International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 05, 2020
ISSN: 1475-7192

# Moral Integration and Transparency as Cornerstone of Safety in Chemistry Laboratories

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***Abstract---*** *Society benefits when chemists work to public awareness by adopting high ethical standards, working to reach out to and assist the community around them, and fostering innovation and teamwork in their research and associated collaborations. When chemists devote their efforts to benefitting mankind and protecting the environment for future generations, people's trust in science and scientists grows. In recognition of this, from 2014 to 2016, the American Chemical Society (ACS), supported by Pacific Northwest National Laboratory (PNNL), led a U.S. Department of State-funded project to develop a Global Chemists' Code of Ethics. In this regard, transparency, integrity, and moral responsibility form the basis for ethical behavior in all scientific endeavors, including laboratory safety, presenting data, publishing, and protecting the environment. Unfortunately, while society has an interest in promoting ethical behavior in its scientific community, learning institutions and chemical enterprises may minimize training and education programs on chemical ethics. Rodda et al have previously emphasized the importance of robust scenario-based training that provides low-risk opportunities to practice ethical behavior to strengthen people's resolve to act when bigger ethical problems arise. In this manuscript, we present a straightforward roadmap to promote transparency as a means to bolster ethical behaviors of people and amenities. This roadmap, if implemented appropriately, could assist not only in maintaining research transparency and integrity but in avoiding or minimizing the effects of dangerous laboratory accidents.*

***Keywords---*** *Transparency, Ethical Principles, Ethical Chemistry, Moral Responsibility*.

## I. INTRODUCTION

People's trust in science and scientists grows. In recognition of this, from 2014 to 2016, the American Chemical Society (ACS), supported by Pacific Northwest National Laboratory (PNNL), led a U.S. Department of State-funded project to develop a Global Chemists' Code of Ethics [1].

Transparency, integrity, and moral responsibility form the basis for ethical behavior in all scientific endeavours, including laboratory safety, presenting data, publishing, and protecting the environment. Unfortunately, while society has an interest in promoting ethical behavior in its scientific community, learning institutions and chemical enterprises may minimize training and education programs on chemical ethics. Rodda et al [2].

Ethics is the discipline that applies to any system or theory of values or moral principles [3]. The words "ethics" or "morals," refer to the set of rules that help to distinguish between wrong and right. In fact, the most common definition of ethics: rules of conduct to distinguish between acceptable and unacceptable behavior [4].

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**DOI: 10.37200/IJPR/V24I5/PR201850**
**Received: 16 Feb 2020 | Revised: 10 Mar 2020 | Accepted: 23 Mar 2020** 

Linguistically, the meaning of these two words is overlapping." Actually, "ethics" is sometimes used on a more limited scale to mean the ethical principles of a tradition, group or individual [5].

One of the ethical principles that this case study focuses on is "transparency" Generally, it means openness, communication, and accountability. The word "transparent" denotes to an object that can be seen across public services, it means that people should be as open as possible about all decisions and actions they make. [6] With no doubt, chemists should promote positive perception, understanding and appreciation of chemistry education and research through innovation, teamwork, cooperation, community communication, and high ethical standards. Those chemists should act as role models, and advocates of safe application of chemicals and chemical protocols in their research institutions. Since chemistry as other natural sciences is for the benefit of humanity and the preservation of the environment for future generations. [7] Any chemist should promote and encourage the highest standards of ethics; it contributes to the sustainability of health and well-being of mankind and the protection of the environment and facilities. This is in fact, a crucial aim to achieve within any research and work environment. However, we believe that it can be achieved via considering the working environment safety and security and protocols to maintain safe handling, use, transfer and use of chemicals by researchers as well as students [8].

To promote sustainable chemical ethics implementation, we recommend a three-step process, which we will describe in detail below: Safety Culture, Environmental Protection, and Hazard Management.

## II. CHEMICAL LABORATORY ENVIRONMENT- SAFETY CULTURE

**Safety Culture** - Safety rules and regulations are created to protect laboratory personnel from unsafe work practices and exposure to hazardous materials. Continually follow and enforce safety rules in order to create a safe and secure laboratory environment in which any work will help promote a safety culture within the workplace [9]. This is an important pillar in enhancing work ethics in that increasing awareness and safety culture will be reflected in securing the work environment and it is one of the most important ethical obligations to protect workers and the workplace

**Environmental Protection** - The environmental impact of teaching and research on chemical waste is increasing. Relevant educational and research institutions through their laboratory and non-laboratory activities contribute to the generation of small quantities of waste, many of which are highly toxic [10]. Human behavior in general to preserve the environment depends mainly on the moral side in terms of the effects that may not affect the people who violate the safety instructions related to the environment, but the effect is limited to others or to the next generation in that the environmental effects are mostly long-term.

**Hazard Management** - Chemical laboratories are hazardous areas and require careful attention to the application of international standards for the chemical laboratory to ensure the safety of laboratory personnel. Control of risk areas is a priority in laboratories and an important part of ethical behavior by creating an appropriate work environment that protects workers and equipment.

Several researches related to the subject of chemical contamination and improved laboratory environment were conducted by researchers [11-16].

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## III. USE OF HAZARDOUS CHEMICALS WITHOUT SUPERVISION – CASE STUDY

The head of the department and the safety officer that there were cases of discomfort and shortness of breath in some of the students and that the laboratory administrator was also suffering from the same symptoms. There was transparency in the presentation of the case by the laboratory officer, seeking quick solutions to this problem. A specialized committee was established to investigate the case. After investigation and inspection, it was found that there were different chemicals, some of which were knowledge and others not known, which were stored irregularly in unsuitable containers, leading to saturation of the surrounding area.

Chemical substances vary in hazard type and severity. Pyrophorics, are substances that ignite and burn in the air immediately. These materials should be dealt with only by chemists with the knowledge and skills to work with them safely. We cite an example of a very tragic accident at the University of California in Los Angeles (UCLA) [17] Here we question the role of the educational institution, the supervisor, the safety officer, the laboratory administrator and laboratory personnel when Sheharbano (Sheri) Sangji (23 years) a University of California research assistant used the tertiary butyl lithium material without knowing the properties of the material. Sangji used a syringe to transport the material in a conventional gas box, which caused the material to explode as it was exposed to the oxygen in the air. (And an open flask of hexane was ignited as well). In addition Sangji was scaling up a reaction without proper precautions. Sangji died after 18 days of severe burns. [18] When assessing the incident and determining liability we see that the educational institution, the supervisor, the safety officer, the laboratory administrator and the laboratory demonstrators were responsible for the accident. Those people did not strictly allow workers to fully understand the standard operating procedures of dealing with these chemicals. Nor, students read the risk assessment sheet for the handling of these dangerous materials. Therefore, we believe that disseminating safety measures and transparency in showing the risk score as well as the ways to deal with hazardous chemicals is essential. The Sangji incident was a lightning bolt and a demand for improved standards across the United States. Several researches related to the subject of fires and explosions carried out by researchers aimed at enhancing aspects of safety and security to prohibit such incidents to be happening again. [19-21].

## IV. MIND WHAT YOU PUT IN A FURNACE: A CASE STUDY

To avoid any risk arises from dealing with chemicals, it is customary that researchers refer to the SDS and prepare a risk assessment data sheet in compliance with the hazard of the chemical to be used. At March, 2017 unknown chemicals were put in a furnace and heated to 400°C upon request from a postgraduate student. The student did not give any information about these chemicals to the person who was in charge of that laboratory. Consequently, under this elevated temperature, all chemicals were charred with evolving some toxic fumes. The student confirmed earlier that these materials are completely safe and they are absolutely stable at high temperatures as he did some thermal treatments before without any problems. Nevertheless, the toxic fumes produced from the furnace upon heating to 400°C were raising the alarm of a serious danger [22]. From an ethical point of view it requires that there be transparency in giving accurate and correct information about the nature of chemicals, especially about their treatment with high temperature. This incident came as a result of the researcher's fear of

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disclosing the secret of the research, which caused the examiner a problem that led to the release of toxic gases, during which the examination sector was evacuated for eight hours.

## V. CONCLUSION

To conclude, we have presented a straightforward roadmap describing essential elements for performing chemistry ethically and safely. We cite Safety Culture, Environmental Protection and Hazard Management as essential elements of the roadmap. It is critically important to report any concerns regarding potentially unsafe or unethical chemical procedures performed in laboratories. Transparency and integrity are crucial in all human endeavors, but especially in those which directly impact peoples' lives. It is incumbent upon chemical professionals to protect the life and health of those who work under their supervision. Raising the awareness of chemical practitioners and administrators alike in laboratory environments and encouraging them to report any concerns about issues they suspect could be dangerous. By working together to ensure safe, secure, environments and to speak up when we see something concerning, we can make the world a safer place.

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**DOI: 10.37200/IJPR/V24I5/PR201850**
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