

Clinical and research laboratories in Peshawar city of KP Province: Analysis of bio-security measures predicts insecurity

Muhammad Asghar, Naheed Asghar, Noor Rehman, Muhammad Naeem, Shah Khalid, Abdus Samad, Hoor Shumail, Waleed Mabood

Received:

7th January, 2019

Accepted:

30th August, 2019

Khyber Teaching
Hospital (KTH), MTI,
Peshawar

M Asghar
M Naeem
A Samad
W Mabood

MTI, Hayatabad Medical
Complex, Peshawar

N Asghar
N Rehman

Islamia College, Peshawar
S Khalid

Women University

Mardan,
H Shumail

Correspondence:

Dr. Naheed Asghar
Assistant Professor,
Department of
Dermatology, MTI, HMC,
Peshawar.
Phone: 0316-4040189
E-mail: drnaheedhmc@
gmail.com

Abstract:

Objectives: Bio-security is an emerging concept not well understood by the local community. It is the protection, control and accountability of biological agents and toxins within laboratories, in order to prevent their loss, theft, misuse, un-authorized access or intentional un-authorized release. Laboratories are responsible for bio-safety and bio-security that protects their workers, animal population, and the environment from exposure or spread of pathogens they come across with. The purpose of this preliminary study was to collect data in order to assess and evaluate the measures being taken for bio-security in clinical diagnostic and research labs. **Materials and Methods:** This preliminary survey was carried out from March 2017 to August 2017 at the department of Botany, Islamia College Peshawar. In this study hundreds of clinical labs, Research labs and Academic purpose labs for routine practical work both in public and private setups were focused. The visits to the sites were pre-scheduled and in some cases were informal and un-scheduled with the hope to get a clear picture of the practices or measures. A detailed observational survey and un-written questions were used to elicit information. The focus was on laboratory licensing system, infrastructure, administration, quality assurance, collection, handling, processing, storage and transportation of clinical samples, waste disposal, Lab records, access to bio-hazardous materials and security checks on pathogens and on researchers and workers.

Results: Based on standard Bio-Risk Management (BRM) guidelines, maximum numbers of the labs were below minimum required standard and were categorized as BSL-0. Varieties of BSL-2 and BSL-3 category bacterial and viral pathogens were easily assessable and, therefore, were isolated and identified in our lab.

Conclusion: We conclude that lab management is lacking at all levels. It is recommended that bio-security concerns be conveyed to all stakeholders for designing and implementing action plan.

Keywords: Bio-security measures, bio-safety, clinical & research laboratories

Introduction:

Bio-risk management (BRM) includes the development of various ways and strategies to reduce and controls the risks related to biological agents. This can be achieved by broadly dividing bio risk management into Bio-safety and Bio-security. Bio-safety includes the basic principles and practices implemented in a laboratory to restrict accidental exposure and release of pathogens and toxins. Whereas, bio-security includes

the protection, control and accountability of important biological materials like pathogens, toxins, vaccines, genetically modified organisms, genetic elements and clinically important samples inside laboratories to prevent their loss, theft, misuse, unauthorized access or intentional unauthorized release.^{1,2}

Bio-safety is a subject that emphasizes to prevent contamination of infectious micro-organisms

and harmful biological wastes. The phenomenon of bio-terrorism is introduced after new research on infectious micro-organisms and the emergence of resistant strains in these micro-organisms created fatal diseases in the world.^{3,4}

Laboratory bio-safety and bio-security are significant to ensure investigators' security, especially from laboratory acquired infections and to keep away the community from un-intentional or deliberate disclosure to infective pathogens.⁵ These hazards have elevated a major threat for the teaching and learning of laboratory investigators.⁶ Despite extensive certification of the incidence of Laboratory Acquired Infections (LAIs) initiating disease and mortality among investigators.⁷ Laboratories are basic and obligatory part of health care systems and research institutions. Many public and private sector laboratories including clinical, hospital, public health and academic laboratories promote improvement in health care and public health through their research and diagnostic activities. Various activities including samples analysis, disease diagnosis, experiments including pharmaceutical development of novel drugs, epi-demiological studies, and scientific research take place in biological laboratories in public and private sectors. Numerous types of biological materials including pathogens, toxins, chemicals, genetically modified organisms are handled in laboratories all over the world for various experimental and diagnostic purposes.⁸

Worldwide it is accepted that surveillance of laboratory-acquired infection (LAI) is effective indicator to analyze the efficacy of biosafety and to improve the hazard evaluation in research laboratories.^{9,10}

It is the responsibility of laboratory personnel to minimize the exposure of community to these risks, to follow safe working protocols in order to keep bio-logical samples and materials safe and secure. In the recent past, pathogens and toxins have been used to harm and threaten the society. A basic approach in reducing these hazards is by conducting risk assessment of biological agents, chemicals and protocols followed

while working in laboratories.¹¹

Due to the day by day increasing bio-logical threat from emerging and re-emerging infectious diseases and bio-terrorism, it is an essential need for the government and agencies around the world to increase awareness among researchers and laboratory personnel for identification, handling, storage and preservation of these agents.

Material and Methods:

This preliminary survey was carried out from March 2017 to August 2017 at the department of Botany, Islamia College Peshawar, focusing clinical, diagnostic and academic and research laboratories in cantt and city areas of Peshawar. All the laboratories situated in the premises of district Peshawar were included in the study. A total of 248 laboratories (table-1) were looked into for bio-risk assessment. A proper bio-risk assessment was necessary for bio-risk mitigation. For bio-safety risk assessment the information we elicited during the visits were about the type of samples, collection, storage, transportation, pathogen type, pathogen storage, processing and discarding pathogens and recording data. Besides, information on administrative control such as policy or SOP's and training of staff was recorded. Also, lab personnel practice and procedures use of PPE, Lab equipment's, incident management and waste management was focused. Bio-security risk assessment was the main purpose of this study. Information about physical security, personal management, material control, and accountability, transport security and information security was focused.

The information collected was based on observation and unwritten questions. In many laboratories we easily managed to collect pathogen containing waste, discarded samples from unclassified or unlabeled dustbins. The purpose was to check the presence of pathogens. The samples were brought to the laboratory and were identified using bio-chemical and molecular techniques.

Result:

Bio risk Assessment: More than 200 labs of both

Table-1: Location and Number of Labs

S.No	Location	Number of Laboratories			
		Clinical/Diagnostic Labs		Academic/Research Labs	
		Public sector	Private sector	Public sector	Private sector
1.	Cantt area	--	17	--	--
2.	City area:				
	a) Central Peshawar city	7	56	--	--
	b) Dabgari garden	--	117	--	--
3.	University town	7	22	4	3
4.	Hayatabad town	2	8	1	4
	Total	16	220	5	7
	Sub total			248	

Table-2: Satisfaction Level in lab Bio-safety

Bio risk Assessment	Number Of Laboratories	
	Satisfactory*	Un-Satisfactory
Sample Handling	75	173
Pathogen Handling	38	210
SOP's	113	135
Training of laboratory workers	67	181
Use of PPE	13	235
Lab equipment's	32	216
Incident Management	86	162
Waste Management	10	238
Recording of Information	140	108
Pathogen Record	45	203

*Biosafety level was considered satisfactory in those labs who followed the basic biosafety guidelines provided by WHO (Lab biosecurity guidelines, Sept, 2006 WHO/CDS/EPR/2006.6)

Table-3: Satisfaction level in Lab Biosecurity

	Bio risk Assessment	Number Of Labs	
		Satisfactory*	Un-Satisfactory
1	Physical Security		
	a) Graded Protection	40	208
	b) Detect/Delay/Response	32	216
2	Personal Management		
	a) Personnel Training	58	190
	b) Security Awareness	92	156
3	Material Control and accountability	27	221
4	Transport Security	9	239
5	Information Security	89	156

*Biosafety level was considered satisfactory in those labs who followed the basic biosafety guidelines provided by WHO. (Lab biosecurity guidelines, Sept, 2006 WHO/CDS/EPR/2006.6)

public and private sectors of clinical, diagnostic, academic and research purposes were assessed for bio risk assessment. Bio-risk was assessed for bio-safety and bio-security using appropriate

parameters and guidelines provided by WHO. On the basis of these parameters the collected data was further divided in three different tables.

Bio-safety: All facilities whether public sector or private sector that deals with pathogenic and hazardous materials has to implement basic bio-safety parameters. In this survey majority of the laboratories were not following standard protocols for bio-risk management. The collected data about the bio-safety parameters is summarized (table-2)

All of the laboratories visited during the study including clinical and research laboratories were not following strict bio-safety guidelines. Most of the labs the laboratory personnel were not even aware of the high risk associated with pathogens they were handling, the pathogens and toxins were not properly labeled, some of them were working without following standard operating procedures. Most of the lab personnel were not using personal protections equipment's during working with pathogens. Aside from this most of the workers in lab were handling pathogens in open air without any safety cabinet. Records of all the samples present and preserved in labs were easily assessable. Those laboratories dealing with just blood samples were disposing of the samples directly in drainage system, aside from this in academic institutes the students and researchers were unaware of the basic concepts of bio-safety and bio-security. Incinerators were not available in majority of public sector labs while in some high reputed hospitals incinerators were not in working condition.

Bio-security: The main purpose of this survey was look deeply into the bio-security practices being followed in Laboratories in Peshawar. Bio-security assessment is the basic step in implementing an effective bio-security system in laboratories as securing pathogens and toxins is a different task from securing other chemicals present in laboratory. The data collected during this survey regarding bio-security practices is summarized (table-3).

The first and basic parameter of biosecurity i.e.

Table-4: Pathogens identified

Name of Pathogen
Salmonella Typhi
Mycobacterium Tuberculosis
E.coli
MRSA
Klebsiella pneumoniae
Pseudomonas aeruginosa
HCV
HBV

physical bio-security was found inadequate in majority of labs as, locks and security cameras were installed in some of the laboratories but most of the cameras were not in working conditions and were not monitored. Fences and grills on windows were present in some of the laboratories. Intrusion alarms were not installed in any laboratory due to which the laboratories were easily assessable by anyone.

High risk pathogens were easily assessable in some of high reputed tertiary care hospitals of Peshawar. Files and records of extremely high risk pathogens (BSL-3, 4) were kept in lock and were not approachable to anyone without proper permission from management. While records of other pathogens were easily available.

Most of the students and researchers were disposing of high risk pathogenic samples directly in the drainage system after completing their experiments. While some of them in spite of properly burring the pathogens after decontamination; were throwing used culture plates in garbage cans without proper decontamination. Highly pathogenic organisms (table-4) were found in the samples collected from these clinical and research labs which suggest that the pathogens were disposed off in the environment without proper decontamination.

Discussion:

Bio risk management is an emerging concept globally due the increased number of emerging, remerging and highly resistant pathogens taking lives of millions of people all over the world. It was important to observe the current status of bio-safety and bio-security in clinical and re-

search laboratories of Peshawar. Bio-safety and bio-security are the terminologies; the global scientific communities are becoming aware of, due to the workshops, trainings and seminars being arranged by different NGO's. The purpose of this study was to summarize the current status of bio risk management practices being carried out in Peshawar. As opposed to a previous study conducted in Asian countries where most of the laboratories were following simple bio-security measure,¹² we are lacking even the basic bio-security parameters in majority of our labs including laboratories of some high reputed public sector hospitals.

This would help in future to develop strategies to overcome these gaps by arranging workshops and trainings on implementing bio risk management practices.

This survey revealed the negligence level of bio-security measures in clinical and research settings. Workshops, trainings and seminars are required to be arranged on emergency basis to introduce and implement the guidelines of bio risk management. As suggested previously literature about the proper handling of bio-logical samples including pathogens and toxins should be developed and distributed among laboratories.¹³ In addition to this extra-ordinary measures are required to be taken as soon as possible as the pathogens which are disposed of in environment without any proper decontamination are the main cause of the increasing infections and diseases in local community at an alarming rate specially hepatitis. Thus bio-safety and bio-security measures should be implemented as mandatory as soon as possible with the development of a regulatory committee that defines and establishes guide lines for bio risk management.

Conclusion:

This study reflects the current level of bio-security in clinical and research labs of both public and private sector. In this survey major gaps were identified in bio-security of the laboratories, the basic concept of bio-security is not understood by laboratory personnel's, students and even researches. This overall survey draws

attention towards the alarming situation of bio-security in Peshawar. In order to overcome this condition few steps should be taken by the local government including the development of proper survey teams and regulatory committees, implementation of bio-security measures in laboratories on urgent basis, training workshops regarding awareness of bio risk management. This study suggests a detailed investigation of all the laboratories in Peshawar cantt and city areas in Peshawar in future to develop bio risk mitigation strategies to secure the pathogens, our community and environment. Furthermore, a detailed survey is required at country level to probe the bio-safety and bio-security levels of all the laboratories and to design new strategies and policies to prevent and upgrade all the laboratories to follow standard bio-safety and bio-security in their facilities.

Conflict of interest: None

Funding source: None

Role and contribution of authors:

Dr Muhammad Asghar, collected the data references and wrote the article.

Dr Naheed Asghar, helped in collecting the data and also helped in introduction writing

Dr Noor Rehman, helped in collecting the references and also helped in tabulation of the result.

Dr Muhammad Naeem, helped in data collection

Dr Shah Khalid, helped in collecting the references

Dr Abdus Samad, helped in data collection and helped in discussion writing

Dr Hoor Shumail, helped in collecting the data and result writing

Dr Waleed Mabood, critically review the article and made final changes

References:

1. Dickmann P. Biosafety and biosecurity : a relative risk-based framework for safer , more secure , and sustainable laboratory. 2015;3(October):1–6.
2. Bakanidze LG, Tsanova SA, Tsertsvadze NS. Biosafety and Biosecurity in Georgia : New Challenges. 2010; 15(2):85–8.
3. Nulens E., Voss A. Laboratory diagnosis and biosafety issues of biological warfare agents. *ClinMicrobiol Infect.* 2002;8: 455–466.
4. Pedrosa P.B.S., Cardoso T.A.O. Viral infections in workers in hospital and research laboratory settings: a comparative review of infection modes and respective biosafety aspects. *Int J Infect Dis.* 2011;15: 366–376.
5. Gaudioso J, Zemlo T. Survey of bioscience research practices in Asia: implications for biosafety and biosecurity. *ApplBiosaf.* 2007;12:260–267.
6. Chamberlain A.T., Burnett L.C., King J.P., Whitney E.S., Kaufman S.G., Berkelman R.L. Biosafety Training and incident-reporting practices in the United States: a 2008 survey of biosafety professionals. *ApplBiosaf.* 2009;14:135–143.
7. Pike R.M. Laboratory-associated infections: summary and analysis of 3921 cases. *Health Lab Sci.* 1976;13:105–114.
8. Alertresponse E. Biorisk management Laboratory biosecurity guidance Biorisk management Laboratory biosecurity guidance. 2006;(September).
9. Kozajda A, Bródka K, Szadkowska-Stańczyk I. Factors influencing biosafety level and LAI among the staff of medical laboratories. *Med Pr* (2013) 64:473–86.
10. Wurtz N, Papa A, Hukic M, Di Caro A, Leparc-Goffart I, Leroy E, et al. Survey of laboratory-acquired infections around the world in biosafety level 3 and 4 laboratories. *Eur J ClinMicrobiol Infect Dis* (2016) 35:1247–58.
11. Gentilli SM, Potts JM, Clarkson AJ, Jacobi HB. An Overview of the NIH Biorisk Management Program. 2016;21(1):26–33.
12. Gaudioso J, Zemlo T. Survey of Bioscience Research Practices in Asia : Implications for Biosafety and Biosecurity. *ApplBiosaf.* 2007;12(4):260–7.
13. Qasmi SA, Khan E, Maqbool AZ. Survey of Biorisk Management in Clinical Laboratories in Karachi, Pakistan. 2012;17(4).