Keene STATE COLLEGE

Wisdom to make a difference.

Systems Risk Assessment

Ralph Stuart, CIH, CCHO
Environmental Safety Manager
Chemical Hygiene Officer
Keene State College
August, 2021

Virtual Presentation

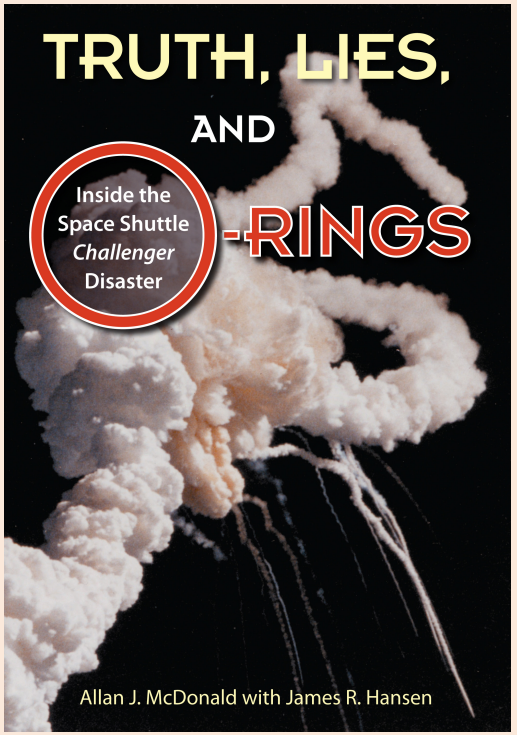
The Safety Culture Challenge

"Most discussions of safety culture ignore features of complex organizations and technological systems from which cultures emerge, for example:

- *varying norms,*
- *conflicting interests within the organization,*
- *inequalities in power and authority.*

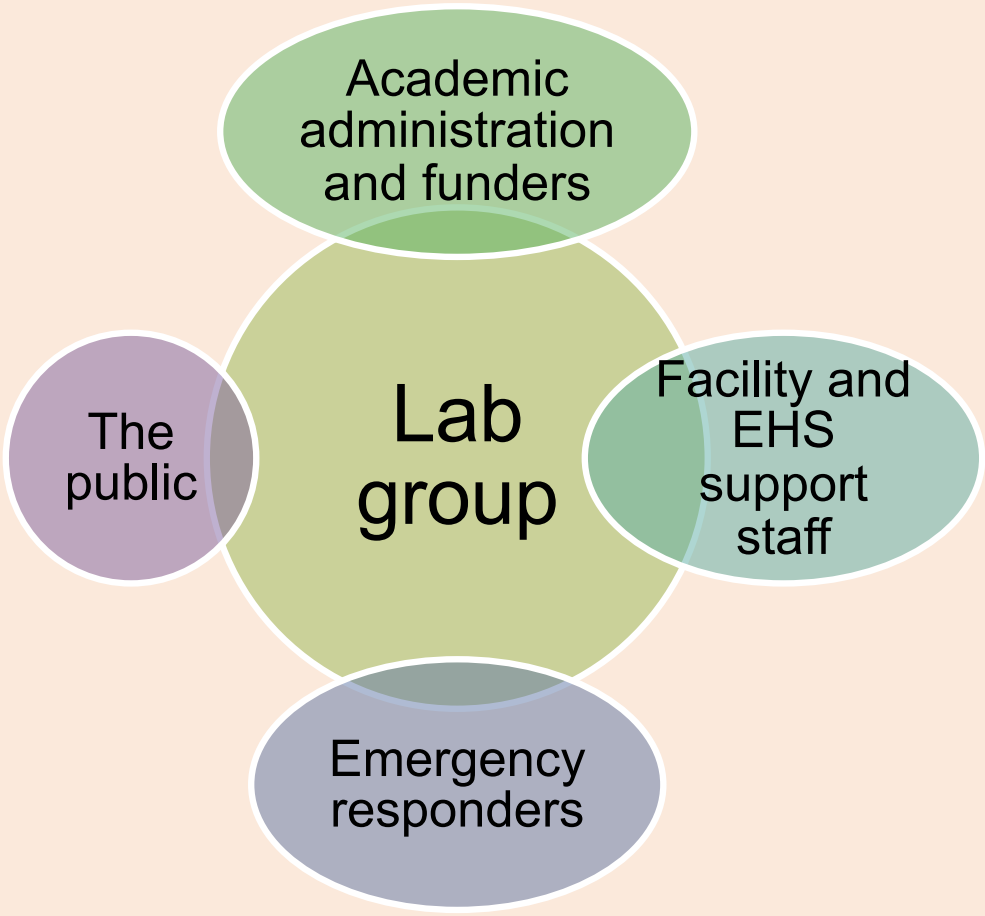
"What is missing from accounts of safety culture are the structural arrangements that impact the system's culture related to risk, safety, authority and control."

- paraphrased from Susan S. Silbey
Massachusetts Institute of Technology
Tracking the Signs and Consequences
Of A Changing Safety Culture, 2015



Safety Culture Goals of Risk Assessment

1. To move beyond **chemists' intuition** to:
   - identify opportunities to improve the reliability and safety of their work
   - prepare for unexpected events
2. To support **professional and organizational development** of the lab team and support staff
3. To **be a good neighbor**
   - Funders and admin expect best safety practices
   - Facility and EHS staff need lab specific information about hazards to do their jobs
   - Emergency responders need to identify worse case scenarios
   - The public receives the EHS results of the work



The Challenge

- While “risk assessment” is identified as a core professional skill for chemists, safety science research has shown that risk assessment is not an objective process with reproducible results.
- Specifically, when practitioners of similar training and experience conduct an assessment separately, the results vary from assessment to assessment.
- For example, emergency responders at an hazmat event is likely to create a very different risk assessment of the event that the designer of the process before the event occurs.
- See https://safetyofwork.com/episodes/ep-63-how-subjective-is-technical-risk-assessment for further discussion of this challenge.

Systems Assessment Challenge

- One reason for this variation is the system boundaries used by the risk assessors varies based on the assessors' experiences in similar situations (i.e. intuition).
- One technical approach to risk assessment is the bowtie diagram. The bowtie can, but usually does not, address the cultural aspects of the system.
- Variation in results also arises from conflicts of interest between those who benefit from the risks and those accept the consequences

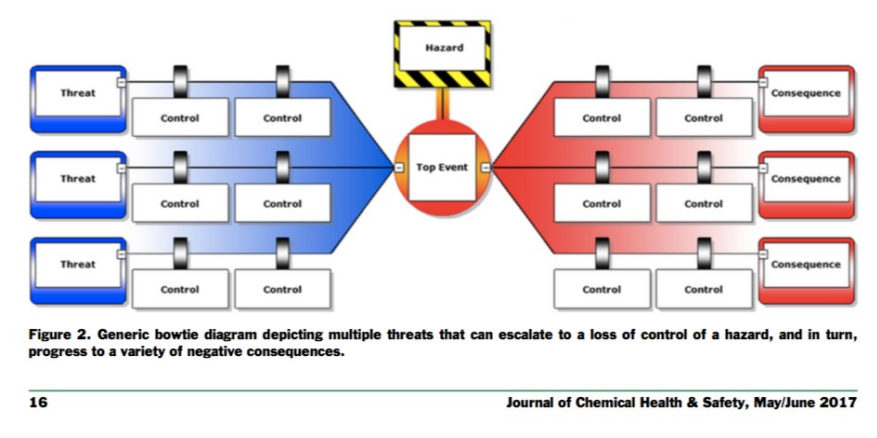
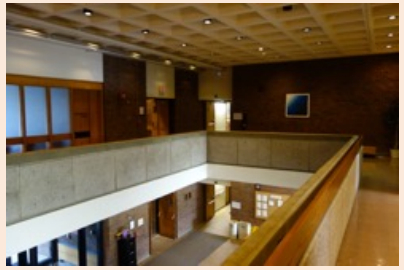


Figure 2. Generic bowtie diagram depicting multiple threats that can escalate to a loss of control of a hazard, and in turn, progress to a variety of negative consequences.

Using the bowtie methodology to support laboratory hazard identification, risk management, and incident analysis, http://dx.doi.org/10.1016/j.jchas.2016.10.003

A Systems Risk Case Study

- In 1985, I was hired by UVM to develop a hazard communication program for the campus as a whole.
- The first step was to collect Material Safety Data Sheets for the campus' chemical inventory.
- I was given budgetary authority to hire a temporary employee for 30 hours/week to collect chemical inventory data in UVM's labs.
- We thought that a logical place to start was the Chemistry Department stockroom.
- One reason we were interested in the chemistry stockroom was that there was a strong, unidentified odor that permeated the first three floors of the building. It was strongest near the stockroom.



A Stockroom Adventure

- We bought a portable computer, a lab coat and some gloves and sent our guy into the chemistry stockroom to do a bottle by bottle inventory

- At the end of the **first day** (6 hours in the stockroom), his clothes and hair stunk and he had a headache. We got him a respirator for the next day.

- At the end of the **second day,** he wasn't feeling well and his hair was brittle.

- During the **third day,** he dropped a bottle and created a mess.

Audience Poll

On the morning of Day 4 we had to make a decision: what do we do next?

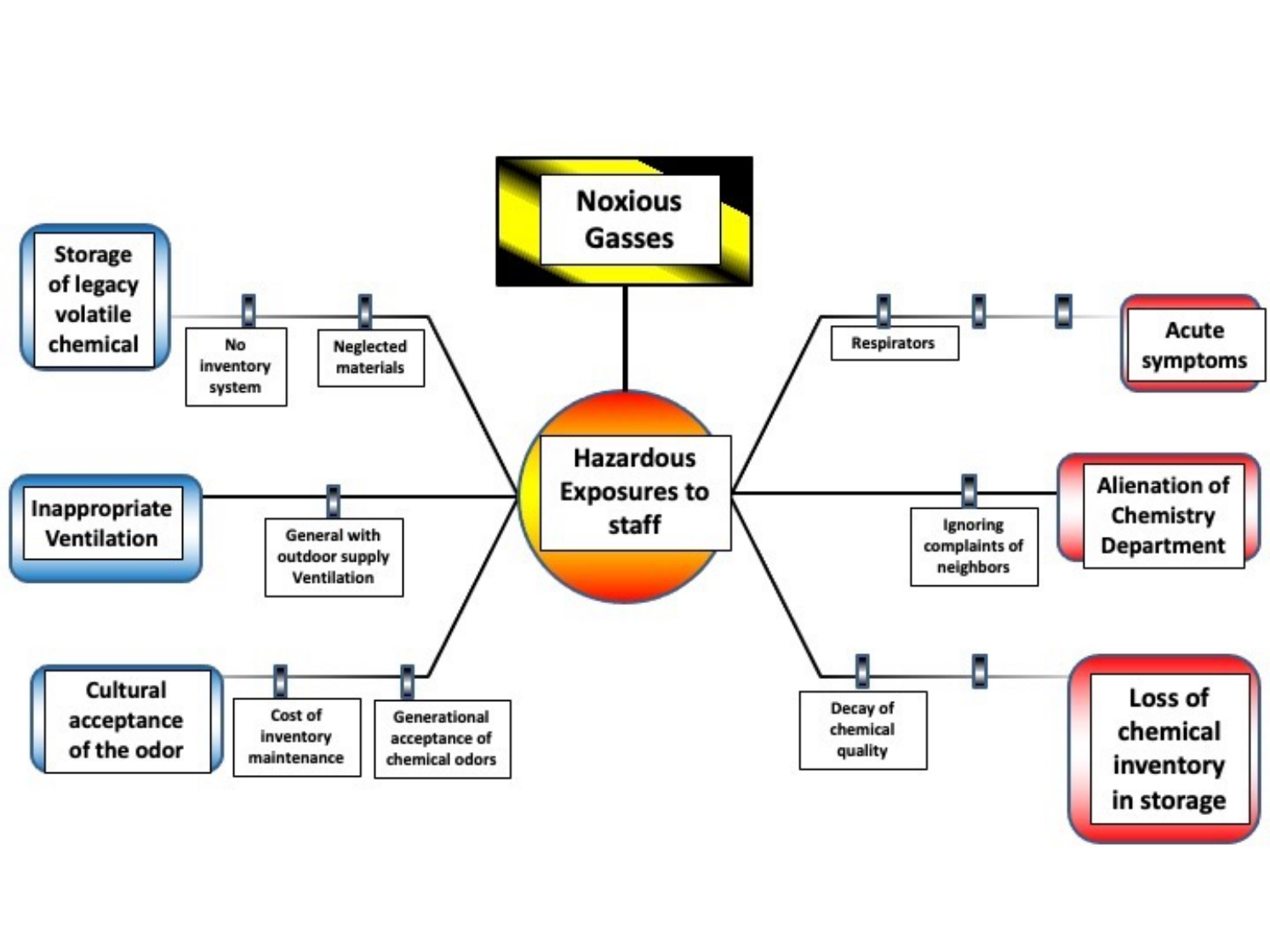
What would you do?

- Should we continue the work in the chemistry stockroom?
- Should we abandon hope of ever conducting an inventory of the chemistry stockroom? (this was 1985, before HAZWOPER services were a thing)
- Other?

Additional input:

- The chemistry department chair said "What's the problem? We have employees who work in the stock room every day"
- My boss, the insurance manager, said "no way; stop now!"

A Technical Risk Assessment



Social Risk Assessment

	Moral Aspects
Reasons to go ahead in the stockroom	The work would benefit lab workers at UVM
Reasons to stop working in the stockroom	We were working with hazardous chemicals with unknown hazards

Social Risk Assessment

	Moral Aspects	Individual ethics
Reasons to go ahead in the stockroom	The work would benefit lab workers at UVM	It wasn't clear that the symptoms were significant enough to change the plan
Reasons to stop working in the stockroom	We were working with hazardous chemicals with unknown hazards	I didn't want to be responsible for impacting my employee's health

Social Risk Assessment

	Moral Aspects	Individual ethics	Legal aspects
Reasons to go ahead in the stockroom	The work would benefit lab workers at UVM	It wasn't clear that the symptoms were significant enough to change the plan	VOSHA required a chemical inventory to comply with their regulation
Reasons to stop working in the stockroom	We were working with hazardous chemicals with unknown hazards	I didn't want to be responsible for impacting my employee's health	UVM had a "general duty" to protect our employee's health

Social Risk Assessment

	Moral Aspects	Individual ethics	Legal aspects	Professional ethics
Reasons to go ahead in the stockroom	The work would benefit lab workers at UVM	It wasn't clear that the symptoms were significant enough to change the plan	VOSHA required a chemical inventory to comply with their regulation	We couldn't collect a complete set of MSDS's until we knew what chemicals were in stock
Reasons to stop working in the stockroom	We were working with hazardous chemicals with unknown hazards	I didn't want to be responsible for impacting my employee's health	UVM had a "general duty" to protect our employee's health	I wasn't qualified to assess the safety of what I was asking my employee to do.

Social Risk Assessment

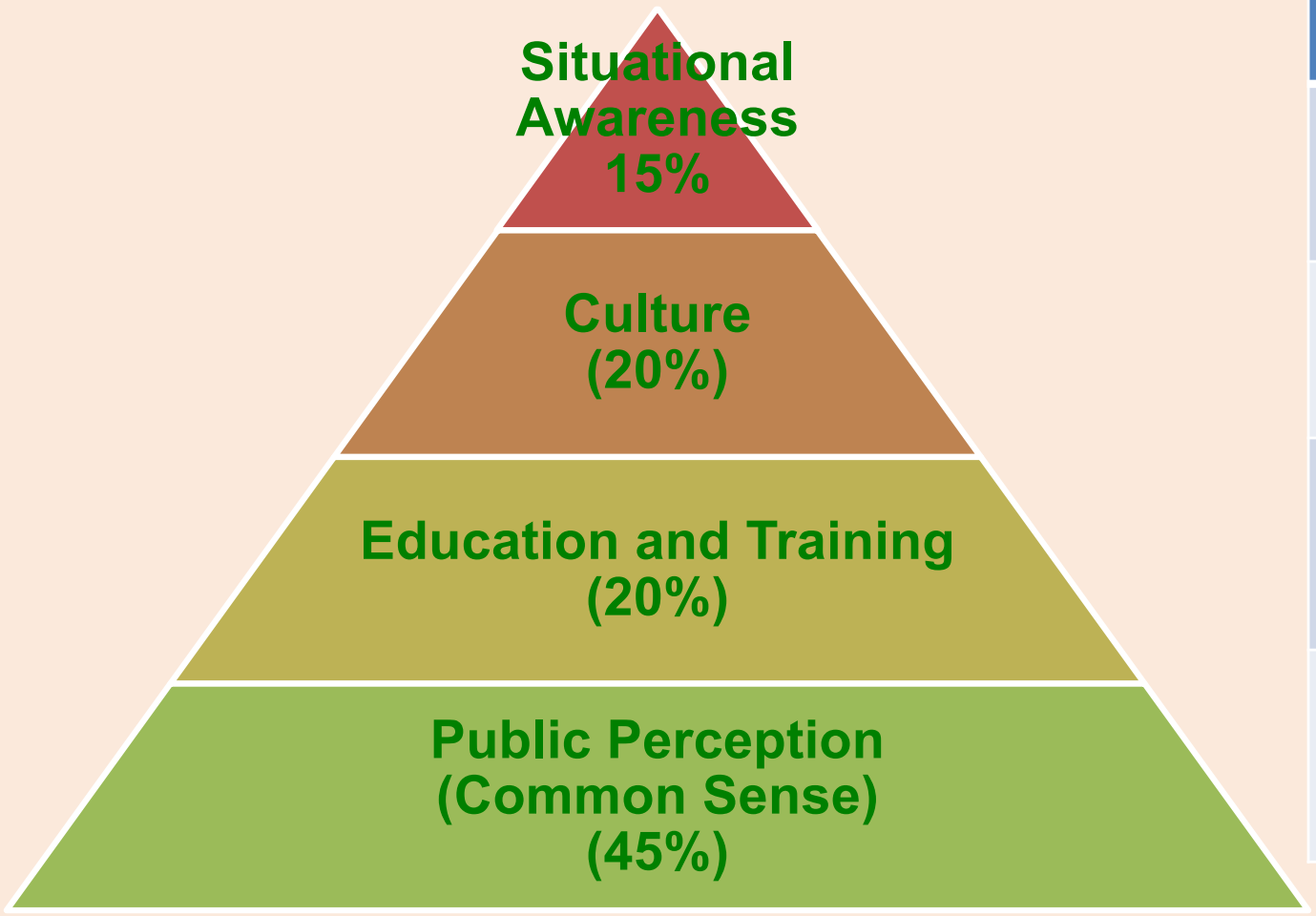
	Moral Aspects	Individual ethics	Legal aspects	Professional ethics	Managerial ethics
Reasons to go ahead in the stockroom	The work would benefit lab workers at UVM	It wasn't clear that the symptoms were significant enough to change the plan	VOSHA required a chemical inventory to comply with their regulation	We couldn't collect a complete set of MSDS's until we knew what chemicals were in stock	I didn't have a Plan B for collecting the data
Reasons to stop working in the stockroom	We were working with hazardous chemicals with unknown hazards	I didn't want to be responsible for impacting my employee's health	UVM had a "general duty" to protect our employee's health	I wasn't qualified to assess the safety of what I was asking my employee to do.	I didn't have clear priorities for the project, so we were able to change plans as we liked

The Outcome and Postscripts

- The inventory taker and I **jointly** decided to **skip the Chemistry stockroom** and work on labs in the medical school, which had smaller chemical collections and better ventilation.
- About 10 years later, I had the opportunity to do **air sampling** in the stockroom and there were many peaks in the spectrum, but no single chemical causing the odor.

Safety Education

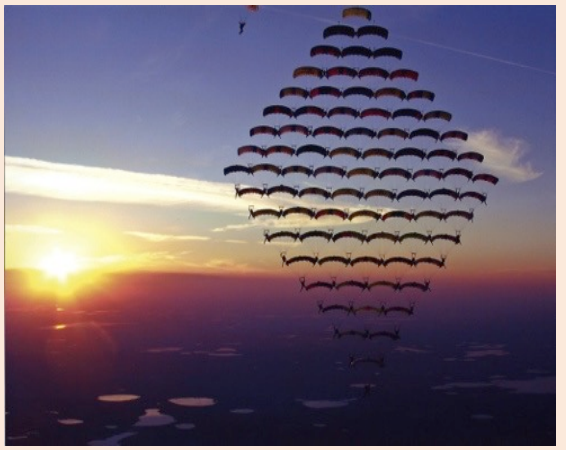
Community Safety rests on:



Driving Analogs
Professional Driver
Traffic Conditions
Licensed Driver
Rider

Tips for Risk Assessment Education

- Start with the explicit statement that everyone is involved in community safety and needs **explicit training** in their roles and responsibilities
- Use **concrete RAMP examples** to demonstrate that risk assessments happen every day
- Then provide practice with different roles in **familiar but not standard** examples
  - Example: acetic acid spill in lab from 4 points of view



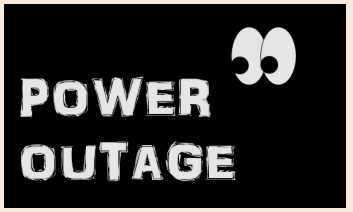
Key Skills for Active Bystanders

1. **Recognize** an event as *potentially dangerous*
2. **Assess** the risk of the situation
3. **Manage** the situation by calling for help
4. **Prepare** to help responders when they arrive

Recognizing Emergencies

Emergencies you should be ready for at Keene State:

- Fire or immediate threat of fire (1-2/year)
- Medical emergency (1-2/week)
- Community violence (every other year)
- Power outage (1-2/year)
- Hazmat spill (1-2/year)



Assessing Risks:
Which of these is the most dangerous?

37,000 US car deaths per year

(3000 in distracted driving crashes)

39,000 US gun deaths per year

(about 50% suicides, 1% of the non-suicides are mass shootings)

Second hand smoking:
41,000 US deaths per year

(Primary smokers: 480,000 US deaths per year)

Comparisions

Occupational fatalities: 5100 deaths per year

Covid-19 Deaths: 550,000 in one year

Managing Emergencies: Who are You Going to Call?

Your Options:

A. a concern to be monitored but you can manage it yourself

B. an urgent, but not dangerous, situation, call Campus Safety

C. an emergency, call 911

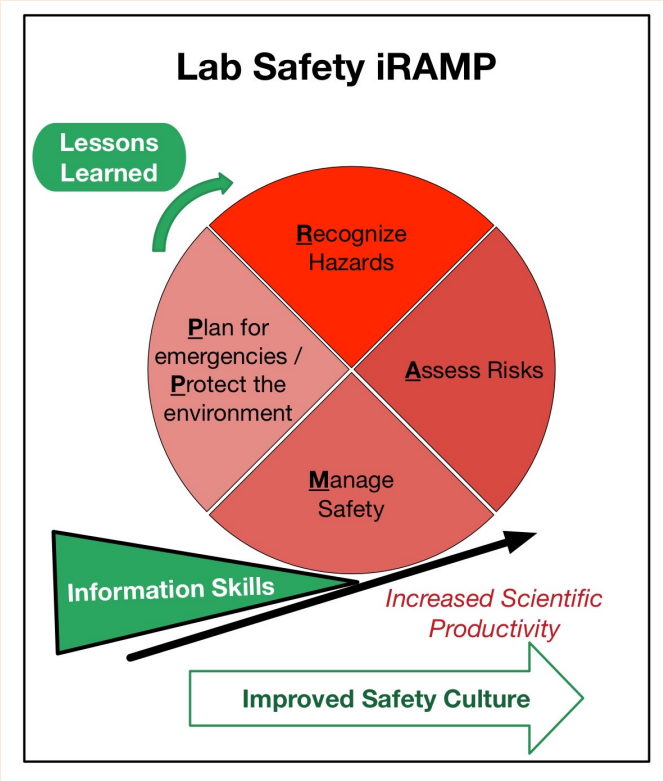
The Situation

- a sidewalk plow in your path
- an incipient fire
- a flooding toilet

The 21st Century Tool: RAMP

RAMP adds value to the risk assessment process:

- By **separating hazard and risk**
  - A lot of confusion arises when this difference is elided (PFAs, asbestos, corona virus)
- By **separating management decisions from assessment**
  - This addresses the conflict of interest between assessing and managing
- By **including planning for emergencies** as part of the routine process
  - Emergencies don't wait to be invited to occur
- By providing a process that is understood by many different stakeholders



Improving Risk Assessment Practices: 1. Diversify the Team

This helps

- Identify **unrecognized hazards**
- Reprioritize risks by better understanding their **potential impacts**
- Recognize **management resource gaps**
- Support teamwork during an **emergency**

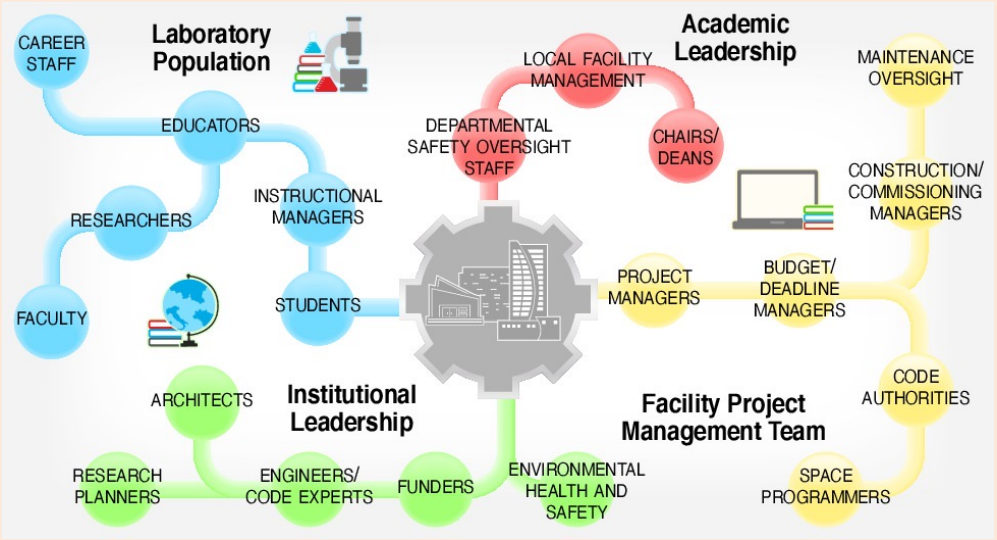
Improving Risk Assessment Practices: 2. Use FAIR Data

Improving Risk Assessment Practices: 3. Connect to external resources

For example:

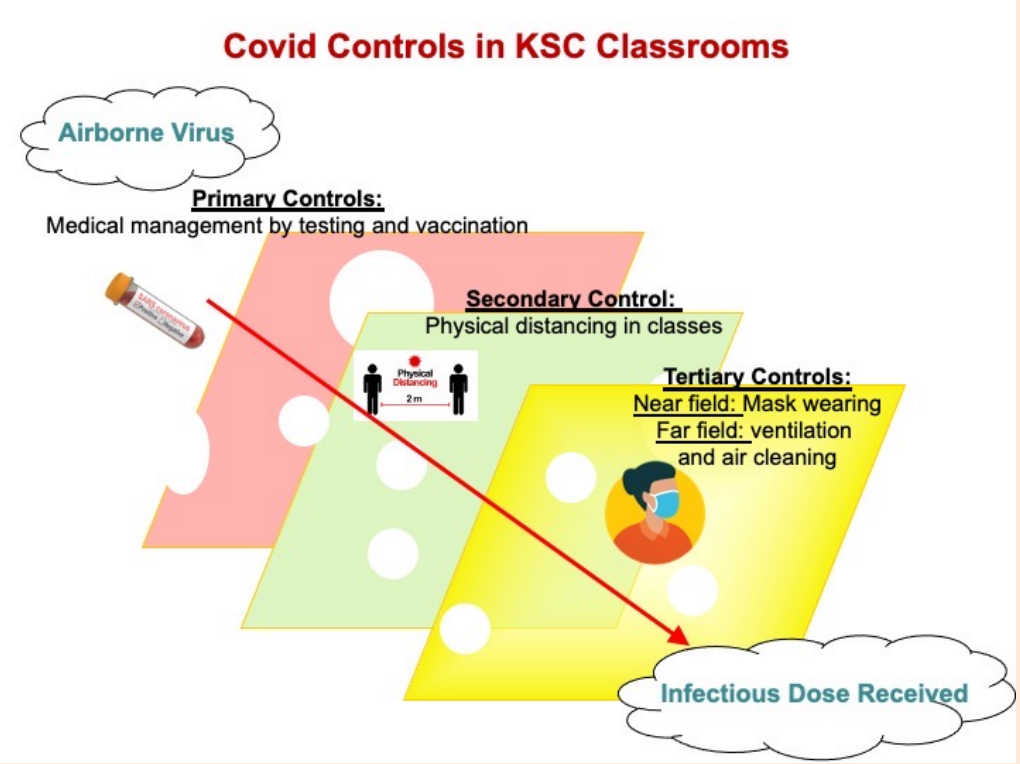
- GHS and Chemical Safety literature
- Facilities and EHS staff
- HAZMAT responders
- Share Lessons Learned

PubChem | OPEN CHEMISTRY DATABASE



CHEMICAL SAFETY LIBRARY

Improving Risk Assessment Practices:
4. Be Aware of the Risk Model You Are Using



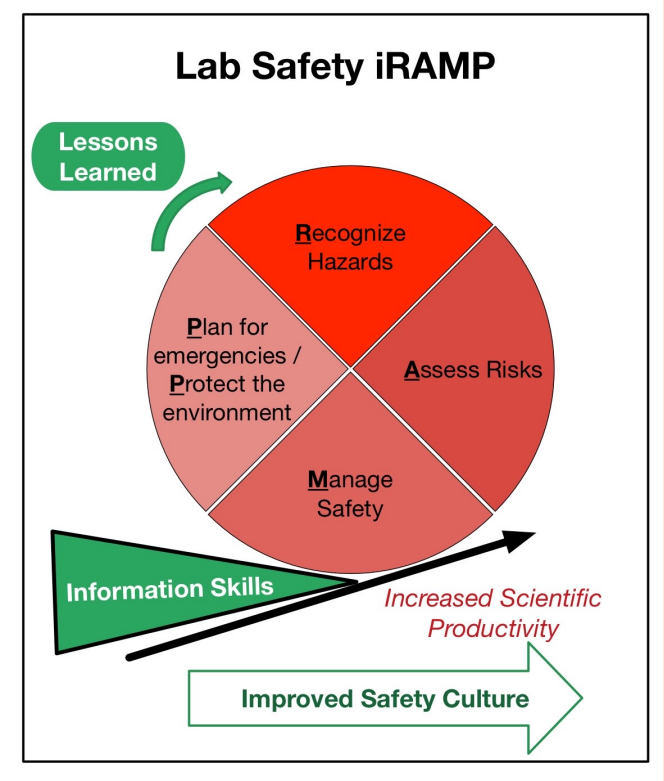
- **Primary control**: Testing to screen infected individuals
- **Secondary control:** Physical distancing in classrooms
- **Tertiary controls:** Mask wearing (near field) and ventilation and air cleaning (far field)

Improving Risk Assessment Practices: 5. Include Uncertainty

Layer	Estimated impact
1) Medical Interventions: Testing and Vaccinations	• Testing reached 95% of the KSC population and isolation of positives and their contacts was rapid. • Vaccinations are more than 90% effective, but uptake in the population is currently 60%
2) Physical distancing	Hallway observations and CO_2 readings at KSC indicate that physical distancing was appropriate in most classrooms. There are CO_2 concerns in some classes in low ventilated, crowded rooms.
3a) Controlling Near-field exposures: Mask wearing	• Lab research finds that masks are about 65% effective in controlling particles. • KSC mask wearing was about 94%, but some people don't cover noses (7% in April; much higher now).
3b) Controlling far-field exposures: Ventilation and air cleaners	We deployed HEPA air cleaners to poorly ventilated classroom spaces. Initial results indicate that cleaners reduce the time required to return to background particle levels from 1 hour to 30 minutes. Covid transmissions have been reported in less than 15 minutes

Closing Thoughts

- Eisenhower's statement that *Plans are worthless but planning is everything* applies to risk assessments: risk assessment is a verb, not a noun.
- If an event happens, non-participants will expect a "risk assessment" to have been documented. What that means in practice is fluid
  - EPA's haz waste determination is the only risk assessment process that is well defined, but remains largely useless in labs
- Systemic risks to both humans and science can not be eliminated, but they can be consciously managed.
- However, they won't be managed well by intuition because intuition is not transferable, scalable, transparent or sustainable. Science aspires to be all of these.



Discussion Questions

- What hurdles for risk assessment and education have you found in the lab setting?
  - Challenge of day to day use of the educational tool
  - RAMP unifies training and lowers cognitive load
  - Perception of risk assessment as a defined process vs. an open question

- What successes have you had in providing risk education, either technically or culturally?
  - more effective emergency responses
  - audience reception
  - understanding of the PPE selection process and back story
  - Where does management of change fit into this?