

Assessment of biorisk management implementation in NIHRD laboratory as national referral laboratory of emerging infectious diseases in Indonesia

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Abstrak

Latar belakang: Laboratorium Badan Penelitian dan Pengembangan Kesehatan (Balitbangkes) ditunjuk sebagai laboratorium rujukan nasional dalam mendeteksi penyakit infeksi Emerging (EID) dan bertugas dalam mendeteksi patogen infeksius serta berperan penting dalam sistem penanggulangan wabah. Laboratorium Balitbangkes harus menerapkan sistem manajemen biorisiko untuk mencegah terjadinya penyebaran penyakit yang bersumber dari laboratorium. Penerapan manajemen biorisiko laboratorium yang terdiri dari biosafety dan biosecurity bertujuan untuk melindungi pekerja, lingkungan dan produk atau agen biologi. Penelitian ini bertujuan untuk menemukan kesenjangan terkait penerapan manajemen biorisiko di Laboratorium Balitbangkes dengan standar.

Metode: Studi dilakukan oleh Asesor profesional pada tahun 2015 dengan mewawancarai Penanggung jawab Laboratorium BSL-3 (PJ BSL-3) dan Biosafety Officer (BSO) serta pemeriksaan dokumen. Pemilihan responden berdasarkan jabatannya di laboratorium. Responden dipilih karena sebagai pelaksana teknis dan memiliki informasi pelaksanaan biosafety dan biosecurity yang mendalam di laboratorium Balitbangkes. Pertanyaan diadopsi berdasarkan CWA 15793: 2011, berisi 160 pertanyaan dari 16 elemen. Analisis skor diinterpretasikan antara 0-2. Skor 0 memenuhi kesesuaian dengan standar dan skor 2 berarti tidak memenuhi standar.

Hasil: Studi ini menunjukkan 3 dari 16 elemen, memiliki kesesuaian penuh dengan standar yaitu teknik mikrobiologi yang baik, alat pelindung diri serta peralatan dan pemeliharaan alat laboratorium. Elemen yang memiliki kesenjangan paling tinggi adalah keamanan dengan skor 1.16. Tidak ada elemen yang dinilai tidak memenuhi kesesuaian standar atau skor 2.

Kesimpulan: Secara keseluruhan, Laboratorium Balitbangkes memiliki sistem manajemen biorisiko yang kuat dan sudah mapan disetiap elemen. Namun, tindakan perbaikan harus segera dilakukan di beberapa elemen untuk memenuhi standar CWA 15793:2011. (*Health Science Journal of Indonesia 2018;9(2):70-5*)

Kata kunci: EID Laboratory, biorisk management, laboratory assessment, CWA15793

Abstract

Background: NIHRD laboratory was appointed as a national referral laboratory to perform laboratory detection for emerging infectious disease (EID). Because of its important role, NIHRD laboratory must implement biorisk management system. A reliable high containment laboratory is crucial to perform laboratory diagnosis for EIDs and to avoid further spread of EIDs. The protection of laboratory workers, environment, and biological agents is achieved by addressing laboratory biorisk management consist of laboratory biosafety and biosecurity measures. This study aims to find gaps related the implementation of biorisk management with standard.

Methods: This study was carried out by Professional Assessor in 2015 by conducting document checking and interviewing BSL-3 Technical Managers and BSO who were considered to have in-depth information regarding biosafety and biosecurity activities in NIHRD laboratory. Questionnaire developed based on CWA 15793:2011, which contain 160 questions provided from 16 elements of the standard. Analysis of the scores was interpreted between ranges of 0-2. Score 0 means full conformity and score 2 means doesn't meet the required standard.

Results: The study showed that only 3 out of 16 elements have full conformity with the standard. They were good microbiological technique, clothing and personal protective equipment, laboratory equipment and maintenance. The highest gap was in security elements with the score: 1.16. No elements has a non-compliance with the standard or score 2.

Conclusion: Overall the NIHRD laboratory has a strong biorisk management system already established which is working well in many areas. However, important action is needed in several elements in order to comply with the standard. (*Health Science Journal of Indonesia 2018;9(2):70-5*)

Keywords: EID Laboratory, biorisk management, laboratory assessment, CWA15793.

The World Health Organization's revised International Health Regulations (IHR) in 2005 and each country members to develop the core capacities needed to detect, assess, report, and respond to events that could constitute a public health emergency of international concern (PHEIC).¹ In terms of IHR, one of the core elements is Laboratory which provided vital support and facilitates the initiation and monitoring of public health interventions.² Therefore strengthening laboratory services must have more attention to provide accurate and reliable outcome. NIHRD laboratory was appointed as a national referral laboratory to perform laboratory diagnosis for Emerging infectious Disease (EID), such as Avian Influenza (H5N1), H7N9, MERS-CoV, Ebola Virus Diseases (EVD) as well as other EIDs (Ministry of Health Decree no. 658/2009).³ A high containment (BSL 3) laboratory in NIHRD has been established and put into operation for this purpose. NIHRD is also tasked to be the National Influenza Centre (NIC) as part of the Global Influenza Surveillance and Response System (GISRS) to monitor influenza trends and provide early detection of novel influenza viruses.⁴

Laboratory in capacity to detect microorganisms related to PHEIC must be implemented a safe and secure workplace, in order to protect workers from diseases infection occurred at laboratory or released from laboratory to environment intentionally.⁵ Management of safety and secure at the laboratory called biosafety and biosecurity, where biosafety is refer to containment or a safe handling of pathogens, in order to reduce the risk of unintentional exposure or accidental release, while biosecurity means all necessary action to reduce the risk of unauthorized access, loss, theft, misuse, diversion or intentional release of valuable biological material (VBM).⁶ Both, biosafety and biosecurity in combination are often called biorisk, and to assure all element of biosafety and biosecurity are in place, biorisk management should be applied in Laboratory. NIHRD laboratory have obligation to implement biorisk management system because it's important role in national health system as referral EID detection laboratory.³ Laboratories that handle dangerous pathogens need to manage it biorisk to prevent any occurrence of human error intentionally or unintentionally in laboratory, implementing biorisk management approach and ethical responsibility.⁷ Equipment and facility may also contribute to the safety of laboratory according their level of pathogen handling.⁸ A reliable high containment laboratory is crucial to perform laboratory diagnosis for EIDs and to avoid further spread of EIDs.⁹ Especially with the existence of

dual-use research issues that has the potential to be misused, addressing laboratory biorisk management has considered to be an action to prevent from bio-weapon release from containment.¹⁰

There are a lot of tools to consider to measures the performance of laboratory in biosafety and biosecurity terms, in order to have specific needs based on its function.^{11,12,13} However, in terms of NIHRD Laboratory, Assessor was considering to use CEN Workshop Agreement (CWA) 15793:2011. This standard was use as an international guideline for laboratory biorisk management. It was developed by 73 stakeholders, facilitated by *Comitee Europeen De Normalisation* (CEN) on 2008 and revised in 2011.¹⁴ The CWA 15793:2011 was based on management system and risk based approach. Requirement of this standard were basic and applicable in laboratory handling biological agent/toxin in all level, likewise, the guidelines for how to implement according to standards have also been made in Indonesia.^{15,16} Assessment using CWA 15793:200 was needed to acknowledge how biorisk policy, objectives and processes to achieve on policy commitment was implemented in order to improve its performance. This study aims to find gaps related the implementation of biorisk management in NIHRD laboratory according to CWA 15793:2011. This study finding is important to develop policies and preventives procedures for the safe and secure work in NIHRD laboratory.

METHODS

This study was carried out by Professional Assessor from Robert Heckert Consulting supported by WHO in October 2015. Total 160 questions were determined by the Assessor based on the 16 elements and 61 sub elements of CWA 15793 standards as a guideline and assessment benchmark. The elements consist of managerial of biorisk in laboratory, risk assessment, inventory of pathogen and toxin, general safety, personnel and competency, good microbiological technique, clothing and personal protective equipment, human factors, health care, emergency response and contingency planning, accident/incident investigation, facility physical requirement, equipment and main tenance, decontamination, disinfection and sterilization, transport procedure and security. The complete assessment has been done by interviewing two person involved closely with biorisk management in NIHRD laboratory,

Biosafety Officer (BSO) and Biosafety Laboratory Level 3 (BSL-3) Technical Manager. They were appointed based on Head of Biomedical and Basic Health Technology Center decree number HK.02.04/II/56/2015. Both personnel was considered to have in-depth data in documentation and information related to biosafety and biosecurity activities in the NIHRD laboratory. Laboratory document records were also validated in place. The assessment system of scoring was used 1= fully met; 2 = partially met/ in progress; 3 = not met/not started. Implementation scores and gap analysis was interpreted using following formula :

$$\text{Gaps score} = \frac{\sum \text{total assessment score per element}}{\sum \text{total question s per element}} - 1$$

The number 1 in the gap score formula represents ideal assessment score (fully met). Therefore, if the implementation of all biorisk management sub-elements is in conformity with the CWA 15793 standard, the gaps score will be zero (0) or in other word, there is no gap between real implementation with the standard. Vice versa, if gaps score is 2.0 then the implementation of all biorisk management sub-elements doesn't meet the required standard.

RESULTS

Elements of biorisk management in CWA 15793 were based on 16 elements, and every element consists of sub-elements that represent all requirement of the standard. Result of the assessment showed that Satisfactory implemented elements were consider no gaps (gap score 0) in all the activities found in three elements: good microbiological technique, clothing and personal protective equipment and equipment and maintenance. No element found that did not conform to the standard (gap score 2). Average gap score of elements was between 0 and 1, which means that each element has already implemented, but some of the sub-element still needs improvement. Only two elements were scored over than 1, they were emergency response and contingency planning and security. It means that in these element most of the sub-elements doesn't meet required standard and much more improvement was needed. (Table 1)

The assessment indicated that more than half activities of NIHRD biorisk management programs are in place, but still there are some elements in specific sub element need to be improved. As in first element,

Biorisk management system, which have 13 sub elements to be addressed, and scores in sub elements was showed that policy, roles and responsibility, audits and inspection has become a shortcoming of these elements. Some sub-elements that are seen with high scores compared to the questions indicate that there is a significant inconsistency with the standard. They are monitoring and control in element number 3, contingency plans in element number 10, commissioning and decommissioning in element number 12, Information security and personnel control in element number 16.

In terms of general requirement and policy, the study found that almost all aspect of important requirement were fulfilled, however the lack of documentation records were occurred in many elements and implementation of routine audit were not fulfilled. The gap score indicates that the highest value element is an element that needs to be prioritized to improve, and in this study, we found that the highest gaps score which has more than 1 score was element security and the second highest is emergency respond and contingency.

DISCUSSION

Biorisk management approach is built on the concept of continual improvement through a cycle of planning, do, correct and act (PDCA) in order to achieve conformity with the standard.¹⁷ It is intended to effectively identify, monitor and control the laboratory biosafety and biosecurity activities. Many standard was built base on international agreement and guideline such as CWA 15793:2011, WHO, CDC and ISO.^{6,18,19} Some countries will adopt them as a national guidelines. in Indonesia, regulations related to biorisk management are made based on international guidelines as well, with a few modifications that are appropriate to the conditions of the country.^{16,9} Every laboratory has different issues regarding their actual implementation of standard. Most standard was referring to ideal condition which will be different with the actual condition of each laboratory must encounter, like environment or culture. However, Laboratory management should create roles and responsibilities to biorisk policies, rules and regulations according to it scope of work, with any special emphasis regarding their issues to protecting workers, environment and the product.^{20,21}

Table 1. Total Scores of elements

No	Element	Sub element, Score and number of Question		Assessment Score	Gaps	
		Sub element	S	Q		
1	Biorisk management system	1) Biorisk management policy	37	13	140	0.77
		2) Objective, targets and programs	8	4		
		3) Roles, responsibilities and authorities	43	30		
		4) Records, document and data controls	3	2		
		5) Analysis of data	2	1		
		6) Change management	1	1		
		7) Consultation and communication	3	3		
		8) Program of work	2	2		
		9) Work planning and capacity	1	1		
		10) Legal requirement	2	1		
		11) Continual improvement	2	1		
		12) Preventive action	4	2		
		13) Control of non-conformities	2	2		
		14) Inspection and audits	12	4		
		15) Corrective actions	3	2		
		16) Contractor and suppliers	6	5		
		17) Biorisk management review	7	4		
		18) Biorisk management system	2	1		
2	Risk Assessment	1) Process, Methodologies and Procedures	8	4	24	0.71
		2) Assessment timing and scope	2	1		
		3) Roles and responsibilities	2	1		
		4) Hazard Identification	3	2		
		5) Risk assessment	6	3		
		6) Risk Control	3	3		
3	Pathogen and toxin inventory and information	1) Inventory	2	1	14	1
		2) Information and records	6	3		
		3) Transfer of biological agent and Toxins	1	1		
		4) Monitoring and control	5	2		
4	General Safety	1) General safety	2	1	2	1
5	Personnel and Competency	1) Recruitment	2	1	17	0.54
		2) Training	1	1		
		3) Competence	12	7		
		4) Continuity and succession planning	1	1		
		5) Exclusion	1	1		
6	Good Microbiological Technique	1) Good microbiological technique	2	2	2	0
7	Clothing and personal protective equipment	1) Clothing and personal protective Equipment	2	2	2	0
8	Human Factors	1) Human Factors	2	1	2	1
9	Healthcare	1) Worker Health Program	2	2	9	0.5
		2) Vaccination of personnel	5	3		
		3) Medical Emergencies	2	1		
10	Emergency responds and contingency planning	1) Emergency scenario	2	1	23	1.09
		2) Emergency response and planning	10	5		
		3) Emergency plans Emergency exercise and simulation	6	3		
		4) Contingency plans	2	1		
11	Accident/incident Investigation	1) Accident/incident Investigation	2	1	2	1

No	Element	Sub element, Score and number of Question		Assessment Score	Gaps
		Sub element	S Q		
12	Facility Physical Requirement	1) Planning, design and Verification	6 5	11	0.37
		2) Commissioning and Decommissioning	5 2		
		3) Infrastructure and operational Management	1 1		
13	Equipment and maintenance	4) Maintenance management	1 1	5	0
		5) Control of equipment	1 1		
		6) Calibration	1 1		
		7) Certification	1 1		
14	Decontamination, disinfection, sterilization	8) Validation	1 1	6	0.2
		Management of biological waste	4 4		
		Inactivation of Biological agents and Toxins	2 1		
15	Transport procedure	Transport procedures	2 1	2	1
16	Security	1) Physical security	2 1	13	1.16
		2) Information security	5 2		
		3) Personnel control	5 2		
		4) Personal security	1 1		

Assessment of biorisk management conducted in Laboratory Hospital in Bangkok, Thailand using biosafety practices tools adopted from Centers for Diseases Control (CDC) and National Institutes of Health (NIH) guidelines.^{18,22} The study found that appropriate of protective barriers were need to be strengthened.²³ It means that there are issues in their facilities and equipment needed according to biosafety requirements. In Singapore, audits for biosafety requirement was conducted in University Laboratories and in Nanyang Technological University, using WHO Biosafety Manual and NTU safety manual for biological work and local requirement, and found that issues regarding consistency of biosafety commitments in laboratory.¹²

In Indonesia, the assessments study of biosafety and biosecurity was also conducted in University of Indonesia, using adopted tools from WHO guidelines and the National University of Singapore (University NUS) laboratory manual for 38 laboratories worked with pathogen. It found that action of improvement was in human resource (good microbiological techniques and recommended work practices) and emergency response.²⁴ NIHRD laboratory in cooperation with WHO was also assessed biosecurity in seven regional and central reference labs in 2010, with the result that physical security, employee management and information security have not been adequately implemented.²⁵

Our study finding was mainly in the area of policy and documentation. Policy statement from top management was not socialize and noticed within

laboratory staff, since the institution guideline was not published yet. While, The challenge with the security element is the need to improvement of the personnel reliability policy and competency. The procedure of laboratory staff recruitment was not controlled by the laboratory management but administered by higher level in Institution causing inadequate test for personal performance and competency. There were no written standard operating procedures has been documented yet for the response and contingency planning and system, where in the event of emergency, adequate contingency measures is needed to be address.

Corrective actions that must be carried out prioritized those that are important and urgent according to assessor were as follow: 1) develop a policy statement from top management regarding biorisk management based upon the elements found in CWA 15793 and 16393; 2) develop a biorisk management manual based upon the CWA 15793 elements as a guide and table of contents; 3) ensure that NIHRD is in compliance with all Indonesian regulatory requirements regarding the operation and risks associated with the activities carried out in the institute; 4) begin an audit/inspection process of all labs based upon a biosafety guideline (US, Canadian, WHO, etc.) to determine the status of biorisk implementation; 5) develop, implement and document a formal risk assessment process; 6) begin better documentation of risk management decisions at all levels and in all areas; 7) ensure that only staff

with the full immunization and required protective titers are allowed to work with pathogens being protected against; 8) establish a uniform incident/accident reporting system for all laboratories and encourage reporting of all incidents and near misses; 9) define and implement a personnel reliability policy.

In conclusion, overall the NIHRD laboratory has a strong biorisk management system already established which is working well in many areas. However, some elements need to be prioritized and important actions must be taken to follow the recommendations of the assessor to comply with the standards, in order to assess the performance of the system and NIHRD needs to establish an assessment review using the same CWA 15793 checklist which can be repeated to ensure that the elements are improving, in order to have safe and secure laboratory.

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