Supporting development of chemical risk assessment skills

Ralph Stuart, Chemical Hygiene Officer
Keene State College

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21st Century Lab Safety involves both Technical and Cultural Challenges

20th Century: Control Based on Rules, guided by Chemical Intuition

21st Century: a Safety System based on Risk Assessment

Culture Change through Safety Education

Manage Hazards

...but there is no bright line between technical learning and cultural learning; that’s why educators think in terms of knowledge, skills and attitude (culture)
Modern Lab Safety Tools

Share JHAs and Lessons Learned

Recognize

Assess

Plan

Protect

Manage

Identifying and Evaluating Hazards in Research Laboratories

Lab Safety iRAMP

Lessons Learned

Recognize Hazards

Plan for emergencies / Protect the environment

Assess Risks

Manage Safety

Information Skills

Increased Scientific Productivity

Improved Safety Culture
The Goal:

Move expectations from the bureaucratic approach (i.e. blame and train) focused on roles and responsibilities to a learning culture based on leadership and empowerment.

This learning culture relies on people being comfortable giving and receiving feedback about where they are in this scale of safety learning.
The Assessing Challenge: Both Knowledge and Judgement are involved

Risk = hazard x exposure

Knowledge (including uncertainties)   Estimate based on scenarios
The Technical Assessment Process

What-If analysis
- Unusual process risks likely
- Multiple perspectives required, both for completeness and buy-in

Standard Operating Procedure and Checklist
- High value on reproducibility
- SOP is available to serve as source material and training
- Team development required

Process description shared with a variety of people, specific to a particular lab
- 5 questions answers likely sufficient in the context of the SOP

Job Hazard Analysis
- Process concerns also likely
- Answering the 5 questions based on a process description

Control Banding
- GHS information sufficient to identify hazards
- 5 questions guide audience information

Methods from Identifying and Evaluating Hazards in Research Laboratories
Conducting a Job Hazard Assessment

Identify hazards → Analyze risks → Select controls
Current Academic Lab
Risk Assessment Practices

• Information Literacy needs to be applied to SDS’s and other safety information sources
• Physical hazards are often overlooked because they are so well controlled in teaching labs
The Managing Safety Step: Control Bands and Job Hazard Analysis

Use of **Chemicals of Special Concern** require process specific **job hazard analysis** to establish appropriate practices.

Standard uses of “service” chemicals can rely on **control bands** to assign:
- Ventilation requirements
- Training and Oversight
- PPE
- Emergency Plans

**GHS Danger Chemicals**

**GHS Warning Chemicals**
Theoretical Considerations in Control Banding

1. Control bands operate best within a specific layer of the hierarchy of controls, when based on specific hazards
2. Successful control banding programs are:
   • Scalable
   • Transferable
   • Sustainable
3. It is important to remember control bands throw away some information to support risk management judgements
### Types of Control Bands

Control bands will be different for different hazards, depending on physical aspects of the hazards.

<table>
<thead>
<tr>
<th>Control</th>
<th>Hazard</th>
<th>Properties of Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Laboratory Ventilation</td>
<td>Flammability; odor; inhalation toxicity</td>
<td>Airborne concentration relative to LEL, odor threshold, OEL</td>
</tr>
<tr>
<td>Inspection frequency</td>
<td>Unusual hazards</td>
<td>GHS Danger signal word</td>
</tr>
<tr>
<td>Training</td>
<td>Standard hazards</td>
<td>GHS classification</td>
</tr>
<tr>
<td>Personal protective equipment</td>
<td>Contamination, emergency releases</td>
<td>Concentration of solids or liquids</td>
</tr>
<tr>
<td>Waste disposal options</td>
<td>Ignitable, corrosive, reactive</td>
<td>Regulatory status (RCRA is what happens when industrial hygiene is applied to labs)</td>
</tr>
<tr>
<td>Emergency Planning</td>
<td>Significant scenarios</td>
<td>Chemical reactivity</td>
</tr>
</tbody>
</table>
Developing a Control Banding System

Control Banding Programs should be built around ANSI Z.10, specifically defining:

1. **Boundaries** of the program
   - OSHA lab standard quantities of chemicals
   - Rooms with single pass general ventilation
   - Chemicals with GHS hazard information available

2. **Stakeholders**
   - Roles (Powers)
   - Responsibilities (Leadership)

3. **Indicators** and **Goals**
   - Availability of chem inventory information (leading)
   - Exposure concentrations (lagging)
   - Availability of GHS hazard information (leading)
   - Frequency and effectiveness of management of change program (lagging)

4. **Change Management**
A Clash of Control Bands

“My chemical safety folks are upset with the below photo of a researcher in a BSL-2 lab. They say a face shield alone offers insufficient splash protection. They say that a face shield should only be used for splash protection when the user is ALSO using goggles or safety glasses.

“But my biosafety folks quote the BMBL for BSL-2, which says, “Eye and face protection (goggles, mask, face shield or other splatter guard) is used for anticipated splashes or sprays of infectious or other hazardous materials when the microorganisms must be handled outside the BSC or containment device.” They claim that the face shield alone is sufficient, appropriate and correct, as it s the photo.”
Different Types of Accident Follow up

Lessons Learned
- The elevator message when investigations are “TLDR”

Public Investigation
- Third part review (CSB, C&EN, UCCLS) with recommendations for improvement

Institutional Incident Review
- Consider restoration requirements
- Opportunities to "blame and train"

Unexpected Chemical Reactions
- Internal lab review of procedure to identify errors or improvements
Questions?
Questions?

GHS + Assessment  ->  Lab Management  + Institutional Support