Planning for the unexpected: laboratory incident response

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A wise man believes only in lies; Trusts only in the absurd; And learns to expect the Unexpected – Roald Dahl

While the ultimate goal is prevention, a process to identify and eliminate hazards before employees are affected.

Even with a comprehensive injury and illness prevention program, incidents occur. Forethought and preplanning by developing a response plan and training and educating employees will help when incidents occur.

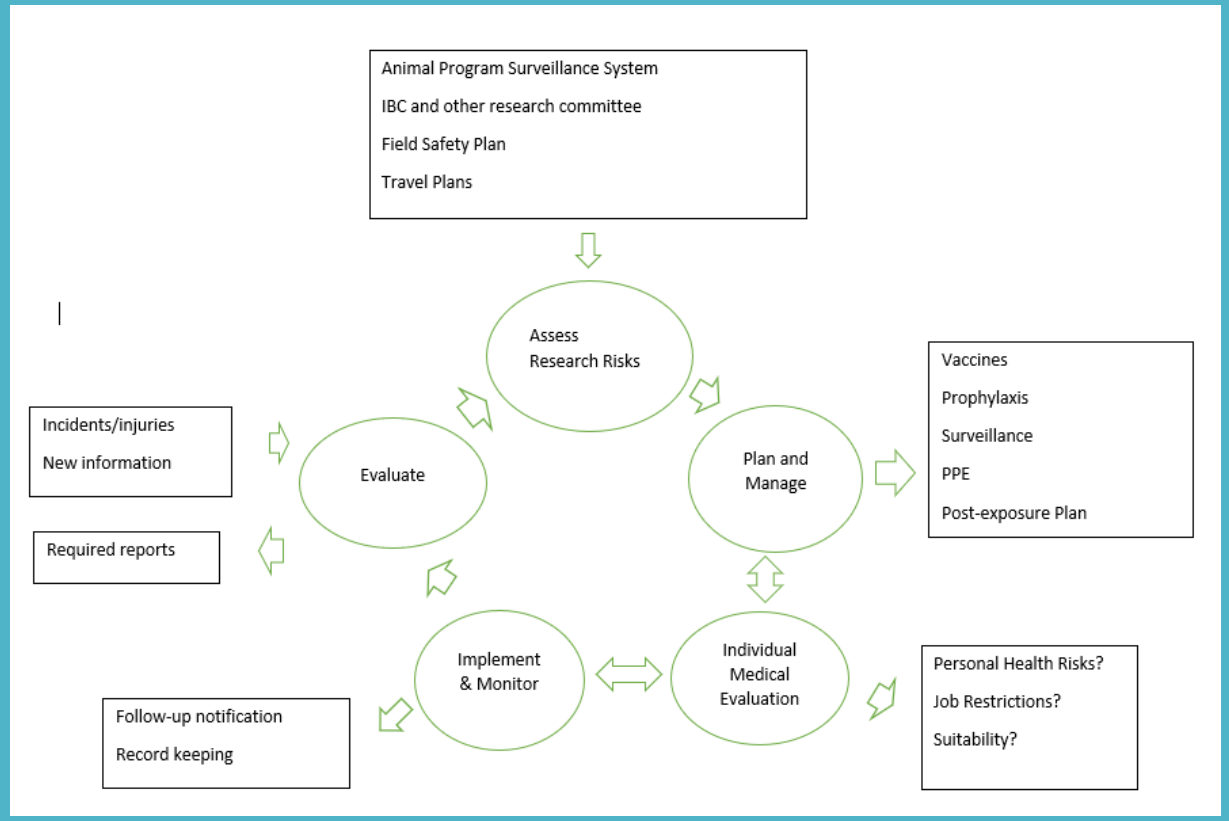
Planning Basics

What can go wrong

How to minimize risks

What if something does go wrong

Preventive vs. Responsive Medicine



Adapted from www.ehs.ucla.edu

Planning

If you fail to prepare you are preparing to fail

(1919 January, The Biblical World, Volume 53, Number 1, Religious Education (Excerpt from “The Group Plan” by rev. H.K. Williams in the “Young People’s Service”), The University of Chicago Press, Chicago, Illinois.)

Prevention

Hazard recognition, evaluation and control

Multiple hazards:

biohazards, chemical, flammable, reactive, explosive, physical, nanomaterials, radioactivity

Prevention Basics

Determine what types of incidents are most likely to occur and the type and magnitude of planning required

Assessment should include a history of occurrences

Academic Research Labs vs. Industry

There is data to suggest that risks of accidents in academic research laboratories are greater than in industry.

Estimate - risks of laboratory accidents in schools and colleges 100-1000 times greater than at Dow or DuPont

(Benderly, B.L. (2009). Taken for granted: the burning question of laboratory safety. Retrieved from http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2009_05_01/caredit.a0900054.

Academic Research Labs – Injury Data

Analysis of injuries at Iowa State University 2001-2014: lab related incidents 1497 out of 8071 first report of injury. The average percentage of incidents that were lab related was 18.4%.

student employees (18.5%)

animal caretakers (14.7%)

graduate assistants (13.9%)

Most common injuries:

lacerations and punctures

animal bites and injuries

bumps, bruises and contusions

(Simmons, H.E., et al. Analysis of injury data to improve safety and training. Journal of chemical health and safety, January/February 2017, pp21-28.

Academic Research Labs – Training

2012 survey of the safety of academic laboratories in the United States, only 59% of the respondents strongly agreed or agreed with the statement that “I received safety training on the specific agent/hazards I work with.”

(Market Research NPG. The Topline Edition of the 2012 UC BIORAFT and NPG Lab Safety Survey Data. 2013, http://dx.doi.org/10.6084/m9.fig-share.105431.)

Learning from Reported Incidents

Mechanical Hazard Injury

Michele Dufault, a 22-year-old senior at Yale University was killed on April 12, 2011.

She was working by herself at night in the machine shop of the chemistry laboratory.

She was using a wood lathe that had no guards and no emergency stop button.

She was found with her ponytail caught in a rotating part of the lathe and her body pressed against the machine.

Cause of death was asphyxia due to neck compression.

Flammable and Combustible Hazards

Sheharbano (Sheri) Sangji, 23-year-old chemistry research assistant died from injuries sustained in a chemical fire in a laboratory at UCLA on December 29, 2008

She was hired to work in the lab in mid-October, missing the EH&S training and would have been expected to attend the January training.

Flammable and Combustible Hazards

She was planning to scale up a reaction she had run once before, using tert-butyllium (tBuLi), a chemical that ignites spontaneously in air.

While working in a fume hood for unknown reasons the syringe plunger she was using came out of the barrel and the chemical was exposed to the atmosphere. Although it was not part of the experiment, an open flask of hexane was also in the fume hood and she knocked it over. The tBuLi ignited and the hexane caught fire, as did her clothes.

She was not wearing a lab coat, no one remembered if she was wearing eye protection.

Flammable and Combustible Hazards

There was a safety shower in the lab, but she did not use it. Another researcher who was cleaning up one of the lab's benches wrapped a lab coat around her to try and put out the fire. A researcher in an adjacent lab called 911 and assisted until emergency services responded. She was transported to the hospital where she died 18 days later.

The two researchers who assisted after the incident had not received general safety training from EH&S either.

Flammable and Combustible Hazards

Because she was an employee rather than a graduate student, Cal/OSHA investigated the incident, and fined the University for lack of training; failure to document training; filling to correct unsafe laboratory conditions and work practices identified in an October 30, 2008 inspection of the lab; and failing to ensure that employees wore appropriate personal protective equipment, such as lab coats.

Biohazard – Seeking Medical Evaluation

Dr. Malcolm Casadaban was a bacterial geneticist at the University of Chicago. He had been performing research on an attenuated strain of Yersinia pestis (plague). He developed fever, body aches, and cough, and after three days, he sought medical treatment.

On September 10, 2009 he was seen at an outpatient clinic and was referred to an emergency department on suspicion of influenza or another acute respiratory infection, but he did not seek the treatment.

Biohazard – Seeking Medical Evaluation

After three more days, he developed shortness of breath and was brought to a hospital. Initially, he was diagnosed with congestive heart failure, but after bacteria were seen on a peripheral blood smear, his medical team gave antibiotics.

Despite antibiotics, he died on September 13, 2009 of plague. He had been infected with the attenuated strain from his laboratory. It was found that he had a condition known as hereditary hemochromatosis, which leads to high iron levels. It was suspected that his high iron levels complemented the attenuated strain of bacteria allowing for disease.

Biohazard – Seeking Medical Evaluation

In the subsequent investigation, no serious deficiencies with the laboratory were discovered. No major reported injuries or known exposure events were on file for the lab.

Laboratory policy was to report to the University's occupational health clinic and report that he worked with Yersinia, which he did not do.

Neither location where he sought care recorded that he worked with Yersinia.

(The Association for Biosafety and Biosecurity. (2016) *Introduction to Biosafety Student Workbook*. Mundelein, IL. ABSA International)

Biohazard – Delayed Reporting

In 2004 BU researchers believed they were working with the weakened strain of tularemia that was engineered specifically for vaccine research and posed no threat to the workers.

However, they unknowingly had been using tularemia that was a mix of the harmless strain and a virulent form. It is unknown how the material became contaminated.

Biohazard – Delayed Reporting

In May, 2004 two researchers became ill with flu-like symptoms. In September, 2004 another researcher became ill, raising suspicions that they had developed tularemia.

On October 28, 2004 test results showed that the researchers were working with material that appeared to be contaminated.

Tularemia is a reportable disease in Massachusetts. State law requires “cases or suspect cases” of such diseases to be reported to public health authorities “immediately, but in no case more than 24 hours” after being identified.

Biohazard – Delayed Reporting

The suspected cases were not reported to the Massachusetts Department of Public Health until November 9, 2004, and to the Boston Public Health Commission on November 10, 2004

The acting Provost of the medical campus, Dr. Thomas Moore, said he could not explain the delay in reporting. Subsequently, BU officials found safety lapses in the lab, including that workers violated rules requiring tularemia to be handled in an enclosed chamber that filters infectious agents out of the air.

(Stephen Smith. BU delayed reporting possibly lethal exposure. Boston Globe. January 20, 2005)

Managing An Emergency

A response plan cannot cover every contingency:

- it is not a recipe or substitute for thinking

Four major phases to managing an emergency:

- mitigation
- preparedness
- response
- recovery

(Board on Chemical Sciences and Technology Division on Earth and Life Studies, National Research Council of the National Academies. (2011) *Prudent practices in the laboratory, handling and management of chemical hazards, updated version*. Washington, DC. The National Academies Press.)

Mitigation

Includes efforts to minimize the likelihood that an incident will occur and to limit the effects of an incident that does occur.

Preparedness

Process of developing plans for managing an emergency and taking action to ensure that the laboratory is ready to handle an emergency.

Response

Efforts to manage the emergency as it occurs

Recovery

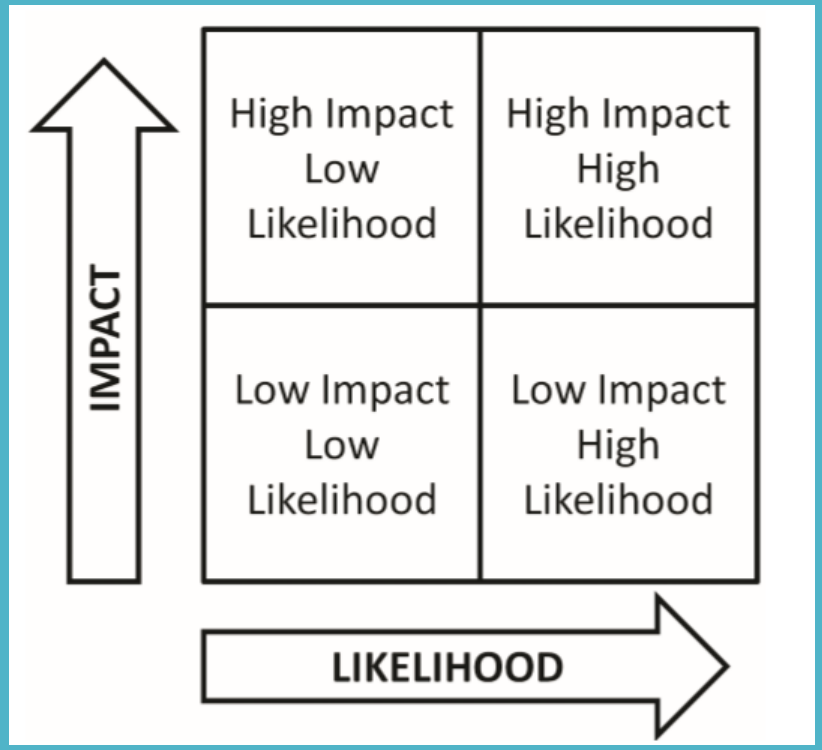
Actions to restore the laboratory

Preplanning

Many stakeholders should be involved, including:

- Industrial hygiene
- Biosafety and compliance
- Training
- Environmental health
- Laboratory personnel
- Security
- Occupational health

Vulnerability Assessment



Vulnerability Assessment

Types of incidents to consider will vary, but may include:

- fire
- weather
- seismic activity
- extreme absences due to illness
- hazardous material spill/release
- visitors
- loss of equipment
- loss of computers
- controversial research
- violence/theft

Training, Drills and Exercises

Evacuation procedures
Outside responders
What to do for signs or symptoms of illness related to exposures
Emergency shutdowns
Communications
Power outages
First aid
Shelter in place/violent behavior
Absences

Leadership and Priorities

Decision makers

Lab priorities

Essential personnel

Communications

Contact list

Communication plan (ex. texts, email)

Media and community

Reporting

Requirements for injuries and illnesses – OSHA, DPH, NIH

Chemical emergencies – SARA Title III

Hazardous waste operations and emergency response – OSHA

Bloodborne pathogen standard - OSHA

Resources

OSHA Injury and Illness Prevention Plan

Biosafety in Microbiological and Biomedical Laboratories

US Department of Labor – Health and Safety Topics: Laboratories

American Industrial Hygienists Association

Lab Safety Institute

Despite prevention efforts, incidents happen.

Developing and incident response plan that includes education and training can help when the unexpected occurs.

References

Injury and Illness Prevention Programs White Paper, US Department of Labor, Occupational Safety and Health Administration, Washington, D.C. 2012.

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Shapiro D.S., and Schwartz, D.R. Exposure of laboratory workers to Francisella tularensis despite a bioterrorism procedure. Journal of Clinical Microbiology, June 2002, p.2278-2281.