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COURSE DIRECTIONS

HOW TO BEST PROCEED WITH THIS COURSE

Each chapter should be approached systematically in a careful and objective manner. It is important to master each chapter before going on to the next. Relax, take your time, and go at your own pace. As 4 credits of continuing education are rewarded after successfully completing this course, the reading of this manual and completion of the test questions should not take less than 4 hours. Only after you have successfully mastered all the material in the course should you proceed to the test questions. Keep in mind that each question has only one correct answer. The test consists of 30 questions. For a passing grade, you must correctly answer 21 questions.

INFORMATION FOR CERTIFICATION

In order to receive your 4 hours of continuing education credit, you must be a registered purchaser of this course. Please notify us of any address or name changes as we keep permanent records for certification and licensure.
COURSE OBJECTIVES

Upon completion of this course, you will be able to:

1. Discuss the anatomy and function of the skin.
2. Describe what factors influence dermal absorption.
3. Describe the difference between allergic dermatitis and irritant dermatitis.
4. Discuss the symptoms of a latex allergy.
5. Learn how healthcare workers can help prevent latex allergic reactions in the workplace.
6. Describe ways to avoid MRSA infection in the workplace.
7. Learn how to select personal protective equipment.
CHAPTER 1
INTRODUCTION

Overview

It is estimated that more than 13 million workers in the United States are potentially exposed to chemicals that can be absorbed through the skin. Dermal exposure to hazardous agents can result in a variety of occupational diseases and disorders, including occupational skin diseases and systemic toxicity. Historically, efforts to control workplace exposures to hazardous agents have focused on inhalation rather than skin exposures. As a result, assessment strategies and methods are well developed for evaluating inhalation exposures in the workplace; standardized methods are currently lacking for measuring and assessing skin exposures.

Occupational skin diseases are the second most common type of occupational disease and can occur in several different forms including:

- Irritant contact dermatitis,
- Allergic contact dermatitis,
- Skin cancers,
- Skin infections,
- Skin injuries, and
- Other miscellaneous skin diseases.

Contact dermatitis is one of the most common types of occupational illness, with estimated annual costs exceeding $1 billion.

Occupations at Risk

Workers at risk of potentially harmful exposures of the skin include, but are not limited to, those working in the following industries and sectors:

- Food service
- Cosmetology
- Health care
- Agriculture
- Cleaning
- Painting
- Mechanics
- Printing/lithography
- Construction
Anatomy and Functions of the Skin

The skin is the body's largest organ, accounting for more than 10 percent of body mass. The skin provides a number of functions including:

- protection,
- water preservation,
- shock absorption,
- tactile sensation,
- calorie reservation,
- vitamin D synthesis,
- temperature control, and
- lubrication and waterproofing.

Skin Hazards

Causes of OSD include chemical agents, mechanical trauma, physical agents, and biological agents.

- **Chemical agents** are the main cause of occupational skin diseases and disorders. These agents are divided into two types: primary irritants and sensitizers. Primary or direct irritants act directly on the skin through chemical reactions. Sensitizers may not cause immediate skin reactions, but repeated exposure can result in allergic reactions.
  - A worker's skin may be exposed to hazardous chemicals through:
    - direct contact with contaminated surfaces,
    - deposition of aerosols,
    - immersion, or
    - splashes.
- **Physical agents** such as extreme temperatures (hot or cold) and radiation (UV/solar radiation).
- **Mechanical trauma** includes friction, pressure, abrasions, lacerations and contusions (scratches, cuts and bruises).
- **Biological agents** include parasites, microorganisms, plants and other animal materials.

Dermal Absorption

Dermal absorption is the transport of a chemical from the outer surface of the skin both into the skin and into the body. Studies show that absorption of chemicals through the skin can occur without being noticed by the worker, and in some cases, may represent the most significant exposure pathway. Many commonly used chemicals in the workplace could potentially result in systemic toxicity if they penetrate through the skin (i.e. pesticides, organic solvents). These chemicals enter the blood stream and cause health problems away from the site of entry.
The rate of dermal absorption depends largely on the outer layer of the skin called the *stratum corneum* (SC). The SC serves an important barrier function by keeping molecules from passing into and out of the skin, thus protecting the lower layers of skin. The extent of absorption is dependent on the following factors:

- Skin integrity (damaged vs. intact)
- Location of exposure (thickness and water content of stratum corneum; skin temperature)
- Physical and chemical properties of the hazardous substance
- Concentration of a chemical on the skin surface
- Duration of exposure
- The surface area of skin exposed to a hazardous substance

Research has revealed that skin absorption occurs via diffusion, the process whereby molecules spread from areas of high concentration to areas of low concentration. Three mechanisms by which chemicals diffuse into the skin have been proposed:

1. Intercellular lipid pathway
2. Transcellular permeation
3. Through the appendages

**Intercellular lipid pathway**
The stratum corneum consists of cells known as corneocytes. The spaces between the corneocytes are filled with substances such as fats, oils, or waxes known as lipids. Some chemicals can penetrate through these lipid-filled intercellular spaces through diffusion.

**Transcellular permeation**
Another pathway for chemicals to be absorbed into and through the skin is transcellular, or cell-to-cell, permeation whereby molecules diffuse directly through the corneocytes.

**Through the appendages (hair follicles, glands)**
The third pathway for diffusion of chemicals into and through the skin is skin appendages (i.e., hair follicles and glands). This pathway is usually insignificant because the surface area of the appendages is very small compared to the total skin area. However, very slowly permeating chemicals may employ this pathway during the initial stage of absorption.

**Contact Dermatitis**
Contact dermatitis, also called eczema, is defined as an inflammation of the skin resulting from exposure to a hazardous agent. It is the most common form of reported OSD, and represents an overwhelming burden for workers in developed nations. Epidemiological data indicate that contact dermatitis constitutes approximately 90-95% of all cases of OSD in the United States. Common symptoms of dermatitis include:

- Itching
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- Pain
- Redness
- Swelling
- The formation of small blisters or wheals (itchy, red circles with a white centre) on the skin
- Dry, flaking, scaly skin that may develop cracks

Occupational contact dermatitis is frequently divided into two categories:

1. **Irritant contact dermatitis (ICD)** is a non-immunologic reaction that manifests as an inflammation of the skin caused by direct damage to the skin following exposure to a hazardous agent. The reaction is typically localized to the site of contact. Available data indicates that ICD represents approximately 80% of all cases of occupational contact dermatitis.

   ICD may be caused by phototoxic responses (e.g., tar), acute exposures to highly irritating substances (e.g., acids, bases, oxidizing/reducing agents), or chronic cumulative exposures to mild irritants (e.g., water, detergents, weak cleaning agents).

2. **Allergic contact dermatitis (ACD)** is an inflammation of the skin caused by an immunologic reaction triggered by dermal contact to a skin allergen. For ACD to occur, a worker must be first sensitized to the allergen. Subsequent exposures of the skin to the allergenic agent may elicit an immunologic reaction resulting in inflammation of the skin. The reaction is not confined to the site of contact and may result in systemic responses.

   ACD may be caused by industrial compounds (i.e. metals, epoxy and acrylic resins, rubber additives, chemical intermediates), agrochemicals (i.e. pesticides and fertilizers), and commercial chemicals.

Because the symptoms and presentation of ICD and ACD are so similar, it is extremely difficult to distinguish between the two forms of contact dermatitis without clinical testing (e.g. patch testing). The severity of contact dermatitis is highly variable and depends on many factors including:

- Characteristics of the hazardous agent (irritant and/or allergen)
- Concentration of the hazardous agent (irritant and/or allergen)
- Duration and frequency of exposure to the hazardous agent (irritant and/or allergen)
- Environmental factors (e.g., temperature, humidity)
- Condition of the skin (e.g., healthy vs. damaged skin, dry vs. wet)

**Why Be Concerned about Working with Chemicals?**

Skin-related health problems may cause or result in:
Skin exposure to chemicals can result in very serious and in some cases life-threatening health problems. Exposures to such chemicals are not only a risk to you; they may pose a hazard to your family if carried home from work on your hands or clothing.

* Do you want to make sure that the hazards you’re exposed to at work aren’t carried home to your family?

* Are you or your family embarrassed by your skin problems, such as rashes and sores?

* Are you experiencing discomfort or pain as a result of a skin-related health problem?

* Have you lost personal or work time dealing with a skin problem? Does a skin problem affect or limit your daily life?

* Could these skin problems keep you from doing your job?

If you answered yes to any of these questions, learn more about how to recognize and control health problems related to chemical exposures to the skin.

**The Function of Your Skin**

Your skin protects your body from the world around you. Your skin limits loss of water and other necessary compounds from your body. Your undamaged skin, in most cases, limits unwanted substances from entering your body. Skin damage as a result of contact with chemicals can reduce your skin’s ability to protect you.

**Impact of Chemical Exposure on Skin**

Chemical exposures to the skin can cause temporary or permanent health damage.

**Temporary Damage**

Temporary skin damage may occur from exposure to chemicals. For example, many workers may experience dry, red, cracked skin from contact with water, soaps, gasoline,
and certain types of solvents. These health problems usually heal quickly when the skin is no longer in contact with the substance.

**Permanent Damage**

Permanent skin damage may result if the skin is exposed to a chemical that is known to have a severe impact. For example, a chemical burn, as shown, may leave a permanent scar. Exposure to certain chemicals can result in permanent loss of skin color.

Permanent damage may also occur to body organs or systems as a result of chemical exposure to the skin. For example, exposure to certain solvents can result in liver damage.

**Types of Adverse Effects**

The four major types of health effects resulting from chemical exposure to the skin are direct, systemic, sensitization, and combined.

**Direct Effects**

Exposure to chemicals can cause a problem at the point of contact. These effects are called direct effects.

**Drying**

Some chemicals remove the natural oils from the skin, causing it to become very dry. The most frequent causes of dry skin are exposures to soaps, solvents, and moisture.

**Irritation**

Some chemicals cause reddening, dryness, and cracking of the skin on contact. These chemicals are known as irritants. Irritation is most frequently caused by fiberglass, soaps, oils/cutting fluids, and solvents.

**Changes in Skin Color**

A permanent change in skin color may result when certain chemicals contact the skin. Chemicals that can cause this include tar, asphalt products, and some disinfectants.

**Corrosion (“Eating away of skin”)**

Corrosive substances can cause severe or serious damage to the skin. A chemical burn can result from a brief exposure to a corrosive substance. Corrosive substances include strong alkaline (basic) materials or acids. Skin scarring is a common outcome.
Chlorine Acne (Chloracne)

Chlorine acne is a type of acne caused by either direct contact with or absorption of certain chemicals. Chlorine acne may occur after exposure to chlorine compounds and certain pesticides.

Skin Cancer

Some chemicals found in the workplace contain cancer-producing substances (carcinogens). When these come in contact with the skin, a malignant tumor may form at the site of contact.

Systemic Effects

A chemical may enter the body through the skin, be carried by the bloodstream to different organs, and cause or contribute to a health problem somewhere else in the body. When this happens, the result is called a systemic health problem. Systemic health problems can affect either a specific organ (liver, kidney, or bladder) or an entire body system (immune system, nervous system, respiratory system, or reproductive system).

Specific Organs

Chemicals entering the body through the skin can cause damage to the liver, kidney, bladder, or some other organ. For example, paints and coatings contain solvents (such as toluene and xylene), which can cause liver and kidney damage.

Body Systems

Chemicals commonly found in the workplace can enter the body through the skin and damage the immune system, nervous system, reproductive system, or respiratory system. For example, some pesticides can enter the body through the skin and cause damage to the nervous system, and possibly lead to death.

Sensitization Effects

Chemical exposure may cause a person to become unusually sensitive to that chemical or a group of chemicals. Reactions may occur from exposure to very small amounts of the substance. Once sensitized, a person will suffer an allergic reaction when exposed to that chemical. The only way to deal with this problem is to prevent any further exposure or contact with the chemical.

Allergic Contact Dermatitis

Allergic contact dermatitis is an allergic response caused when certain chemicals contact the skin. For example, epoxy resins, chromates, rubber chemicals, amine
hardeners, and phenol-formaldehyde resins may cause allergic contact dermatitis. Exposure to a chemical on the wrist rest of a computer keyboard caused this response on the worker’s hand shown at right.

Airway Sensitization

An allergic reaction of the mucous membranes or airways may result when certain chemicals are inhaled or are exposed to the skin. For example, skin exposures to isocyanates (contained in many paints and other building materials, like spray-on insulation and roofing materials) can result in airway sensitization.

Combined Effects

Chemical exposure to the skin may cause multiple health problems. For example, individuals working with cement may experience combined health problems. Contact with the cement may result in direct irritation at the point of contact from the ability of the cement to dry out the skin. Workers may also become sensitized to cement due to the chrome salts present in the material.

What Do You Need to Know?

With these steps, you can help prevent health problems from chemical exposure to the skin:

* Recognize the hazard
* Manage the risk
* Reduce exposure and prevent injury
  
  Direct contact with liquid, including spills and splashes
  Contact with contaminated surfaces
  Contact with spray or mist

Recognize the Hazard

Be aware of how your skin can be exposed to chemicals at work:

  Direct contact with liquid, including spills and splashes
  Contact with contaminated surfaces
  Contact with spray or mist
Obtain information about chemicals:

Know the names of the chemical you work with

Read labels and the information provided by the manufacturer

Learn which chemicals can cause adverse health effects following exposure

**Manage the Risk**

Prevent chemical exposure to the skin by removing the chemical:

Eliminate: Eliminate unnecessary chemicals from a work process. For example, use disposable brushes rather than cleaning them with a solvent.

Substitute: Replace a chemical or product capable of causing skin problems with one that is less harmful. For example, substitute a water-based product for a solvent-based one.

**Reduce Exposure and Prevent Injury**

Take action to reduce or control your exposure:

Modify: Modify a process to eliminate chemical exposure. For example, rather than hand-cleaning metal parts during repair operations, use a mechanical cleaner. Modify work practices to reduce or eliminate skin contact with chemicals. For example, rather than applying a solvent with a rag, use a brush.

Ventilate: Reduce airborne exposures by adding local or general ventilation. For example, use ventilation during spray-painting operations to reduce airborne levels of isocyanates.

Maintain skin: Clean skin with mild soap, rinse thoroughly, and use moisturizer. Dry skin is damaged and more affected by chemicals.

Clean up: A clean work area helps prevent contact with chemicals on work surfaces.

Personal Protective Equipment: Use personal protective equipment (PPE) when exposure to chemicals is unavoidable. PPE may include chemical-resistant gloves, aprons, coveralls, and boots. For example, use appropriate gloves when mixing epoxy resin, to avoid skin contact. Selection of the correct PPE is critical.

Remember! Preventing skin contact with chemicals will prevent skin problems. Discuss these issues with your safety and health professional or supervisor and report all work-related health problems, including skin problems.
Labels

Read labels to identify the chemical contents of materials being used and to be aware of any handling or health warnings.

Material Safety Data Sheets

A material safety data sheet (MSDS) is designed to provide both workers and emergency personnel with the proper procedures for handling or working with a particular substance. MSDSs contain information on physical data, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill/leak procedures.

Safety and Health Professionals

Discuss the potential health effects related to the chemicals you use with available safety and health professionals and your physician.

NOTES:
Since 1990, latex allergies have become a serious health care problem. This may be due to the increased use of latex gloves. Health care workers and others use these gloves to protect themselves against HIV/AIDS, hepatitis B and other infectious diseases. But those who have had frequent medical procedures or whose work puts them in frequent, direct contact with latex are at greatest risk. But, anyone can have a latex allergy.

What is latex?

Latex is natural rubber that is made from the sap of the Brazilian rubber tree. Hundreds of products may contain latex:

- medical devices (gloves, blood pressure cuffs, IV tubes and catheters);
- dental items (dams and orthodontic rubber bands);
- clothing (the elastic waistbands in pants and underwear);
- children’s items (bottle nipples, pacifiers, teething toys and toys);
- household items (rugs, bathmats and rubber gloves);
- personal care items (diaphragms and condoms);
- office and school supplies (rubber bands, erasers, rubber cement and paint).

Not all brands of all items contain latex. Check labels carefully or contact the manufacturer if you are allergic to latex.

What is latex allergy?

A latex allergy is a reaction to a protein in the sap of the rubber tree. If someone who is sensitive touches or breathes the protein, he or she can have an allergic reaction.
Some of the other chemicals used in making latex gloves can cause serious allergies, as well. Also, latex gloves are dusted with powder to make them easier to put on and take off. When this powder combines with the latex protein, it can get into the air when the gloves are used and be inhaled.

**Who is at greatest risk for latex allergy?**
People at greatest risk include:

- people with allergies who may have cross reactions (see below);
- children with spina bifida or multiple surgeries;
- health care workers and housekeeping staff in health facilities;
- people who require frequent medical procedures, such as catheterization;
- child care providers;
- food service workers;
- workers in tire factories and rubber manufacturing; and
- others who must wear latex gloves at work.

**What are the symptoms of latex allergy?**
Some of the symptoms of a latex allergy are:

- skin rash or itching (usually on the hands);
- hives;
- swollen, red skin;
- swollen lips and tongue, with difficulty breathing;
- shortness of breath, wheezing;
- dizziness;
- fainting;
- stomach pain;
- diarrhea;
- shock (rare, except in people who have chronic allergic reactions to latex products).

**Statistics**
At least 7.7 million people are employed in the growing health care industry. While there are no overall statistics on the prevalence of latex allergy in that work force, studies do indicate that 8 to 12% of health care workers regularly exposed are sensitized, compared with 1 to 6% of the general population.

Among groups of sensitized workers, the proportion of those with symptoms of latex allergy varies; one study of exposed hospital workers found that about half of those who became sensitized developed latex asthma.

**What can I do if I think I have latex allergy?**
If you have these symptoms, do not use latex gloves or other latex products. See a doctor who is experienced in diagnosing and treating latex allergy. If you must wear gloves, use nonlatex gloves.
How can I reduce my risk of latex allergy?
If you must use latex gloves, use powderfree gloves to reduce the amount of latex protein that can get into the air. The following are different types of gloves available.

Chemical - and Liquid - Resistant Gloves
Chemical-resistant gloves are made with different kinds of rubber: natural, butyl, neoprene, nitrile and fluorocarbon (viton); or various kinds of plastic: polyvinyl chloride (PVC), polyvinyl alcohol and polyethylene. These materials can be blended or laminated for better performance. As a general rule, the thicker the glove material, the greater the chemical resistance but thick gloves may impair grip and dexterity, having a negative impact on safety.

Some examples of chemical-resistant gloves include:

**Butyl gloves** are made of a synthetic rubber and protect against a wide variety of chemicals, such as peroxide, rocket fuels, highly corrosive acids (nitric acid, sulfuric acid, hydrofluoric acid and red-fuming nitric acid), strong bases, alcohols, aldehydes, ketones, esters and nitrocompounds. Butyl gloves also resist oxidation, ozone corrosion and abrasion, and remain flexible at low temperatures. Butyl rubber does not perform well with aliphatic and aromatic hydrocarbons and halogenated solvents.

**Natural (latex) rubber gloves** are comfortable to wear, which makes them a popular general-purpose glove. They feature outstanding tensile strength, elasticity and temperature resistance. In addition to resisting abrasions caused by grinding and polishing, these gloves protect workers' hands from most water solutions of acids, alkalis, salts and ketones. Latex gloves have caused allergic reactions in some individuals and may not be appropriate for all employees. Hypoallergenic gloves, glove liners and powderless gloves are possible alternatives for workers who are allergic to latex gloves.

**Neoprene gloves** are made of synthetic rubber and offer good pliability, finger dexterity, high density and tear resistance. They protect against hydraulic fluids, gasoline, alcohols, organic acids and alkalis. They generally have chemical and wear resistance properties superior to those made of natural rubber.

**Nitrile gloves** are made of a copolymer and provide protection from chlorinated solvents such as trichloroethylene and perchloroethylene. Although intended for jobs requiring dexterity and sensitivity, nitrile gloves stand up to heavy use even after prolonged exposure to substances that cause other gloves to deteriorate. They offer protection when working with oils, greases, acids, caustics and alcohols but are generally not recommended for use with strong oxidizing agents, aromatic solvents, ketones and acetates.
What should I do if I am allergic to latex?

- Learn all you can about latex allergies.
- If possible, avoid contact with latex products.
- If you have to wear gloves at work, ask your employer for nonlatex gloves.
- Ask your health care provider if you should carry an emergency epinephrine kit.
- Wear a personal medical ID bracelet with information about your allergy.
- Before any dental or medical procedures, tell your health care provider about your allergy. Ask to be the first patient in the morning to try to avoid latex protein in the air.
- Inform your local emergency responders (police, fire and ambulance service) about your condition.
- If your child has a latex allergy, you should also tell school officials or day care providers.

What is a cross reaction?

People who have a latex allergy may be allergic to some foods, as well. This is called a cross reaction. When this happens, your body responds with the same allergic symptoms that you would have if you were exposed to latex. Cross reactions differ from one person to another. Someone may have a reaction to all the foods noted to cause cross reaction while another may have no reaction at all. Likewise, if you are allergic to any of these foods, you may also be allergic to latex:

- apples, bananas, kiwi, peaches, plums, figs, grapes, melons, papaya, passion fruit, cherries, nectarines, pears, pineapple and strawberries;
- carrots, celery, raw potatoes, avocados and tomatoes;
- chestnuts and hazelnuts;
- wheat and rye.

If you are allergic to any of these foods, tell your doctor before having any medical procedure. You could have a cross reaction to latex.

How healthcare workers can help prevent latex allergic reactions in the workplace

Latex products are made from natural rubber, and sensitivity can develop after repeated exposure. Limiting exposure to latex can help prevent allergic reactions for both home healthcare workers and their clients.

Latex Exposure Reactions

Three types of reactions can occur when using latex products:

**Irritant Contact Dermatitis** This is the most common negative reaction to latex. Symptoms include dry, itchy, irritated skin—most often on the hands.
Allergic Contact Dermatitis (delayed hypersensitivity) This skin reaction looks like the rash from contact with poison ivy and usually shows up 24–96 hours after contact.

Latex Allergy (immediate hypersensitivity) This type of reaction usually happens within minutes of exposure, but symptoms can also show up a few hours later. Symptoms of a mild reaction are skin redness, hives, or itching. Symptoms of more serious reactions might include runny nose, sneezing, itchy eyes, scratchy throat, wheezing, coughing, or difficulty with breathing. Rarely, shock may occur, but a life-threatening reaction is seldom the first sign of sensitivity. A latex-exposed worker developing any serious allergic reactions should be taken to a doctor immediately.

What employers should do to reduce latex allergic reactions
* Provide workers with non-latex gloves when there is little contact with infectious material.
* Consider the use of vinyl, nitrile, or polymer gloves appropriate for infectious materials.
* Provide reduced-protein, powder-free gloves, if latex gloves are selected for use with infectious materials.
* Provide training to workers on latex allergy.
* Promptly arrange a medical evaluation for workers with symptoms of latex allergy. Provide these employees with non-latex gloves.

What employees should do to reduce latex allergic reactions
* Use non-latex gloves for activities not likely to involve contact with infectious materials.
* Request gloves that do not contain latex but still offer protection against infectious materials.
* Ask for reduced-protein, powder-free gloves, if your employer supplies latex gloves.
* Avoid oil-based creams or lotions when using latex gloves. They may cause the gloves to break down.
* Wash hands with a mild soap and dry hands completely after using gloves.
* Recognize symptoms of latex allergy (rash; hives; flushing; itching; nasal, eye, and sinus irritation; asthma; and shock).
* Avoid direct contact with latex gloves and other latex-containing products if you develop symptoms of latex allergy, until you can see a doctor.

IF YOU ARE DIAGNOSED WITH LATEX ALLERGY
* Avoid touching, using, or being near latex-containing products.
* Avoid areas where latex is likely to be inhaled (for example, where powdered latex gloves are being used).
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* Inform your employer and your personal healthcare professionals that you have latex allergy.
* Wear a medical alert bracelet.
* Follow your doctor’s recommendations about latex allergy.
* Before receiving any shots (such as a flu shot), be sure the person giving it uses a latex-free vial stopper.
* Before undergoing a medical procedure or surgery, consult the specialist who will perform the procedure about any modifications that may be needed.

**Hazardous Drugs in Healthcare Settings**
Modern society is fortunate to have powerful treatments available for a wide range of medical conditions. However, some useful medications can also have serious side effects. When using these drugs for medical treatment, doctors carefully control the dose and monitor the patient to minimize harmful consequences. But the doctors, nurses, pharmacists, and other healthcare workers who handle these medications are also being exposed and may also demonstrate adverse health effects.

Hazardous drugs include drugs used for chemotherapy, antiviral drugs, hormones, and some immunosuppressant drugs—all of which may have damaging effects on the body. When these drugs must be prepared and administered, there are workplace best practices that can minimize potentially harmful exposure. These include the use of engineering controls such as biological safety cabinets, closed system transfer devices, needleless systems, and personal protective equipment such as gloves, masks, and gowns. In order to use this equipment appropriately and effectively, healthcare workers need to know which drugs pose a hazard.

Starting in 2000, the National Institute for Occupational Safety and Health (NIOSH) began working with multiple partners and stakeholders to address the issue of occupational exposure to hazardous drugs. The NIOSH Hazardous Drug Committee—with representatives from nursing and pharmacy professional associations, federal agencies, pharmaceutical companies, health and safety professionals, manufacturers of safety equipment, and academia—developed recommendations for how to minimize exposure when working with hazardous drugs.

**Relevant Information**
* Exposure to hazardous drugs may occur through inhalation, skin absorption, ingestion, or injection.
* Adverse health effects from hazardous drug exposure may include harm to internal organs, damage to the reproductive system, genetic damage, birth defects, and cancer. About 8 million U.S. healthcare workers are potentially exposed to hazardous drugs, including pharmacy and nursing personnel, physicians, environmental services workers, workers in research laboratories, veterinary care workers, and shipping and receiving personnel.
What is MRSA?

Methicillin-resistant Staphylococcus Aureus (MRSA) is a type of staph bacteria that is resistant to certain antibiotics called beta-lactams. These antibiotics include methicillin and other more common antibiotics such as oxacillin, penicillin, and amoxicillin. In the community, most MRSA infections are skin infections. More severe or potentially life-threatening MRSA infections occur most frequently among patients in healthcare settings. While 25% to 30% of people are colonized in the nose with staph, less than 2% are colonized with MRSA.

This germ does not cause any problems for most people who have it on their skin. But sometimes it can cause serious infections such as skin or wound infections, pneumonia, or infections of the blood.

Antibiotics are given to kill Staph germs when they cause infections. Some Staph are resistant, meaning they cannot be killed by some antibiotics. “Methicillin-resistant Staphylococcus aureus” or “MRSA” is a type of Staph that is resistant to some of the antibiotics that are often used to treat Staph infections.

Who is most likely to get an MRSA infection?

In the hospital, people who are more likely to get an MRSA infection are people who:

- have other health conditions making them sick
- have been in the hospital or a nursing home
- have been treated with antibiotics.

People who are healthy and who have not been in the hospital or a nursing home can also get MRSA infections. These infections usually involve the skin.

MRSA infections can occur in any geographic location and anywhere on a person’s body and can affect anyone. Historically, MRSA infections occurred in hospitalized patients, but now these infections are common in the community. The biggest risk factor for MRSA infection is open or broken skin (such as a wound or surgical site); however, MRSA infections can occur even on areas of the skin where there is no obvious wound or break in the skin.
Patients in Healthcare Settings

Patients in healthcare facilities have weakened immune systems and undergo procedures (such as surgery) or have catheters inserted into the skin that make it easier for MRSA to get into the body. It is for this reason that healthcare personnel must follow infection control procedures (such as hand hygiene and proper catheter care) to prevent patients from acquiring MRSA infections. When patients get MRSA in healthcare facilities, the infections tend to be severe. Common infections include surgical wound infections, urinary tract infections, bloodstream infections, and pneumonia.

Visitors of Infected Patients

When visiting MRSA patients, individuals should follow the facility’s visitor policies. Casual contact—such as kissing, hugging, and touching—is usually acceptable. Visitors should avoid touching catheters or wound sites and should wash their hands before leaving an infected person’s room.

Skin Infections in the Community

MRSA in the community is widespread and therefore, anyone is at risk. Most people who get MRSA in the community get infections of the skin. Factors that have been associated with the spread of MRSA skin infections include: close skin-to-skin contact, openings in the skin such as cuts or abrasions, contaminated items and surfaces, crowded living conditions, and poor hygiene. People may be more at risk in locations where these factors are common, including: athletic facilities, dormitories, military barracks, correctional facilities, and daycare centers.

Although rare, severe infections such as pneumonia following flu can occur in the community.

How MRSA is Spread in the Community

MRSA infections, as with all staph, are usually spread by having contact with someone’s skin infection or personal items they have used, like towels, bandages, or razors that touched their infected skin. These infections are most likely to be spread in places where people are in close contact with others—for instance, schools and locker rooms where athletes might share razors or towels.

Factors that have been associated with the spread of MRSA skin infections include: close skin-to-skin contact, openings in the skin such as cuts or abrasions, contaminated items and surfaces, crowded living conditions, and poor hygiene. People may be more at risk in locations where these factors are common, including: athletic facilities, dormitories, military barracks, households, correctional facilities, and daycare centers.
Risks from Contaminated Surfaces

MRSA is found on people and not naturally found in the environment (e.g., soil, the ocean, lakes). MRSA could get on objects and surfaces outside the body if someone touches infected skin or certain areas of the body where these bacteria can live (like the nose) and then touches the object or surface. Another way that items can be contaminated with staph and MRSA is if they have direct contact with a person’s skin infection. Keeping skin infections covered with bandages is the best way to reduce the chance that surfaces will be contaminated with MRSA.

Even if surfaces have MRSA on them, this does not mean that you will definitely get an infection if you touch these surfaces. MRSA is most likely to cause problems when you have a cut or scrape that is not covered. That's why it's important to cover your cuts and open wounds with bandages. MRSA can also get into small openings in the skin, like the openings at hair follicles. The best defense is good hygiene. Keep your hands clean, use a barrier like clothing or towels between you and any surfaces you share with others (like gym equipment) and shower immediately after activities that involve direct skin contact with others. These are easy ways to decrease your risk of getting MRSA.

Hospitals and Healthcare Settings

Healthcare procedures can leave patients vulnerable to MRSA, which is typically spread in healthcare settings from patient to patient on unclean hands of healthcare personnel or through the improper use or reuse of equipment.

Hands may become contaminated with MRSA by contact with:

- colonized or infected patients;
- colonized or infected body sites of the personnel themselves; or
- devices, items, or environmental surfaces contaminated with body fluids containing MRSA.

Symptoms of MRSA

As with all regular staph infections, recognizing the signs and receiving treatment for MRSA skin infections in the early stages reduces the chances of the infection becoming severe.

Severe Infections

MRSA in healthcare settings usually causes more severe and potentially life-threatening infections, such as bloodstream infections, surgical site infections, or pneumonia. The signs and symptoms will vary by the type and stage of the infection.
Skin Infections

In the community, most MRSA infections are skin infections that may appear as pustules or boils which often are red, swollen, painful, or have pus or other drainage. They often first look like spider bites or bumps that are red, swollen, and painful. These skin infections commonly occur at sites of visible skin trauma, such as cuts and abrasions, and areas of the body covered by hair (e.g., back of neck, groin, buttock, armpit, beard area of men).

Prevention of MRSA Infections

While good personal prevention practices are the key to preventing MRSA infections, prevention efforts can vary depending on your setting.

Personal Prevention of MRSA Skin Infections

Protect yourself through good hygiene.

The key to preventing MRSA infections is for everyone to practice good hygiene:

1. Keep your hands clean by washing thoroughly with soap and water or using an alcohol-based hand rub.
2. Keep cuts and scrapes clean and covered with a bandage until healed.
3. Avoid contact with other people’s wounds or bandages.
4. Avoid sharing personal items such as towels or razors.

Prevent the spread of MRSA if you have it.

Prevent spreading MRSA skin infections to others by following these steps:

1. Cover your wound. Keep wounds that are draining, or have pus, covered with clean, dry bandages until healed. Follow your healthcare provider’s instructions on proper care of the wound. Pus from infected wounds can contain staph, including MRSA, so keeping the infection covered will help prevent the spread to others. Bandages and tape can be discarded with the regular trash.
2. Clean your hands. You, your family, and others in close contact should wash their hands frequently with soap and water or use an alcohol-based hand rub, especially after changing the bandage or touching the infected wound.
3. Do not share personal items. Avoid sharing personal items, such as towels, washcloths, razors, clothing, or uniforms, that may have had contact with the infected wound or bandage. Wash sheets, towels, and clothes that become soiled with water and laundry detergent. Use a dryer to dry clothes completely.
4. Maintain a clean environment. Establish cleaning procedures for frequently touched surfaces and surfaces that come into direct contact with your skin.
Visitors of Infected Patients

When visiting MRSA patients, individuals should follow the facility’s visitor policies. Casual contact—such as kissing, hugging, and touching—is usually acceptable. Visitors should avoid touching catheters or wound sites and should wash their hands before leaving an infected person's room.

Patient Education

Patient education is a critical component of MRSA case management. Healthcare professionals should educate patients and visitors on methods to avoid MRSA transmission to close contacts.

Standard Precautions

These standard precautions should control the spread of MRSA in most instances.

1) Hand Hygiene

Perform hand hygiene after touching blood, body fluids, secretions, excretions, and contaminated items, whether or not gloves are worn. Perform hand hygiene immediately after gloves are removed, between patient contacts, and when otherwise indicated to avoid transfer of microorganisms to other patients or environments. When hands are visibly soiled with blood or other body fluids, wash hands with soap and water. It may be necessary to perform hand hygiene between tasks and procedures on the same patient to prevent cross-contamination of different body sites.

2) Gloving

Wear gloves (clean nonsterile gloves are adequate) when it can be reasonably anticipated that contact with blood or other potentially infectious materials, mucous membranes, nonintact skin, or potentially contaminated intact skin (e.g., of a patient incontinent of stool or urine) could occur. Remove gloves after contact with a patient and/or the surrounding environment (including medical equipment) using proper technique to prevent hand contamination. Do not wear the same pair of gloves for the care of more than one patient. Do not wash gloves for the purpose of reuse since this practice has been associated with transmission of pathogens.

3) Mouth, nose, eye protection

Use PPE to protect the mucous membranes of the eyes, nose and mouth during procedures and patient-care activities that are likely to generate splashes or
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sprays of blood, body fluids, secretions and excretions. Select masks, goggles, face shields, and combinations of each according to the need anticipated by the task performed.

4) Gowning

Wear a gown, that is appropriate to the task, to protect skin and prevent soiling or contamination of clothing during procedures and patient-care activities when contact with blood, body fluids, secretions, or excretions is anticipated.

5) Appropriate device handling of patient care equipment and instruments/devices

Handle used patient-care equipment soiled with blood, body fluids, secretions, and excretions in a manner that prevents skin and mucous membrane exposures, contamination of clothing, and transfer of microorganisms to other patients and environments. Ensure that reusable equipment is not used for the care of another patient until it has been appropriately cleaned and reprocessed and that single-use items are properly discarded. Clean and disinfect surfaces that are likely to be contaminated with pathogens, including those that are in close proximity to the patient (e.g., bed rails, over bed tables) and frequently-touched surfaces in the patient care environment (e.g., door knobs, surfaces in and surrounding toilets in patients' rooms) on a more frequent schedule compared to that for other surfaces (e.g., horizontal surfaces in waiting rooms).

6) Appropriate handling of laundry

Handle, transport, and process used linen to avoid contamination of air, surfaces and persons.

More on Standard Precautions...

Contact Precautions

CDC recommends contact precautions when the facility (based on national or local regulations) deems MRSA to be of special clinical and epidemiologic significance. The components of contact precautions may be adapted for use in non-hospital healthcare facilities, especially if the patient has draining wounds or difficulty controlling body fluids.

Treating MRSA Skin Infections

Incision and drainage constitutes the primary therapy for these purulent skin infections. Empiric antimicrobial coverage for MRSA may be warranted in addition to incision and drainage based on clinical assessment (e.g., presence of systemic symptoms, severe local symptoms, immune suppression, extremes of patient age, infections in a difficult to drain area, or lack of response to incision and drainage alone).
Antibiotic treatment, if indicated, should be guided by the susceptibility profile of the organism. Obtaining specimens for culture and susceptibility testing is useful to guide therapy, particularly for those with more severe infections and those who fail to respond adequately to initial management.

MRSA skin infections can develop into more serious infections. It is important to discuss a follow-up plan with your patients in case they develop systemic symptoms or worsening local symptoms, or if symptoms do not improve within 48 hours.

Treating Severe MRSA Infections

For severe infections, consider consulting with an infectious disease specialist. Treatment may include surgical or antimicrobial interventions.

NOTES:
CHAPTER 4
PERSONAL PROTECTIVE EQUIPMENT

The Requirement for Personal Protective Equipment (PPE)

To ensure the greatest possible protection for employees in the workplace, the cooperative efforts of both employers and employees will help in establishing and maintaining a safe and healthful work environment.

In general, employers are responsible for:

- Performing a "hazard assessment" of the workplace to identify and control physical and health hazards.
- Identifying and providing appropriate PPE for employees.
- Training employees in the use and care of the PPE.
- Maintaining PPE, including replacing worn or damaged PPE.
- Periodically reviewing, updating and evaluating the effectiveness of the PPE program.

In general, employees should:

- Properly wear PPE,
- Attend training sessions on PPE,
- Care for, clean and maintain PPE, and
- Inform a supervisor of the need to repair or replace PPE.

Selecting Personal Protective Equipment

All PPE clothing and equipment should be of safe design and construction, and should be maintained in a clean and reliable fashion. Employers should take the fit and comfort of PPE into consideration when selecting appropriate items for their workplace. PPE that fits well and is comfortable to wear will encourage employee use of PPE. Most protective devices are available in multiple sizes and care should be taken to select the proper size for each employee. If several different types of PPE are worn together, make sure they are compatible. If PPE does not fit properly, it can make the difference between being safely covered or dangerously exposed. It may not provide the level of protection desired and may discourage employee use.
OSHA requires that many categories of PPE meet or be equivalent to standards developed by the American National Standards Institute (ANSI). ANSI has been preparing safety standards since the 1920s, when the first safety standard was approved to protect the heads and eyes of industrial workers. Employers who need to provide PPE in the categories listed below must make certain that any new equipment procured meets the cited ANSI standard. Existing PPE stocks must meet the ANSI standard in effect at the time of its manufacture or provide protection equivalent to PPE manufactured to the ANSI criteria. Employers should inform employees who provide their own PPE of the employer's selection decisions and ensure that any employee-owned PPE used in the workplace conforms to the employer's criteria, based on the hazard assessment, OSHA requirements and ANSI standards. OSHA requires PPE to meet the following ANSI standards:

- **Eye and Face Protection**: ANSI Z87.1-1989 (USA Standard for Occupational and Educational Eye and Face Protection).
- **Head Protection**: ANSI Z89.1-1986.

For hand protection, there is no ANSI standard for gloves but OSHA recommends that selection be based upon the tasks to be performed and the performance and construction characteristics of the glove material. For protection against chemicals, glove selection must be based on the chemicals encountered, the chemical resistance and the physical properties of the glove material.

**Training Employees in the Proper Use of PPE**

Employers are required to train each employee who must use PPE. Employees must be trained to know at least the following:

- When PPE is necessary.
- What PPE is necessary.
- How to properly put on, take off, adjust and wear the PPE.
- The limitations of the PPE.
- Proper care, maintenance, useful life and disposal of PPE.

Employers should make sure that each employee demonstrates an understanding of the PPE training as well as the ability to properly wear and use PPE before they are allowed to perform work requiring the use of the PPE. If an employer believes that a previously trained employee is not demonstrating the proper understanding and skill level in the use of PPE, that employee should receive retraining. Other situations that require additional or retraining of employees include the following circumstances: changes in the workplace or in the type of required PPE that make prior training obsolete.

The employer must document the training of each employee required to wear or use PPE by preparing a certification containing the name of each employee trained, the date of training and a clear identification of the subject of the certification.
Selecting Personal Protective Equipment
Personal protective equipment may include gloves, gowns, laboratory coats, face shields or masks, eye protection, pocket masks, and other protective gear. The PPE selected must be appropriate for the task. This means the level and type of protection must fit the expected exposure. For example, gloves may be the only PPE needed for a laboratory technician who is drawing blood. However, a pathologist conducting an autopsy would need much more protective clothing because of the different types of exposure (e.g., splashes, sprays) and the increased amount of blood and other potentially infectious materials (OPIM) that are encountered. PPE must be readily accessible to workers and available in appropriate sizes. If it can be reasonably expected that a worker could have hand contact with blood, OPIM, or contaminated surfaces or items, the employer must ensure that the worker wears gloves. Single use gloves cannot be washed or decontaminated for reuse. Utility gloves may be decontaminated if their ability to provide an effective barrier is not compromised. They should be replaced when they show signs of cracking, peeling, tearing, puncturing, or deteriorating. Non-latex gloves, glove liners, powderless gloves or similar alternatives must be provided if workers are allergic to the gloves normally provided. Gloves are required for all phlebotomies outside of volunteer blood donation centers. If an employer in a volunteer blood donation center judges that routine gloving for all phlebotomies is not necessary, then the employer is required to periodically re-evaluate this policy; make gloves available for workers who want to use them; and cannot discourage their use. In addition, employers must ensure that workers in volunteer blood donation centers use gloves

(1) when they have cuts, scratches or other breaks in their skin,
(2) while they are in training, or
(3) when the worker believes that hand contamination might occur.

When splashes, sprays, splatters, or droplets of blood or OPIM pose a hazard to the eyes, nose or mouth, then masks in conjunction with eye protection (such as goggles or glasses with solid side shields) or chin-length face shields must be worn. Protection against exposure to the body is provided by protective clothing, such as gowns, aprons, lab coats, and similar garments. Surgical caps or hoods, and shoe covers or boots are needed when gross contamination is expected, such as during orthopedic surgery or autopsies. In HIV and HBV research laboratories and production facilities, laboratory coats, gowns, smocks, uniforms, or other appropriate protective clothing must be used in work areas and animal rooms. Also, protective clothing must not be worn outside of the work area and must be decontaminated before being laundered.

The Centers for Disease Control and Prevention (CDC) recommends eye protection for a variety of potential exposure settings where workers may be at risk of acquiring infectious diseases via ocular exposure. This document provides background information and specific details on eye protection that can be used to supplement eye protection recommendations provided in current CDC infection control guidance.
documents. It is intended to familiarize workers with the various types of eye protection available, their characteristics, and their applicable use. Workers should understand that regular prescription eyeglasses and contact lenses are not considered eye protection.

Infectious diseases can be transmitted through various mechanisms, among which are infections that can be introduced through the mucous membranes of the eye (conjunctiva). These include viruses and bacteria that can cause conjunctivitis (e.g., adenovirus, herpes simplex, Staphylococcus aureus) and viruses that can cause systemic infections, including bloodborne viruses (e.g. hepatitis B and C viruses, human immunodeficiency virus), herpes viruses, and rhinoviruses. Infectious agents are introduced to the eye either directly (e.g., blood splashes, respiratory droplets generated during coughing or suctioning) or from touching the eyes with contaminated fingers or other objects.

Eye protection provides a barrier to infectious materials entering the eye and is often used in conjunction with other personal protective equipment (PPE) such as gloves, gowns, and masks or respirators.

What types of eye protection should be worn?

The eye protection chosen for specific work situations depends upon the circumstances of exposure, other PPE used, and personal vision needs. There is wide variety in the types of protective eyewear, and appropriate selection should be based on a number of factors, the most important of which is the nature and extent of the hazard. Eye protection must be comfortable and allow for sufficient peripheral vision and must be adjustable to ensure a secure fit. It may be necessary to provide several different types, styles, and sizes. Selection of protective eyewear appropriate for a given task should be made from an evaluation of each activity, including regulatory requirements when applicable. These hazard assessments require a clear understanding of the work tasks, including knowledge of the potential routes of exposure and the opportunities for exposure in the task assessed (nature and extent of worker contact). Exposure incident reports should be reviewed to identify those incidents (whether or not infection occurred) that could have been prevented by the proper use of protective eyewear.

**Goggles**

Appropriately fitted, indirectly-vented goggles* with a manufacturer’s anti-fog coating provide the most reliable practical eye protection from splashes, sprays, and respiratory droplets. Newer styles of goggles may provide better indirect airflow properties to reduce fogging, as well as better peripheral vision and more size options for fitting goggles to different workers. Many styles of goggles fit adequately over prescription glasses with minimal gaps. However, to be efficacious, goggles must fit snugly, particularly from the corners of the eye across the brow. While highly effective as eye protection, goggles do not provide splash or spray protection to other parts of the face. * Directly-vented goggles may allow penetration by splashes or sprays; therefore, indirectly-vented or non-vented goggles are preferred for infection control.
Face Shields
Face shields are commonly used as an infection control alternative to goggles.** As opposed to goggles, a face shield can also provide protection to other facial areas. To provide better face and eye protection from splashes and sprays, a face shield should have crown and chin protection and wrap around the face to the point of the ear, which reduces the likelihood that a splash could go around the edge of the shield and reach the eyes. Disposable face shields for medical personnel made of light weight films that are attached to a surgical mask or fit loosely around the face should not be relied upon as optimal protection.
** In a chemical exposure or industrial setting, faceshields should be used in addition to goggles, not as a substitute for goggles (ANSI Z87.1-2003 Practice for occupational and educational eye and face protection).

Safety Glasses
Safety glasses provide impact protection but do not provide the same level of splash or droplet protection as goggles and generally should not be used for infection control purposes.

Exception to Use of Personal Protective Equipment
A worker may choose, temporarily and briefly, under rare and extraordinary circumstances, to forego use of personal protective equipment. It must be the worker’s professional judgment that using the personal protective equipment would prevent the delivery of health care or public safety services or would pose an increased hazard to the safety of the worker or coworker. When such a situation occurs, the employer is required to investigate and document the circumstances to determine if there is a way to avoid it from happening again in the future. Employers and workers should be aware that this is not a blanket exemption to the requirement to use PPE. OSHA expects that this will be an extremely rare occurrence.

Decontaminating and Disposing of Personal Protective Equipment
Employers must ensure that workers remove personal protective equipment before leaving the work area. If a garment is penetrated by blood or OPIM, it must be removed immediately or as soon as feasible. Once PPE is removed, it must be placed in an appropriately designated area or container for storage, washing, decontamination, or disposal. In addition, employers must ensure that workers wash their hands immediately or as soon as feasible after removal of gloves or other personal protective equipment.

END OF COURSE
GLOSSARY

Allergic contact dermatitis is an inflammation of the skin caused by an immunologic reaction triggered by dermal contact to a skin allergen.

Blood means human blood, human blood components, and products made from human blood.

Contact dermatitis is defined as an inflammation of the skin resulting from exposure to a hazardous agent.

Diffusion means the process whereby molecules spread from areas of high concentration to areas of low concentration.

Irritant contact dermatitis is a non-immunologic reaction that manifests as an inflammation of the skin caused by direct damage to the skin following exposure to a hazardous agent.

Latex is natural rubber that is made from the sap of the Brazilian rubber tree.

Occupational Exposure means reasonably anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from the performance of an employee’s duties.

OSHA means Occupational Safety and Health Administration.

Other Potentially Infectious Materials (OPIM) means (1) The following human body fluids: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids; (2) Any unfixed tissue or organ (other than intact skin) from a human (living or dead); and (3) HIV-containing cell or tissue cultures, organ cultures, and HIV- or HBV-containing culture medium or other solutions; and blood, organs, or other tissues from experimental animals infected with HIV or HBV.

Personal Protective Equipment is specialized clothing or equipment worn by an employee for protection against a hazard. General work clothes (e.g., uniforms, pants, shirts or blouses) not intended to function as protection against a hazard are not considered to be personal protective equipment.
REFERENCE LIST


