Quantitative and Qualitative Indicators of Safety Culture Evolution in the Joint Safety Team

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Division of Chemical Health and Safety
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The Joint Safety Team (JST): A Researcher-Led Organization

Department heads brought faculty on board (safety officers)

Provide training, resources, and expertise

LSOs up to speed on good lab practices

Dissemination of safety sentiments & initiatives to promote departmental safety culture

Volunteers & Lab Safety Officers across both departments

Perspective on state of safety in labs & apply safe practices from EHS

= Lasting Changes
Initiation of JST in 2012 Through Industrial Support

Partnership: DOW

Offered suggestions and demonstrated industrial safety values
Defining Goals Towards Improving Safety Culture

Mission Statement: **increase safety awareness** and **improve the safety culture** in the Departments of Chemistry (CHEM) and Chemical Engineering & Materials Sciences (CEMS) at the University of Minnesota

**CARES**

- **Compliance**: Define and enforce standard roles and expectations through biannual lab audits
- **Awareness**: Enhance safety through signage, safety moments, posters, and email communication
- **Resources**: Provide easy access to information and establish a system for maintaining records
- **Education**: Provide frequent and relevant training
- **Spread**: Connect work to local chemical industry, PUIs, and high schools.

Design committees to organize and achieve our goals.
JST Organization

Analysis & Compliance
• Lab walkthroughs & surveys

Public Relations
• Social media, stall walls, safety moments, & safety posters

Education & Resources
• Bi-monthly educational meetings & safety resources (templates, guidebook)

Community Connections
• Educational events with industry, high school teachers, and PUIs

Compiled of Lab Safety Officers (LSOs) (~ 90 people) as well as volunteer undergraduates, graduates, and postdocs.
Analysis & Compliance: Safety Surveys

• Semesterly surveys gauge the:
  – Graduate student and postdoc views on safety in their labs and department
  – Evolving safety concerns
  – JST efficacy

• Results are used to:
  – Investigate safety culture and sentiments evolution
  – Develop new or adjust JST initiatives

Safety Culture in Lab

These questions address how your research group approaches and discusses lab safety.

If you see a labmate participating in unsafe lab practices, which of the following reasons would prevent you from discussing better lab practices with that labmate?
Check all that apply

- Seniority
- Personality differences
- Don’t want to disrupt labmate
- Lab practice isn’t too dangerous
- It’s not my responsibility to regulate others.
- I’ve said things in the past, but it hasn’t helped.
- I’ll definitely say something.
- Other:
Survey Evolution Over the Decade

- OS = Original Survey
  - Demographic
  - PPE
  - Unsafe practices
  - JST posters
  - Lab cleanliness & organization
  - Advisor support

- Inclusion of new categories and questions over time
  - Dynamic approach to evaluating safety
  - Not detrimental to participation

Average participation ~ 120 respondents
Interplay Between JST Initiatives & Survey Results (2019-2021)

- Survey results inspire JST initiatives based on researcher needs, resulting in a reduction of reported uneasiness with safety item of interest
  - Issue & strategy: Increase in TA and RA waste concerns led to a E&R waste talk and spill carts in scavenger hunt
  - Resolution: Concern regarding waste (RA & TA), spills (TA), and injury/illness (RA) decrease
Analysis & Compliance: Lab Safety Walkthroughs

• Groups of 2-4 LSOs walk through and evaluate each other’s lab spaces with a rubric
  – Participation from >45 labs
  – Hazard-specific and mixed hazard (generic) walkthroughs and rubrics
    • Fall – Hazard-specific, Spring – Mixed
    • Hazard classes: Organic, Inorganic, Polymers, Lasers, ChemBio, and Physical Hazards

• Semesterly walkthroughs aims:
  – Engage LSOs with each other and other lab spaces with emphasis on safety
  – Evaluation of lab spaces & feedback for improvement
  – Distinguish common, unaddressed safety items in the departments
  – Provide JST with safety items to focus on for future educational content
General Walkthrough Rubric Categories

- PPE
- Food & Drink
- Eyewash
- Clutter
- Electronics
- Hood Sashes
- Documentation
- Safety Kits

- Secondary Containment
- Segregation by Hazard
- Labelling of Samples
- Secure Placement
- Waste Labelled and Capped
- Waste Lifetime (< 90 days)
- Chemical Transport

<table>
<thead>
<tr>
<th>Safety Item</th>
<th>Score</th>
<th>Possible Scores</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proper lab documentation (emergency contacts, PPE requirements, SOPs)</td>
<td></td>
<td>(1,3,5)</td>
<td></td>
</tr>
<tr>
<td>Researchers wearing correct PPE</td>
<td></td>
<td>(1,2,3,4,5)</td>
<td></td>
</tr>
<tr>
<td>No food or drink in lab</td>
<td></td>
<td>(1 or 3)</td>
<td></td>
</tr>
<tr>
<td>Eyewash checked</td>
<td></td>
<td>(1,3,5)</td>
<td></td>
</tr>
<tr>
<td>Assis and hallways clear of chemicals and clutter</td>
<td></td>
<td>(1,3,5)</td>
<td></td>
</tr>
<tr>
<td>Electronics neatly organized</td>
<td></td>
<td>(1,2,3,4,5)</td>
<td></td>
</tr>
<tr>
<td>Hood functionality is optimized</td>
<td></td>
<td>(1,2,3,4,5)</td>
<td></td>
</tr>
<tr>
<td>Secondary containment of samples and chemicals as needed</td>
<td></td>
<td>(1,2,3,4,5)</td>
<td></td>
</tr>
<tr>
<td>Segregation of samples and chemicals by hazard</td>
<td></td>
<td>(1,2,3,4,5)</td>
<td></td>
</tr>
<tr>
<td>Labeling of samples and chemicals (name, date, hazards)</td>
<td></td>
<td>(1,3,5)</td>
<td></td>
</tr>
<tr>
<td>Secure placement of chemicals and samples</td>
<td></td>
<td>(1,2,3,4,5)</td>
<td></td>
</tr>
<tr>
<td>Waste labeled and capped</td>
<td></td>
<td>(1,2,3,4,5)</td>
<td></td>
</tr>
<tr>
<td>Waste less than 90 days old</td>
<td></td>
<td>(1,2,3,4,5)</td>
<td></td>
</tr>
<tr>
<td>Knowledge of appropriate transportation for chemicals and hazardous materials</td>
<td></td>
<td>(1,3,5)</td>
<td></td>
</tr>
<tr>
<td>Safety Kits</td>
<td></td>
<td>(1,3,5)</td>
<td></td>
</tr>
</tbody>
</table>
**Walkthrough Scoring System**

- Scores of 1-5 where:
  - 1 = “Needs Attention”
  - 2 = “Not Very Acceptable”
  - 3 = “Acceptable”
  - 4 = “Very Acceptable”
  - 5 = “Exemplary”

<table>
<thead>
<tr>
<th>1</th>
<th>Lack of secondary containment. Spills might create a serious hazard.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Some chemicals (especially larger than 0.5 L) are not in secondary containment or secondary containment is inadequate to contain a spill of the sample/chemical being stored.</td>
</tr>
<tr>
<td>3</td>
<td>Most chemicals stored in correctly sized secondary containment (especially those greater than 0.5 L). Some smaller sample vials are also stored in secondary containment.</td>
</tr>
<tr>
<td>4</td>
<td>All liquids &gt; 0.5 L and most chemicals are stored in appropriate secondary containment. Most smaller sample vials are in secondary containment as well.</td>
</tr>
<tr>
<td>5</td>
<td>All chemicals stored in appropriate secondary containment. All smaller samples are also in secondary containment. All glass solid containers are also in secondary containment.</td>
</tr>
</tbody>
</table>

- For later analyses, 1 & 2 = “Needs Attention” and 3 & 4 = “Acceptable”
- Some safety items only have 1, 3, 5 (e.g. Eyewash) or 1, 3 (e.g. Food and Drink)
# Hazard-Specific Walkthrough Rubrics Inclusive of Unique Safety Items

*Introduced in Fall 2020*

<table>
<thead>
<tr>
<th>Hazard Class</th>
<th>Hazard-Specific Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic</td>
<td>Glove box</td>
</tr>
<tr>
<td>ChemBio</td>
<td>Bio-workspace(s), biohazardous waste</td>
</tr>
<tr>
<td>Inorganic</td>
<td>Glove box</td>
</tr>
<tr>
<td>Polymers</td>
<td>Schlenk line, liquid nitrogen, glove box</td>
</tr>
<tr>
<td>Lasers</td>
<td>Beam control</td>
</tr>
<tr>
<td>Physical Hazards</td>
<td>Glove box, furnaces</td>
</tr>
</tbody>
</table>

- Computational hazard class recently included
  - Rubrics are short and need further development.
- For Lasers, a few general safety items regrouped into a broader category.
  - Details added to some items to include hazard-specific details
    - Example: high-voltage equipment and circuitry for physical hazards
Normalized Average Walkthrough Scores Over Time

- Normalization accounts for changes to rubric and scoring over time

- COVID-19 pandemic has not significantly affected lab safety

- Fall semesters typically have a lower average
  - Summer off from JST & higher volume of researchers in lab
  - Transition of LSOs

- Point system & detailed criteria introduced
- “Exemplary” added to “Needs Attention” & “Acceptable”
- Groups categorized by hazard class
- Reintroduce grouped walkthroughs
- Self-guided (COVID-19 precaution)
Summed % of “Needs Attention” Scores Over the Decade

• Decrease in “Needs Attention” scoring since 2012

• Trend of lower number of “Needs Attention” scoring in the spring

• Fall 2020 sees significantly lower “Needs Attention” scoring vs other fall semesters
  – Self-guided
  – LSOs may be more lenient on themselves and/or resolving the issue during the walkthrough
A Closer Look Into the Fall Walkthrough Results Over Time

- General increase in “Acceptable” and decrease in “Exemplary” scores over time
  - Scoring guidelines become more specific and stricter over time

- Many safety items experience a decrease in “Needs Attention” items during self-guided walkthroughs
  - Increase the following year with grouped walkthroughs
Hazard-Specific Rubrics Effect on Walkthrough Scores

- Find overall score to be swayed up to 2% from hazard-specific items
  - Any bias introduced from rubrics is minimal

- Some classes score 100% due to 1 or 3 scoring
  - E.g. glove box functioning properly vs not
Conclusions & Future Work

• The JST utilizes metrics from walkthroughs and surveys to evaluate our success as a safety resource and educator for CEMS and CHEM

• Results indicate improvements in handling of safety items in research labs
  – Effects from COVID-19 are minimal
  – Self-guided walkthroughs may not be as effective

• JST initiatives outside of A&C also improve researcher sentiments on safety in research and teaching labs

• A deeper evaluation of survey results can provide greater insight into JST influence on safety while revealing common, unaddressed, or arising safety items
Acknowledgements

Joint Safety Team Advisory Committee

& all LSOs and JST volunteers!
Thank you!
A Closer Look Into the Spring Walkthrough Results Over Time
Participation in Surveys Over Time

- Steady # of respondents over time
- Gift card incentives have had no effect on the # of respondents