International Journal of Health and Life Sciences **IJHLS, 2015, 1(2): 21-27**

Evaluation of the environment, health and safety (EH&S) state of laboratories at the Environmental Health Department, School of Public Health, Kermanshah University of Medical Sciences, 2015

Hiwa Hossaini[a], Meghdad Pirsaheb[a], Sheler Khedri[b], Shoeib Rahimi[b], Hooshyar Hossini[*a]

[a] Department of Environmental Health Engineering, School of Public Health, Kermanshah University of Medical Sciences, Kermanshah, Iran
[b] Students research committee, Kermanshah University of Medical Sciences, Kermanshah, Iran.

ARTICLE INFO

Article Type:
Original Article

Article History:
Received: 2016-04-15
Accepted: 2016-04-21
ePublished: 2016-04-25

***Keywords*:**
Environment health and safety
Management System
Laboratory
Hazards potential

ABSTRACT

Integrated environment, health and safety (EH&S) Management System uses a new and systematic approach to explain the interaction between health, safety, and the environment. It is a useful tool for addressing defects, risks, and accidents and for providing a prevention-based system. The aim of this study was to establish a suitable procedure to evaluate the EH&S conditions of environmental health laboratories, and a case study of the Environmental Health Laboratories of Kermanshah University of Medical Sciences was conducted in 2015. In this study, an evaluation proposal was derived using standard checklists from OSHA and the University of Colorado (including EH&S and legal resources and Iranian standards). Based on these standards and recommendations, a final protocol was prepared and was used by the Department of Environmental Health Laboratories, Kermanshah University of Medical Sciences, Kermanshah, Iran, 2015. The study sample included 28 undergraduate and graduate students of engineering and environmental health and three persons with laboratory expertise. These people were working in the chemistry, microbiology, reference labs, and the pilot room. The results of the study showed that a prepared checklist could be a useful tool to assess the EH&S conditions of environmental laboratories. Categorizing the results for further corrective acts provided an opportunity to plan a future approach and to prevent undesired accidents and health hazards. Evaluation of the studied cases showed that the chemistry, microbiology, and reference labs had poor environmental conditions. The health status of the chemistry, reference, and microbiology laboratories as well as the pilot room was poor. The microbiology laboratory had an optimal safety status; the chemistry and reference laboratories, a moderate safety status; and the pilot room, an undesirable safety status. Finally, the lack of an integrated EH&S policy was the major defect observed at the laboratories, and the efficacy of the derived protocol for evaluating the EH&S conditions of the laboratories was well documented.

[*]**Corresponding author Hooshyar Hossini, Email:** h.hosseini@kums.ac.ir

Introduction

In the past century, the use of interdependence theory or a systematic approach has been emphasized. According to this view, any system is formed as a network of interlinking bonds; in this system, all phenomena and events interact with each other. However, everything must be organized, and constituent members should be under a systematic relationship as a part of whole-operate [1,2]. By investigating the mentality and beliefs of institutions with regard to environment, health and safety (EH&S), systematic management has explored the reasons for risk control or lack of control[3].

In an organization, if the elements of management exist but no improvement occurs, the lack of an optimal EH&S management system is clear[4,5]. EH&S has its own specific components, and ignorance regarding these components and elements leads to problems in the system.

Integrated EH&S Management System uses a new approach with a systematic, creative, and cultural context to explain the interaction between health, safety, and the environment; consequently, by systematically assessing the failures, hazard potential, accidents, and problems, it offers a prevention-based approach to reduce problems[6,7]. Historically, before the creation of an integrated EH&S system, health and safety in industries were simultaneously evaluated, and their roles were not separable from each other. These two patterns have an important role in the health of staff, and by providing technical services for health and safety, work-related risk factors and diseases can be minimized and controlled[8-10]. Universities play the most important and reasonable role in the education of countries. Therefore, a healthy and safe environment for students and staff should be guaranteed. In developing countries, injuries related to laboratory accidents, and even deaths among the students and staff, were frequently reported. Hence, the maintenance of health and safety in the laboratory is important[11]. It is clear that safety shortcomings such as poor management and inadequate training can cause laboratory accidents. Improvement of the EH&S system leads to better performance and reduces accidents and injuries[12,13]. In today's competitive world, many organizations have found EH&S management to be an integral and essential, as well as a vital and valuable, part of the management of the organization. As a consequence, the ultimate goal in EH&S systems is protection of people, communities, and properties and the environment[14]. Besides the elimination of parallel activities, simultaneous health, safety and environment considerations can easily increase productivity and improve sustainable development, and this is reached only in a technical and economic balance [15,16].

Due to high-risk cases, including EH&S, laboratories are important elements in the field. Because of the lack of EH&S responsibility in Iranian academic labs, there isn't any specific procedure for EH&S inspection, operation and training of students and laboratory staff.

The aim of this study was to provide a suitable procedure to evaluate EH&S conditions of environmental health laboratories and, as a case report, Environmental Health Laboratories of Kermanshah University of Medical Sciences in 2015 were studied.

Materials and Methods

In this descriptive study, EH&S of laboratories of the Environmental Health Engineering Faculty, Kermanshah University of Medical Sciences, was examined. In this manner, prepared checklists by OSHA 1 and the University of Mining, Land, Energy and the Environment, Colorado[2], were used. Environment conditions of laboratories were investigated based on five subdivisions of air (12 items), solid-waste management (10 items), wastewater (five items), and hazardous waste management (six items). In assessing the safety of the mentioned laboratories, several subdivisions including sample and chemical storage, general laboratory safety, safety knowledge of staff and students, chemical safety, biological safety, personal protective equipment, and emergency acts, collectively through 105 items, were monitored. A total of 12 items related to personal health were considered in determining the health aspect of the laboratories. Twenty-eight researchers and three lab staff were interviewed. In order to analyze data, the responses and filled-in checklists were recoded to allow entry into Excel. 'Yes' responses were recorded as 1 and null ones as 0; scoring was done based on mean value in each sector. Based on the acquired marks, the analyzed data were classified as poor, inadequate and good condition. The results were presented to a committee comprising of three environmental health engineering physicians to

prioritize the action plans. Accordingly, a three step plan of; emergency acts, intermediate plan and long-term plan, was set up. Finally, the results in any areas of concern were reported to the person in charge of the area and the final report was developed.

Results

This study aimed to determine the state of EH&S conditions of environmental health engineering laboratories, Kermanshah University of Medical Sciences, which were assessed in 2015. Four laboratories of chemistry, microbiology, reference and pilot room, were considered.

As is clear from Figs. 1 to 5, all laboratories suffered from poor environmental conditions, also, in all the labs except microbiology, health and safety standards were unsatisfactory (Figs. 6 and 7). Adequate safety was only proved in the microbiology labs. It should be mentioned in all figures that red, orange and green colors illustrated poor, not enough, and good conditions, respectively.

Inadequacy of environmental conditions in surveyed labs, except in the microbiology lab, was a result of poor conditions in the environmental branches of wastewater, waste, and hazardous waste management and ventilation. There wasn't any neutralization or specified wastewater treatment system to manage produced wastewater. Also, due to lack of sufficient waste segregation, all laboratories wastes, except microbiological cultured media, plates, and used needles, were collected and disposed of as municipal solid waste. Accordingly, hazardous liquid waste such as acid, base and toxic chemical solutions, was poured into municipal sewer without further detoxification and neutralization. In all labs, inadequate ventilation was observed, and tests of the chemical hood showed that there was inadequate vacuum power; in addition, biological and chemical hoods were interchangeably used. Lack of integrated waste and hazardous waste management programs and facilities were the major drawbacks observed.

Poor safety conditions in the studied labs are clearly shown in Figs. 7-14. The lack of important safety indicators such as proper chemical storage cabinets, suitable biological decontamination procedures, trained emergencies, and adequate personal protective equipment was observed.

The results showed that 37% of researchers working in the studied labs had poor EH&S knowledge and only 25% had satisfactory knowledge (Fig. 15).

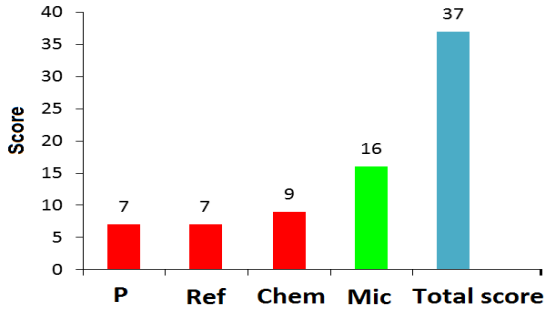

Figure 1: Environmental condition of laboratories (P: Pilot, Ref: Reference, Chem: Chemistry lab, Mic: Microbiology lab)

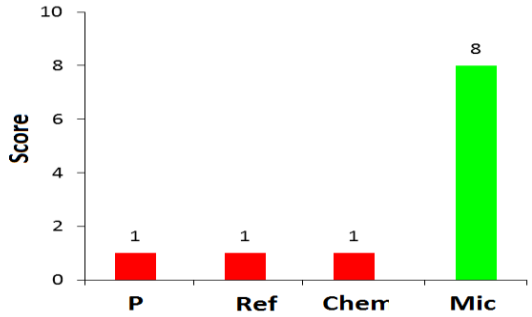

Figure 2: The state of solid waste management in laboratories

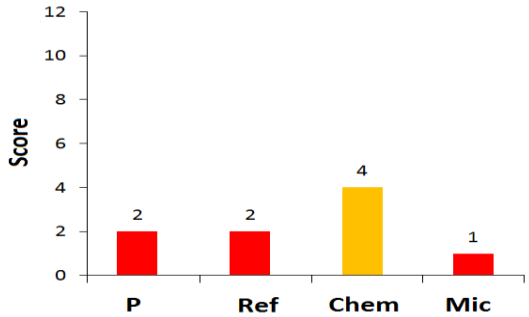

Figure 3: The state of ventilation and air pollution control in laboratories

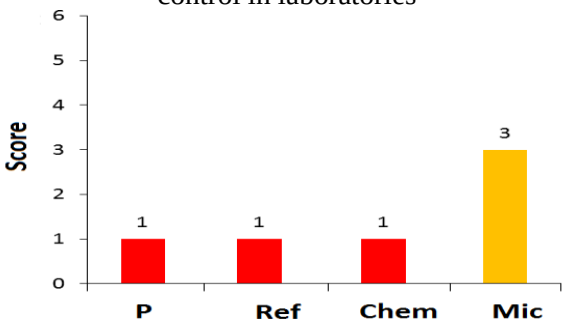

Figure 4: The state of hazardous solid waste management of labs

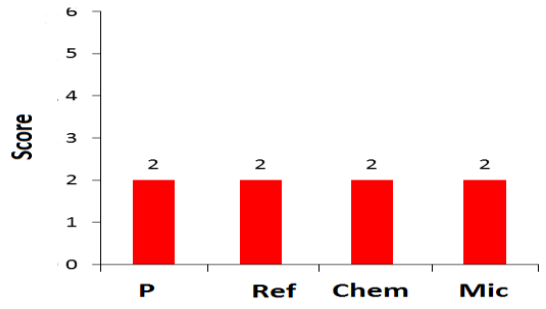

Figure 5: The state of wastewater management of labs

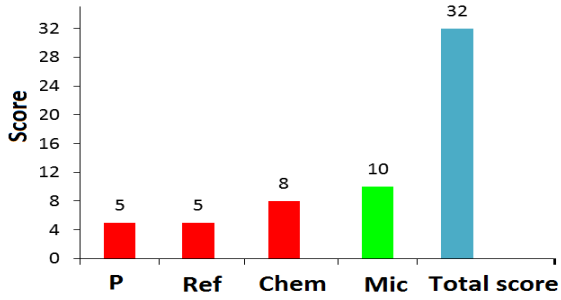

Figure 6: The state of personal hygiene of labs

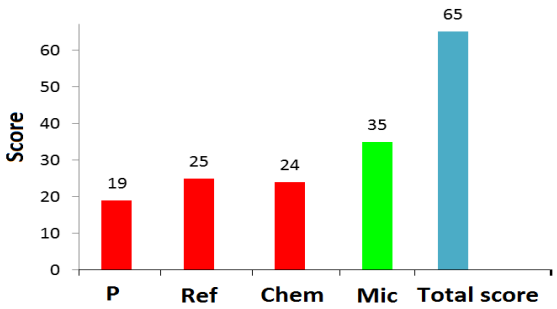

Figure 7: Overall state of laboratories safety

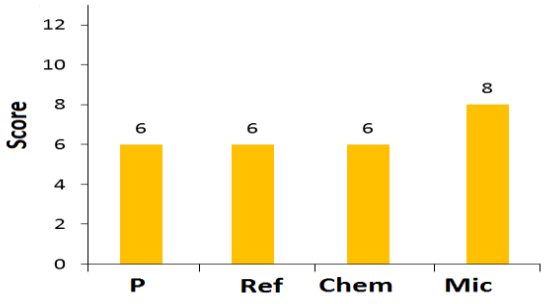

Figure 8: Chemical safety in each labs

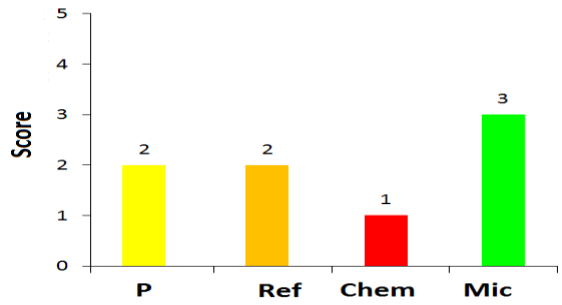

Figure 9: Biological safety in each labs

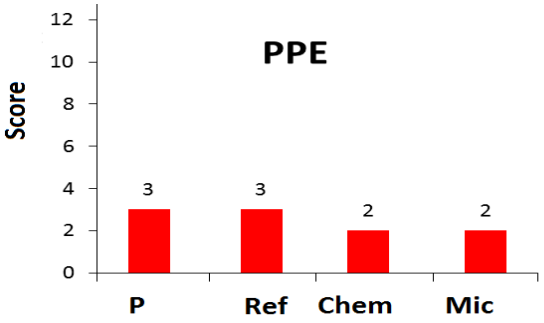

Figure 10: State of personal protective equipment in the labs

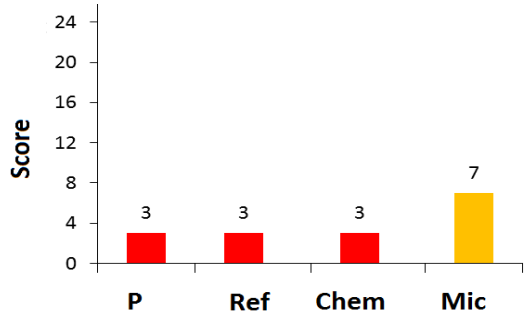

Figure 11: The state of hazardous solid waste of labs

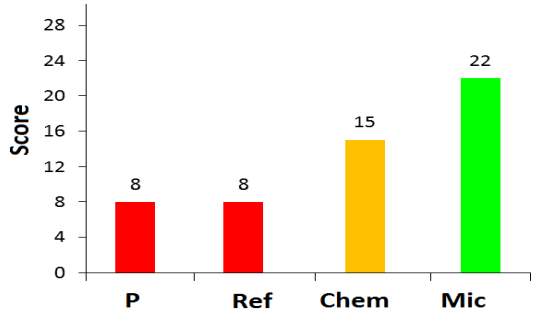

Figure 12: The state of emergency act in the labs

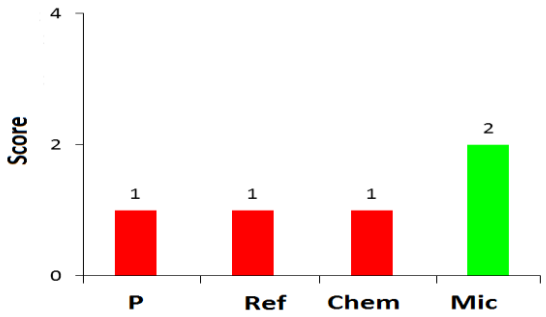

Figure 13: The state of general safety of the labs

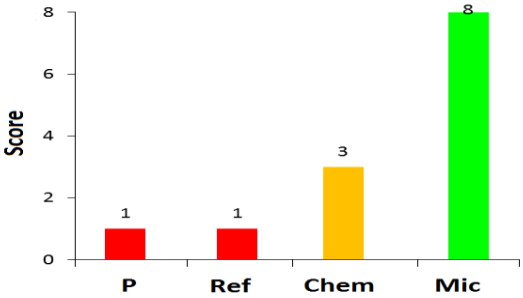

Figure 14: Storage condition in the labs

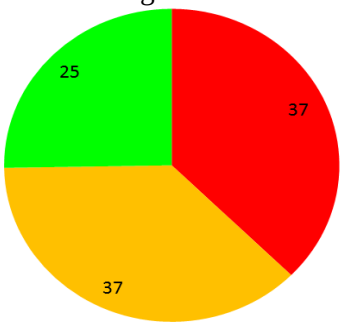

Figure 15: Overall student knowledge about labs' EH&S

Discussion

A safety policy is to protect all engaged researchers, staff and the environment to promote and maintain healthy and safe conditions. Results of this study showed that better safety conditions were seen in the microbiology lab with regard to environmental aspects mentioned previously. All laboratories, except the microbiology lab, had inadequate states of chemical and biological safety. It can be said that the lack of safety policies and personal protective equipment were the major safety issues facing researchers and staff. The survey of an emergency policy showed that there is no clear procedure and action. Regarding working materials, chemicals and samples in environmental laboratories provided enough microbial contamination, so all people in such disciplines were at risk from this unsafe situation. Evaluation of health conditions showed that all labs except microbiology were in poor condition. In order to set priority actions and amendments, all the results were analyzed by three environmental health physicians. In this manner, three priority classifications; of urgent action, intermediate program and long-term program, were provided. Observed defects of studied labs were categorized in these groups based on health-threat characteristics.

Urgent actions for cases that posed threats to the health of students, staff, and the environment included the following:

1. Provide safety boxes for disposal of needles, syringes and sharps.
2. Make enough gas exchange (ventilation) available in the laboratory.
3. Operation and maintenance of laboratory hoods were guaranteed.
4. All laboratory infectious wastes (culture, needles, etc.) are decontaminated before final disposal.
5. Provide internal safety doors for centrifuges.
6. Users' instructions should be provided for firefighting facilities.
7. Sand buckets should be provided for each laboratory.
8. First-aid box should be properly equipped for the laboratory.
9. Material Safety Data Sheet (MSDS) must be used in the laboratory.
10. Hand-washing guidelines should be prepared.
11. Enforcement of the non-food consumption law in the laboratory.
12. Providing restroom apart from labs.
13. Prohibition of mouth pipetting.
14. Providing first-aid kits.
15. Trained emergency should be accessible.
16. Standard washbasin should be provided.
17. Laboratory should be equipped with body and eye showers.
18. Laboratory should be equipped with protective equipment such as safety glasses or face covers (shields), protective gloves, and breathing apparatus.
19. In each section of the laboratory, proper trash containers and garbage bags should be used.
20. Hazardous liquid glass bottles should be stored in ventilated noncorrosive cabins.

Short-term measures can be done as follows:

1. The laboratories should be embedded with heating and cooling systems.

2. All stored and maintained places such as refrigerators are labeled.
3. Danger warning signs and warnings should be installed (e.g., biological, radioactive or equipment noisy warning signs)
4. Storage locations (rooms, refrigerators, freezers, cupboards) for toxic or infectious matter should be labeled.
5. Centrifuges with internal safety doors should be used.
6. User instructions for firefighting facilities should be installed.
7. Inform the researchers, students, and staff about the compatibility.
8. Chemicals shouldn't be stored at a height above eye level.
9. Flammable reagents and solvents should be stored in fire-resistant cabins.
10. Store the bottles containing strong acids or strong bases in noncorrosive trays.
11. All flammable materials, solvents and sharps should be properly labeled.
12. A cloakroom should be considered in order to keep the clothes outside of the laboratory.
13. Hand-washing guidelines should be prepared in the laboratory.
14. Eating and drinking should be considered outside of the laboratory.
15. Microbiological safety cabinets should be used for controlling exposure of biological agents.
16. Staff and students should be trained for safety procedures and should know "How to contact emergency services".
17. Procedures and emergency telephone numbers should be clearly installed in the laboratories.
18. Washbasins should be available.
19. The laboratory should be equipped with eye wash.
20. Staff and research students should be trained on "How to use protective equipment".

To improve the EH&S of laboratories, long-term measures were proposed as follows:

1. Preparation and implementation of guidelines for safe handling, collection, decontamination and disposal of generated laboratory waste.
2. All staff dealing with laboratory waste should be properly trained on lab waste management.
3. Safety instructions on the use of laboratory equipment should be in writing.
4. Laboratory-specific cabins and benches must be used.
5. An accident emergency plan should be provided.
6. Trained emergency should be available.
7. Proper disinfection and sterilization plans should be developed.
8. The laboratories should be equipped with neutralization and wastewater-treatment facilities.
9. Discharge of laboratories untreated chemical wastewater into municipal collection systems should be prohibited.

Conclusions

The results of the study illustrated that the environmental aspects of chemistry and reference labs were undesirable, but the microbiology laboratory was in average condition in terms of environmental aspects. The health status of chemistry, reference, microbiology laboratories and pilot room was poor. Microbiology lab was in optimal safety condition while the immune status of chemistry and reference laboratories was placed in moderate condition, and the pilot room was evaluated undesirable. The derived protocol can be addressed as a good way for usage in EH&S evaluation of laboratories.

Acknowledgement

The authors gratefully acknowledge the Research Council of Kermanshah University of Medical Sciences (Grant Number: 95125) for the financial support.. The authors declare that there is no conflict of interest.

References

[1] European Agency for Safety and Health at Work Checklist for the prevention of accidents in laboratories. 2014. URL : http://osha.europa.eu
[2] Clorado school of Mines, Earth, Energy, Environment Laboratory Safety and Environmental Health Assessment Program (2015).
[3] Dukic K, Zoric M, Pozaic P, Starcic J, Culjak M, Saracevic A, Mile M. How compliant are technicians with universal safety measures in medical .laboratories in Croatia? – A pilot stud. Biochemia Medica 2015;25 (3):386–92.
[4] Pandit AP, Garg SM, Matwankar SKP, et al. A study to ascertain the adequacy of observance of universal precautions in acute medical and surgical wards of a large teaching hospital. Med J Armed Forces India 1998;54:115-20.
[5] Kotwal A, Taneja DK. Health care workers and universal precautions: Perceptions and determinants of

non-compliance. Indian J Community Med 2010;35:526-8.
[6]Chittaro M, Calligaris L, Farneti F, et al. Healthcare Workers' Compliance with Hand Hygiene After the Introduction of an Alcohol-Based Handrub. Int J Infect Control 2009;5:1-6.
[7] Main CL, Carusone SC, Davis K, Loeb M.. Compliance with personal precautions against exposure to bloodborne pathogens among laboratory workers: a Canadian survey. Infect Control HospEpidemiol. 2008;29:66–8. 10.1086/524325
[8]Efstathiou G, Papastavrou E, Raftopoulos V, MerkourisA.. Factors influencing nurses' compliance with Standard Precautions in order to avoid occupational exposure to microorganisms: A focus group study. BMC Nurs. 2011;10:1. 10.1186/1472-6955-10-1Phukan P.. Compliance to occupational safety measures among the paramedical workers in a tertiary hospital in Karnataka, South India. Int J Occup Environ Med. 2014;5:40–50.
[9]Nasim S, Shahid A, Mustufa MA, Kazmi SU, Siddiqui TR, Mohiuddins, et al. Practices and awareness regarding biosafety measures among laboratory technicians working in clinical laboratories in Karachi, Pakistan. ApplBiosaf. 2010;15:172–9.Mustafa A, AJan F, Qadri GJ, Tabish S. Safety in Laboratories: Indian Scenario. International Journal of Health Sciences. 2008; 2 (2) :112-117.
[10] Mustafa A, AJan F, Qadri GJ, Tabish S. Safety in Laboratories: Indian Scenario. International Journal of Health Sciences. 2008; 2 (2) :112-117.
[11] Sewell DL. Laboratory-associated infections and biosafety. ClinMicrobiol Rev. 1995 Jul; 8(3):389- 405.
[12] Stark AA. Cancer hazards in the recombinant laboratory. Occup Med. 1991 Apr-Jun; 6(2):311-21.
[13] Li H, Qu C, Xu G, Yan C, Zhang G, Li C, et al. Safety surveillance and management of specimen associated with SARS in clinical laboratory. Beijing Da XueXueBao. 2003 May 31; 35 Suppl:92-4.
[14] Ofili AN, Asuzu MC, Okojie OH. Hospital workers' opinions on the predisposing factors to bloodrelated work accidents in Central Hospital, Benin City, Edo State, Nigeria. Public Health. 2003 Sept; 117(5):333-8.
[15] American Industrial Hygiene Association (AIHA), Laboratory Health and Safety Committee. Biosafety (links to online resources). http://www2.umdnj.edu/eohssweb/aiha/technical/biosafety.htm
[16] American Industrial Hygiene Association (AIHA), Laboratory Health and Safety Committee. Personal Protective Equipment (links to online resources). http://www.umdnj.edu/eohssweb/aiha/technical/ppe.htm

