CONTROLLING EXPOSURES TO OCCUPATIONAL HAZARDS WITH THE

HIERARCHY OF CONTROLS

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UNM ENVIRONMENTAL HEALTH & SAFETY

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TRAINING OBJECTIVES

- To learn about hazard control by using the five elements of the hierarchy of controls:
  1. Elimination
  2. Substitution
  3. Engineering controls
  4. Administrative controls
  5. Personal protective equipment (PPE)
- To conduct an interactive discussion of hazard controls for a couple of example scenarios

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WHAT IS THE HIERARCHY OF CONTROLS?

- A METHOD OF IDENTIFYING AND MITIGATING EXPOSURES TO OCCUPATIONAL HAZARDS
- DEVELOPED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY & HEALTH (NIOSH) & WIDELY ACCEPTED & PROMOTED BY SAFETY ORGANIZATIONS
- THE HIERARCHY OF CONTROLS PRIORITIZES HAZARD CONTROL MEASURES BASED ON THE PREMISE THAT IF THE HAZARD YOU'VE IDENTIFIED CAN'T BE ELIMINATED, THEN FOLLOW THE HIERARCHY TO SELECT THE NEXT-BEST CONTROL TO MITIGATE THE RISK OF AN ACCIDENT, INCIDENT, INJURY, OR NEAR-MISS IN THE LABORATORY

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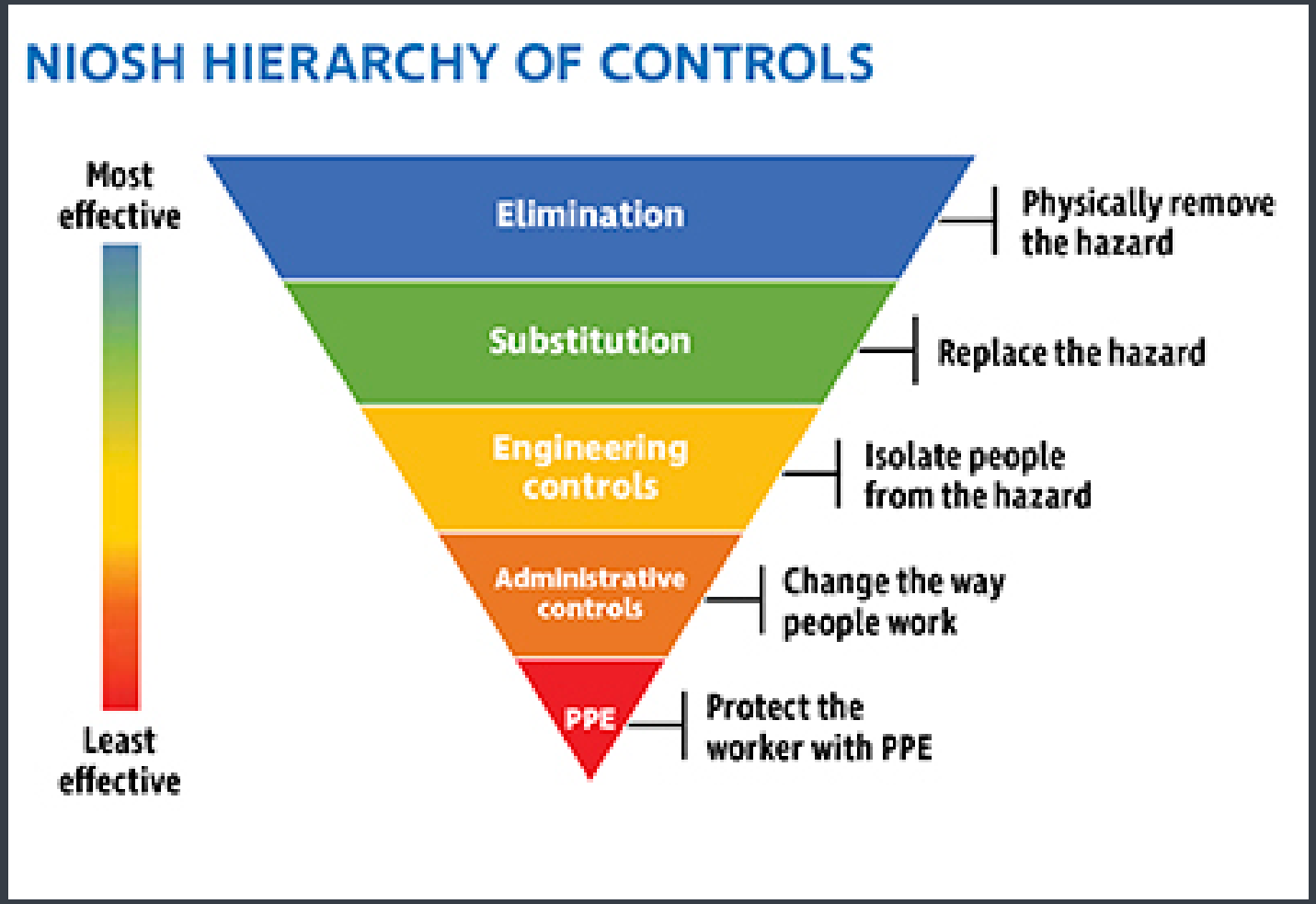
THE NIOSH HIERARCHY OF CONTROLS – VISUAL



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ELIMINATION

- Physically remove/eliminate the hazard
- the **preferred** way to control a hazard and should be used whenever possible
- Often the most difficult to implement in an existing process but can be inexpensive and simple to implement if the process is still in design or development stage
- Example: moving a noisy piece of equipment from a room occupied by people to a room without occupants

SUBSTITUTION

- Similar to hazard elimination
- Involves replacing/substituting something that is hazardous with something that is not hazardous
- Care must be taken to ensure a new hazard is not introduced when substituting one material for another
- Example: replacing/substituting a solvent-based paint with a water-based paint

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ENGINEERING CONTROLS

- Next best option after elimination or substitution
- The hazard is not eliminated but workers are protected from the hazard
- Essentially, the work environment and the work process are engineered to reduce or eliminate exposure to hazards
- Examples: fume hoods, glove boxes, splash guards, self-closing containers

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ADMINISTRATIVE CONTROLS

- Used to direct people to work in a safe manner
- The Hazard is not eliminated, but access to the hazard is restricted by the use of rules, policies and procedures
- Examples: SOPs, buddy system, training & refresher training, warning signage and labels, conducting a job hazard analysis prior to the start of a procedure

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PERSONAL PROTECTIVE EQUIPMENT (PPE)

- The least effective and least desirable method of protecting workers
- when all other control methods cannot reduce or eliminate the hazard, PPE must be used
- Use of PPE is mandatory when working in a lab, as it offers protection in the event that other control measures fail
- The success of PPE depends on whether or not lab workers actually use it properly
- Examples: gloves, safety glasses/goggles, lab coat, respirator

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INTERACTIVE DISCUSSION – SCENARIO #1:
YOU ARE A FIELD BIOLOGIST WHO WORKS AT HIGH ELEVATION (ABOVE TREE LINE) DURING MONSOON SEASON

- What is the hazard?
- Can we eliminate the hazard?
- How about substitution?
- Are there engineering controls to reduce the hazard of lightening?
- How about administrative controls?
- Is there any PPE for lightening?

- Lightening
- No
- Yes, we can substitute spring or fall season for monsoon season
- No
- Yes, we can reduce the hazard by stopping work early in the day
- Not really

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INTERACTIVE DISCUSSION – SCENARIO #2:

You are an engineering student who must attend an in-person lab twice per week during a COVID-19 pandemic

- What is the hazard?
- Can we eliminate the hazard?
- How about substitution?
- Are there engineering controls we can use?
- What about administrative controls?
- How about PPE?

- Contracting COVID-19
- No
- No
- Yes, we can install plexiglass/sneeze guards between work tables
- Yes, we can limit the number of students in the lab, we can disinfect surfaces between classes, we can be diligent about hand washing & social distancing
- Yes, we can wear a mask

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IN SUMMARY

- Emphasis should always be placed on the most effective methods for reducing risks. For example, a respirator (PPE) should not be used for protection from chemical fumes when fumes are more effectively managed by a fume hood (engineering control)
- Don't overlook the simple, inexpensive hazard control measures such as general housekeeping and removal of tripping hazards
- Extend the use of the hierarchy of controls to your everyday activities
  - for example: walking instead of driving (if possible) and wearing a seatbelt if you have to drive or ride in a car

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REFERENCES & QUESTIONS

- National institute of occupational safety & health (NIOSH) – hierarchy of controls
- Occupational safety & health administration (OSHA) – hazard prevention & control
- Safety & health magazine – the hierarchy of controls
- Laboratory hazard assessment tool – available soon on the UNM environmental health & safety website
- Questions?

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NEED MORE INFORMATION?

CONTACT EHS FOR MORE INFORMATION OR FOR GUIDANCE ON PPE SELECTION AND HAZARD CONTROL

505-277-2753

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THE BASICS OF PERSONAL PROTECTIVE EQUIPMENT (PPE)

Presenter: Melissa Terry, Hazardous Materials Specialist

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WHAT IS PPE?

- Personal Protective Equipment (PPE) is any safety equipment workers wear to prevent injury in the workplace when engineering and administrative controls fail to eliminate the hazard
- OSHA requires employers to train employees on the proper use of PPE
- In this training, you will learn:
  - Different types of PPE
  - What type of PPE is required for certain work hazards
  - How to properly don, doff, adjust and wear PPE
  - The proper care, maintenance and disposal of PPE
  - Some examples of consequences of improper & insufficient PPE usage

COMMON TYPES OF PPE FOR WORKING IN A LABORATORY

PPE to protect:

- Eyes
- Face
- Hands
- Body
- Hearing
- Respiratory

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EYE PROTECTION

- Required when employees are exposed to hazards that have the potential to injure or damage the eyes
- Examples of hazards that can be mitigated with eye PPE:
  - Working with chemicals or biological material (splashes)
  - Working with or around tools or machinery (flying debris)
  - Working with or around lasers (burns)

TYPES OF EYE PROTECTION

- **Regular Safety Glasses**
  - Designed to protect your eyes from impact and dust/particulates
- **Splash-Proof Goggles**
  - Designed to protect your eyes from impact, dust and splashes.
  - Generally stronger than regular safety glasses and are used for higher impact, particle and splash protection
- **Laser & Welding Goggles**
  - Designed to protect the eyes from harmful light
- **All eye protection must be ANSI Z87 approved**

EYE PPE CARE & MAINTENANCE

- Check for cracks or damage prior to each use
- Make sure they are clean
- Do not share eye PPE – Pinkeye, COVID-19 and other viruses and infections can be contracted from sharing PPE
- Store in a clean, dust-free area or in a protective case
- Replace as necessary

INSUFFICIENT PPE CONSEQUENCES EXAMPLE #1

What happened: a graduate student researcher was working at a lab bench synthesizing one gram of diazonium perchlorate crystals. The student was transferring synthesized perchlorate using a metal spatula when the material exploded, sending porcelain fragments into his face. The fragments shattered the lenses of his eyeglasses and lacerated his cornea. A researcher nearby assisted the student to the eyewash and called campus police. The student was taken to the hospital where he underwent surgery on his eye and treatment for facial lacerations.

What went right:

- **The student was wearing a flame-resistant lab coat and nitrile gloves, as called or in the SOP**
- **The student had previously read and signed the SOP and had completed Lab Safety training**
- **Emergency protocol was followed once the incident took place**

What should have been done differently:

- **The student *was not* wearing ANSI-approved safety glasses, as is called for in the SOP**
- **The work was being performed on an open benchtop, without use of a fume hood sash or blast shield**
- **The transfer was performed with a metal spatula, while the SOP called for use of a non-metal spatula**

INSUFFICIENT PPE CONSEQUENCES EXAMPLE #1

FACE PROTECTION

- Required when employees are exposed to hazards that have the potential of causing facial and/or eye injuries
- Examples of hazards that can be mitigated with face PPE:
  - Chemical splashes
  - Flying particles or objects
  - Working with pressurized items
  - Working with electricity

TYPES OF FACE PROTECTION

- **Face Shield**
  - Designed to protect your entire face from impact and splashes
  - If a face shield is required, safety glasses are also required

- **Welding Shield**
  - Designed to protect the eyes and face from harmful light

WEAR IT CORRECTLY

- If you are doing work that requires a face shield, you must also be wearing safety glasses or goggles
- Once eye protection is in place, position face shield over face and secure on brow with headband
- Adjust to fit comfortably

HAND PROTECTION

- Required when employees are exposed to hazards that have the potential of absorbing through the skin and/or causing hand injuries
- Examples of hazards that can be mitigated with hand PPE:
  - Absorption of chemicals through skin
  - Cuts, abrasions or punctures from sharp objects
  - Working with extremely hot or cold items or materials
  - Working with electricity

TYPES OF HAND PROTECTION

- **Chemical Resistant Gloves**
  - Designed to protect your hands from harmful chemicals and infectious agents
- **Cut or Puncture Resistant Gloves**
  - Designed to protect your hands from sharp objects or edges
- **Temperature Resistant Gloves**
  - Designed to protect your hands from extreme temperatures
- **Voltage Rated Gloves**
  - Designed to protect your hands against electrical shock

HOW TO REMOVE DISPOSABLE GLOVES WITHOUT CONTAMINATING YOURSELF

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INSUFFICIENT PPE CONSEQUENCES EXAMPLE #2

What happened: Karen Wetterhahn, Ph.D., 48 years old, internationally known research chemist was measuring the nuclear magnetic resonance spectrum of dimethyl mercury. She was using a fume hood and was wearing a face shield, safety glasses and latex gloves when she spilled a drop or so of dimethyl mercury on her glove. Initially, she did not regard the incident as serious, but five months later she began having trouble with balance, speech, vision and hearing. She was hospitalized in January 1997 and diagnosed with mercury poisoning. She went into a coma and died six months later, in June 1997.

What went right:

- **Dr. Wetterhahn was wearing what believed to be sufficient PPE, and she was using a fume hood.**

What should have been done differently:

- **Although latex gloves were, at the time, thought to be sufficient protection from organic mercury absorption, they were not. Today, it is recommended that two pairs of nitrile gloves or laminated gloves be used when handling organic mercury.**

INSUFFICIENT PPE CONSEQUENCES EXAMPLE #2

Source: Courtesy of Dartmouth College Library

Karen Wetterhahn's death saw a massive reappraisal of dimethylmercury safety precautions

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BODY PROTECTION

- Required when work presents a potential for contamination or injury to arms, legs, back or chest
- Examples of hazards that can be mitigated with body PPE:
  - Chemical splashes
  - Working with radiation
  - Working with hot/cold metals or liquids
  - Working with electricity

TYPES OF BODY PROTECTION

- Lab Coats
- Aprons
- Chemical Resistant Sleeves
- Tyvek Suits
- Coveralls

LACK OF PPE CONSEQUENCES EXAMPLE #3

What happened: Sheri Sangji, 23 year-old research assistant at UCLA, was transferring tert-butyllithium from the original container to another container. Tert-butyllithium is a pyrophoric – ignites on contact with air. Sheri was wearing nitrile gloves and safety glasses but no fire-retardant lab coat over her synthetic sweater. The syringe she was using to extract the material from the original container came apart and spilled the material all over her body and ignited. She suffered 3rd degree burns on 40% of her body and she died 18 days later.

What went right:

- Sheri was wearing nitrile gloves and safety glasses

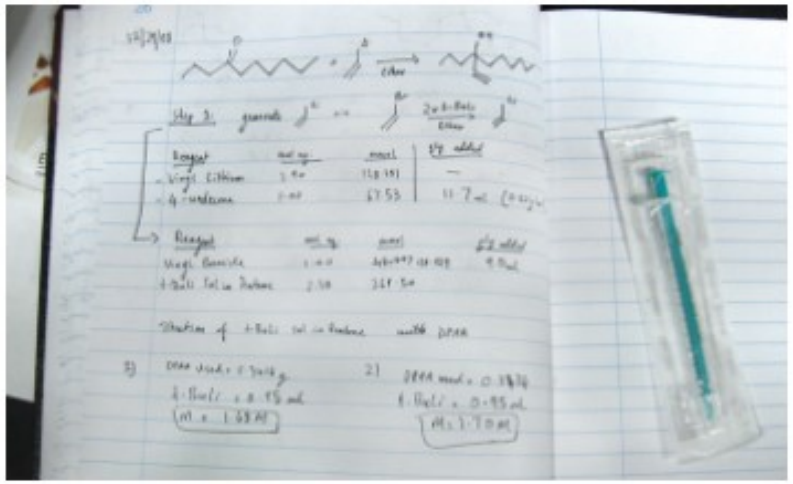
What could have been done differently:

- Sheri should have been wearing a flame-resistant lab coat
- She should have been wearing clothing made of natural fibers under her lab coat
- She should not have been working alone with highly hazardous materials

LACK OF PPE CONSEQUENCES EXAMPLE #3

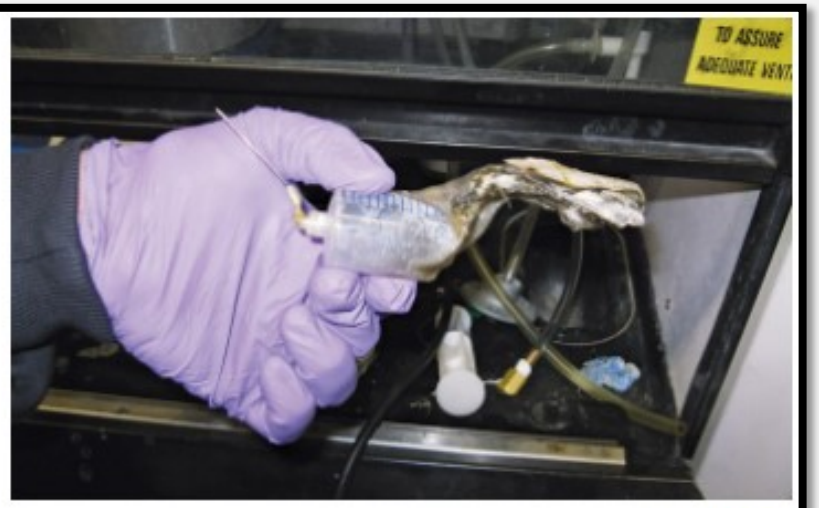
Credit: Courtesy of Naveen Sangji

Sheri Sangji



Credit: UCLA

Sheri Sangji's lab notebook page from the day of the fire.



Credit: UCLA

Sheri Sangji used a plastic 60 mL syringe to transfer *t*-BuLi.

RESPIRATORY PROTECTION

- Required when work presents an inhalation hazard
- Examples of hazards that can be mitigated with respiratory PPE:
  - Working with highly toxic chemicals
  - Cleaning up chemical spills
  - Working in dusty environments
  - Painting
  - Welding

TYPES OF RESPIRATORY PROTECTION

- Dust Mask/N95
- Half-Face & Full-Face Respirator
- Self-Contained Breathing Apparatus (SCBA)
- Powered Air-Purifying Respirator (PAPR)
- Supplied Airline Respirator

RESPIRATORY PROTECTION – FIT TESTING

- You must be medically cleared to wear a respirator
  - EOHS can provide medical clearance
- You must then be fit-tested with the respirator you will be wearing
  - EH&S can perform N95 fit-testing
  - EH&S can arrange for a vendor to perform fit-testing for a full-face respirator

RESPIRATOR CARE & MAINTENANCE

- Check for cracks, broken straps and other damage prior to use and DO NOT USE if any damage is found
- Use an alcohol wipe or mild soapy water to clean your respirator after each use
- If respirator is contaminated and cannot be decontaminated safely, it should be disposed of as hazardous waste through SRS
- Store respirator in a dust-proof bag, away from light and heat

HEARING PROTECTION

- Hearing protection must be made available to employees when the average noise level reaches 85 decibels
- Examples of high noise areas:
  - Mechanical rooms
  - Workshops
  - Construction sites
  - Vicinity of machinery or power tools

TYPES OF HEARING PROTECTION

- Earplugs
- Canal Caps
- Earmuffs

IN SUMMARY

- Always wear the required PPE when working with hazardous materials and/or processes – *the consequences of insufficient PPE can be deadly*
- UNM provides all required PPE
- Take care of your PPE – don't share it, keep it clean
- Leave work each day with all your fingers, toes and eyeballs

QUESTIONS?

For general guidance or questions about PPE, call EH&S:

505-277-2753