

BIOLOGICAL RISK AND OCCUPATIONAL SAFETY: HEALTH AMONG NURSES

*(RISIKO BIOLOGI DAN KESELAMATAN PEKERJAAN: KESIHATAN DI
KALANGAN JURURAWAT)*

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Abstract

Many work activities in hospital are hazardous to nurses, these biological risk is particularly important, mostly because of different types of exposure, contact with highly dangerous agents, presence of nurses with defective immune systems. Nurses are dealing with higher biological risk because they are permanently exposed to blood and body fluids. The purpose of this study is to survey nurse's perception towards biological risk at UKM Medical Centre (PPUKM), Cheras, Kuala Lumpur. A total of 300 respondents from various departments who work at the PPUKM were selected by using purposive sampling method. Overall, the findings indicate that perception of nurses towards biological risk at PPUKM is at the moderate level. Thus, based on the findings obtained and the recommendations given, it is expected that this research can help PPUKM to improve their occupational safety and health management to ensure that nurses are always protected from biological risk.

Keywords: Biological, Risk, Occupational safety, Health

Abstrak

Banyak aktiviti kerja di hospital adalah berbahaya kepada jururawat, risiko biologi ini sangat penting, kebanyakannya kerana pelbagai jenis pendedahan, hubungan dengan agen yang sangat berbahaya, menyebabkan kehadiran jururawat dengan sistem imun yang terganggu. Jururawat menghadapi risiko biologi yang lebih tinggi kerana mereka sentiasa kekal terdedah kepada darah dan cecair badan. Tujuan kajian ini adalah untuk meninjau persepsi jururawat terhadap risiko biologi di Pusat Perubatan Universiti Kebangsaan Malaysia (PPUKM), Cheras, Kuala Lumpur. Seramai 300 responden dari pelbagai jabatan yang bekerja di PPUKM telah dipilih dengan menggunakan kaedah pensampelan purposif. Secara keseluruhannya, penemuan menunjukkan bahawa persepsi jururawat terhadap risiko biologi di PPUKM berada pada tahap yang sederhana. Oleh itu, berdasarkan penemuan yang diperolehi dan cadangan yang diberikan, diharapkan kajian ini dapat membantu PPUKM untuk meningkatkan pengurusan keselamatan dan kesihatan pekerjaan bagi memastikan jururawat sentiasa dilindungi dari risiko biologi.

Kata kunci: Biologi, Risiko, Keselamatan pekerjaan, Kesihatan.

INTRODUCTION

Health care sector presents diverse working conditions with various risk factors hazardous to the health of people working in this field (Vanadzins 2010). Based on the study conducted by previous researchers that the nurses are daily exposed to various types of risk factors or hazards involved physical, biological, chemical and psychosocial (Brinia and Antonaki, 2013; Grebenkov et al., 2010).

Biological risks are well known in the hospitals. The classical examples, tuberculosis and streptococcal septicaemia, have now largely been prevented, but the emergence of multi-drug resistant *Mycobacterium tuberculosis* has caused us to cease to be complacent. Hepatitis B and C and HIV infection now have taken over as potential infective causes of death among the hospital employees. Preventive measures in the hospitals should ensure that these risks are kept to a minimum (Agius & Seaton 2006).

LITERATURE REVIEW

Biological risk or hazards refer to the presence of microbial agents in the work environment, including bacteria, viruses, fungi, and parasites, which may be transmitted to other individuals via contact with infected patients or contaminated body secretions/fluids that can cause various occupational diseases. These agents are considered occupational because it can be affected from direct exposure at work (Tsing & Koh 2011; Rogers 2003).

According to Occupational Health Unit (2007) biological hazard is a hazard arising from organism such as bacteria, virus and protozoa, and this living organism can be transmitted from patient to health care worker and vice versa through blood, body fluid and air droplets. Healthcare workers especially nurses are at an increased risk of exposure and transmission of infectious diseases (Civljak et al. 2013).

Based on Kotze and Acutt (2011), biological agents are defined as ‘any micro-organism, cell culture or human endoparasite including any that have been genetically modified, which may cause infection, allergy or toxicity, or otherwise create a hazard to human health’ in the Regulations for Hazardous Biological Agents (2001) of the Occupational Health and Safety Act (Act 85 of 1993).

Biological risk or hazards were defined to include cuts/ wounds/ lacerations, sharp related injuries, direct contact with contaminated specimens/ biohazardous materials, bioterrorism, bloodborne pathogens, infectious diseases/ infections, airborne diseases, vector borne diseases, and cross contamination from soiled materials (Ndejjo et al. 2015). Biological hazards can be differentiated into live agents (microorganisms) and toxins (Calder & Bland 2015).

Biological risk or hazards include infectious disease agents such as bacteria, viruses, and fungi (Friis 2016; Parker 2001). Nurses, others healthcare personnel, veterinarians, laboratory technicians, and sanitation workers are among the groups of workers who may come into direct contact with infectious disease agents during the course of their work-related activities. For example, healthcare personnel such as nurses can be infected as a result of direct contact with patients and through indirect contact with infectious agents from blood and body fluids (Friis 2016).

Blood borne infectious agents such as hepatitis B virus (HBV), hepatitis C virus (HCV) and human immune deficiency virus (HIV) constitute a major occupational hazard for nurses. Needle stick injuries and splashes are common among healthcare workers at Tumbi and Dodoma hospitals. Knowledge of the risk of HIV transmission due to occupational exposure and knowing whom to contact in event of exposure predicted practice of managing the exposure. Thus provision of health education on occupational exposure may strengthen healthcare workers’ practices to manage occupational exposure (Mashoto et al. 2013 a).

Potential types of exposure to infections from blood and body fluids include unintentional needle sticks and cuts with surgical instruments (known as “sharps”), skin and other contact with microbes, and bites from patients. Doctors, nurses, other healthcare professionals, and custodians are among the workers who can have occupational exposures to blood and body fluids and are at increased risk of acquiring a blood-borne infection (Friis 2016).

Biological hazards distinguish the health care industry from most other industries because if controls are inadequate, illnesses can be transmitted between caregivers and clients. Bacteria, viruses, fungi, and other living organisms can cause infections and illnesses, and physical reactions may result from breathing in the spores or toxins produced by microorganisms. Biological hazards put people at risk through exposure by inhalation (breathing), direct contact with skin or mucosa (touching or injection), or through ingestion (eating or drinking) of biological agents (Matz 2008).

In general, the risk of transmission from an infected client to a health care worker is approximately 3 to 10% for HBV, 3% for HCV, 0.3% for HIV with a percutaneous exposure, and 0.09% for HIV with a mucous membrane exposure (Horning 2008). Risk from inhalation may come from unprotected exposure to an individual with a known or suspected infectious disease transmitted through the air, such as pulmonary tuberculosis or severe acute respiratory syndrome. Exposure involving unprotected direct contact with infectious agents such as methicillin-resistant *Staphylococcus aureus* may increase the risk of infection. Blood splashes or punctures with contaminated needles may increase the risk of getting a bloodborne disease (Matz 2008).

Nurses are employed in essentially every kind of healthcare setting. The wide range of practice settings include public health (national, state and country level), skilled nursing facilities, community based residential care centres, hospitals (public, private and teaching), clinics, urgent care centres, offices, industrial (occupational settings and home healthcare). Nurses are an integral part of clinical services and have primary responsibility for a significant proportion of patient care in most healthcare settings. As such, nurses are confronted with a variety of hazards during the course of performing their duties (Ramsay 2005).

Health workers are considered at higher biological risk and this risk cannot be estimated. In fact, health care workers are exposed to the patient population whose prevalence may differ significantly to that of general population. Biological risk can be significant in countries with increasing economic development and advanced technologies or particular habits. Therefore, biological risk can concern health professions as biotechnology, showing specific variations. In addition, very different diseases are caused by biological agents (infections, allergies, poisoning, cancer and foetal harm) and work-related transmission can also occur by different system (Corrao et al. 2012).

Biological hazards are very serious in the nursing profession. Every year, hundreds of health workers are exposed to dangerous viruses such as hepatitis (mainly B and C) and HIV, when injured by needles and sharp objects (Hosoglu et al. 2008).

HBV can cause persistent infections, chronic liver disease, and hepatocellular carcinoma in the long term. In acute illness, it causes fever, anorexia, and jaundice and, rarely, acute liver failure. HCV infections rarely cause acute illness, but most of those infected will develop chronic infection and 10-15%, will develop cirrhosis. HIV infection may cause an initial infection with flu-like symptoms. Without treatment, HIV progresses to Acquired Immune Deficiency Syndrome (AIDS), which damages the immune system. Healthcare personnel is at risk of bloodborne disease work in a variety of settings. They include intensive care units, operating rooms, emergency rooms and inpatient units (Nimbalkar 2013).

In Malaysia, there were cases of sharp injury and mucosal exposure among the nurses reported in Universiti Kebangsaan Malaysia Medical Centre (UKMMC). Statistics below indicated that the house officer, medical officer and nurses are highly exposed to sharp injuries and mucosal exposure in 2018.

Table 1. Inoculation Incident Reporting (Sharp Injuries and Mucosal Exposures) (Infection Control Unit, UKMMC 2018)

Occupation	Total case
House officer	36
Medical officer	14
Staff nurse	15

Needlestick and sharp injuries are one of the major risk factors for blood-borne infections at healthcare facilities (Kakizaki et al. 2011; Lakbala et al. 2012). More than one third of health care workers at the two largest public tertiary hospitals in Ulaanbaatar, Mongolia, were exposed to the risk of infection with bloodborne pathogens through their contact with needlesticks and sharps (Kakizaki et al. 2011).

Based on research by Lakbala (2012), needlestick and sharp injuries are a common risk factor for infection among health care workers within hospitals in Iran and one of the major risk factors for blood borne infections at healthcare facilities. Healthcare workers are at risk of acquiring human immune-deficiency virus and other infections via exposure to infectious patients' blood and body fluids (Mashoto et al. 2013 b).

Sharp injuries in the studied hospital were common and were likely to be underreported. Therefore, an effective reporting system and sufficient education on occupational safety should be implemented by the relevant institutions. Moreover, it is important to take effective measures to manage sharp injuries in healthcare workers and provide guidance for their prevention (Cui et al. 2018).

In sub-Saharan Africa, bloodborne pathogens exposure is a serious risk to health care workers (Lahuerta et al. 2013). Bloodborne pathogens are microorganisms which transmit disease by contact with blood. Contact may be direct, such as needlesticks or splashes of blood-containing fluids to the mucous membranes or open wounds, or indirect, such as when surfaces contaminated with blood come in contact with someone's mucous membranes or abraded skin. The most common bloodborne risks to healthcare personnel are Hepatitis B (HBV), Hepatitis C (HCV), and Human Immunodeficiency Virus (HIV) infections (Nimbalkar 2013).

Although the prevalence of blood borne pathogens in many developing countries is high, documentation of infections due to occupational exposure is limited. 70 percent of the world's HIV infected population lives in Sub-Saharan Africa, but only 4 percent of cases are reported from this region. Under reporting of needle stick and sharp injuries in healthcare facilities was common (Bekele et al. 2015).

METHODOLOGY

Biological risk study is a small part of the studies of occupational safety and health risks among the nurses. It is a descriptive type of research, which was conducted with the intention to identify and analyse the current situation (biological hazards) within a specific context: it was based on various nursing departments at UKM Medical Centre. This survey was carried out in 2018 in UKM Medical Centre.

The research sample was chosen with the method of purposive sampling. It consisted of 300 nurses: 20 (6.7 percent) were male and 280 (93.3 percent) were female. Their age was from 22 (minimum age) to 47 (maximum age). The majority of the respondents were married (241 people, 80.3 percent). They had been working as nurses for many years.

With regards to the quantitative part of the research, a questionnaire was used because it would allow researchers to collect data within a short period of time and make sure of past experience from similar studies or questionnaires.

The questionnaire was finalized after a pilot survey in order to identify possible weaknesses/ areas for improvement before its wider distribution. Data processing took place with the use of SPSS (Version 21).

FINDINGS

The details of the respondents' demographic factors are shown in Table 2.

Table 2. Demographics of respondents

Characteristics		Percentage (n = 300)
Gender	Male	6.7
	Female	93.3
Marital Status	Single	18.3
	Married	80.3
	Divorced	1.3
Education	Diploma	83.3
	Bachelor Degree	14.7
	Master	2.0

With regards to the objective to identify biological risk, the results have been summarized on Table 3.

Table 3. Perception of nurses towards biological risk

	Biological risk	Mean	SD
1.	I am not exposed to Hepatitis	2.11	1.082
2.	I am not exposed to HIV	2.15	1.084
3.	I am not exposed to Staphylococcus	2.56	1.191
4.	I am not exposed to Streptococcus	2.53	1.189
5.	I am not exposed to Cytomegalovirus	2.71	1.191
6.	I am not exposed to Measles virus	2.36	1.020
7.	I am not exposed to Tuberculosis	2.02	1.054

The table 3 shows the nurses' perception towards biological risk. The respondents disagree and moderately agree towards biological risk is at mean value of 2.02 and 2.71 respectively. Item 7 "I am not exposed to Tuberculosis" was at the lowest mean value of "disagree" which was 2.02 with standard deviation of 1.054, followed by Item number 1 "I am not exposed to Hepatitis" with mean value of 2.11 with standard deviation of 1.082 in biological risk. Nurses are disagree that they are not exposed to Hepatitis, HIV, Measles virus and Tuberculosis. Actually, nurses at risk of bloodborne disease such as Hepatitis, HIV, Measles, Tuberculosis, Staphylococcus, Streptococcus and Cytomegalovirus, while working in hospital.

DISCUSSION

Nurses are dealing with biological risk because they are permanently exposed to blood and body fluids. Their exposure to infectious agents is widely regarded as the most important occupational risk factor, even because of the high probability that accidents at work can increase the of exposure to infectious agents. It is well known that training and knowledge are able to reduce the risk of accidents by exposure to biological agents.

Biological risk can be significant in countries with increasing economic development and advanced technologies or particular habits. According to Grebenkov et al. (2010), implementation

of new technologies and materials, including biotechnology and nanotechnology, demographical, social and economic changes have brought about new risks and changes in the existing occupational risks of health care workers.

Health and safety at work is a basic human right that employers and governments should ensure for the workers. A substantial proportion of nurses suffer from occupational or work-related diseases, or injuries due to biological hazards at the workplace. With healthy and motivated workers in the health sector, the public health goals of the countries can be met (Kim 2010). The nurses are exposed to many risks such as biological risk that can affect human body system at their own workplace. Therefore, the awareness of the biological risk among the nurses might increase the effectiveness of the OSH risks management among the nurses in the hospital.

CONCLUSION

Understanding about biological risk is very important to improve safety and health among the nurses because biological risk can be considered a risk in evolution. However biological cannot be estimated and the nurses are exposed to the patient population whose prevalence may differ significantly to that of general population.

Nurses and others health personnel tend to retire earlier than workers in other sectors of the economy because of work-related stress and other occupational safety and health risks. Considering the critical shortages of nurses caused by the high turnover and early retirement in many European countries, the protection and promotion of occupational safety and health of health care workers especially nurses should be a high priority in Europe (Kim 2010).

Nurses' knowledge and skills is also vital in order to help them acquire a less distorted perception of biological risk. Nurses at risk of bloodborne disease work in a variety of settings. They include intensive care units, operating rooms, emergency rooms and inpatient units (Nimbalkar 2013). Nurses are highly exposed to dangerous and deadly blood borne pathogens through contaminated needle stick injuries (Kebede & Gerensea 2018).

The working conditions and the character of work in the various occupational groups of health care workers such as nurses need special attention because of their exposure to diverse occupational risk or hazards can lead to increased general morbidity and development of occupational diseases (Grebekov 2010).

Needle stick injuries, sharp injuries and other occupational exposures to blood and body fluids among nurses are underestimated hazard. Especially, for nurses who work in operation room/ interventional ambulance. There is a need for preventive programs for healthcare workers and further work on the establishment of an effective surveillance system (Musa et al. 2014).

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REFERENCES

- Agius, R. & Seaton, A. 2006. *Practical Occupational Medicine*. London: Hodder Arnold
- Bekele, T., Gebremariam, A., Kaso, M. & Ahmed, K. 2015. Attitude, reporting behaviour and management practice of occupational needle stick and sharps injuries among hospital healthcare workers in Bale zone, Southeast Ethiopia: a cross-sectional study. *Journal of Occupational Medicine and Toxicology* 10: 42-48.
- Brinia, V. and Antonaki, E. 2013. Health and safety risks, implications and training in hospitals. *Industrial and Commercial Training* 45(7): 420-427.
- Calder, A. and Bland, S. 2015. Chemical, biological, radiological and nuclear considerations in a major incident. *Surgery for Major Incidents* 33(9): 442-448.

- Civiljak, R., Papic, N., Stamenic, V., Kalenic, S., Kuzman, I. & Car, J. 2013. Influenza and hepatitis B vaccination coverage among healthcare workers in Croatian hospitals: a series of cross – sectional surveys, 2006-2011. *BMC Infectious Diseases* 13(520): 1-8.
- Corrao, C.R.N., Mazzotta, A., La Torre, G. & De Giusti, M. 2012. Biological risk and occupational health. *Industrial Health* 50: 326-337.
- Cui, Z., Zhu, J., Zhang, X., Wang, B. & Li, X. 2018. Sharp injuries: a cross-sectional study among health care workers in a provincial teaching hospital in China. *Environmental Health and Preventive Medicine* 23: 2-7
- Friis, R. H. 2016. *Occupational Health and Safety for the 21st Century*. Burlington: Jones & Bartlett Learning.
- Grebenkov, S. V., Shimanskaya, T. G. and Milutka, E. V. 2010. New and emerging occupational risks in the public health care system of the Russian Federation. *Proceedings of the Special Session in the Annual Meeting of the Baltic Sea Network on Occupational Health and Safety*. Tartu: Estonia.
- Horning, M. M. 2008. Understanding hazards and controls in healthcare. In Fell-Carlson, D (ed.). *Working Safely in Health Care: A Practical Guide*. United States: Thomson Delmar Learning.
- Hosoglu, S., Akalin, S., Sunbul, M. & Ozturk, R. 2008. Predictive factors for occupational blood borne exposure in Turkish hospitals. *Am. J. Infect. Control* 37(1): 65-69
- Infection Control Unit UKMMC. 2018. Inoculation Incident Reporting (Sharp Injuries & Mucosal Exposures).
- Kakizaki, M., Ikeda, N., Ali, M., Enkhtuya, B., Tsolmon, M., Shibuya, K. and Kuroiwa, C. 2011. Needlestick and sharps injuries among health care workers at public tertiary hospitals in an urban community in Mongolia. *BMC Research Notes* 4(184):1-6.
- Kebede, A. & Gerense, H. 2018. Prevalence of needle stick injury and its associated factors among nurses working in public hospitals of Dessie town, Northeast Ethiopia, 2016. *BMC Res Notes* 11(413):1-6
- Kim, R. 2010. Health care workers in Europe and WHO programmes. *Proceedings of the Special Session in the Annual Meeting of the Baltic Sea Network on Occupational Health and Safety*. Tartu: Estonia.
- Kotze, A. J. and Acutt, J. 2011. Occupational hygiene. In Acutt, J and Hattingh, S. (eds.) *Occupational Health: Management and Practice for Health Practitioners*. Cape Town: Juta & Co.
- Lahuerta, M., Selenic, D., Mwakitosh, G., Hokororo, J., Ngonyani, H., Kassa, G., Mbatia, R., Basavaraju, S.V., Courtenay-Quirk, C., Liu, Y., Simbeye, D., Kazura, K., Antelman, G. & Bock, N. 2013. O029: Reporting and case management of bloodborne pathogen exposures among healthcare workers in Tanzania. *Antimicrobial Resistance and Infection Control* 2(Suppl 1): O29.
- Lakbala, P., Azar, F. E. and Kamali, H. 2012. Needlestick and sharps injuries among housekeeping workers in hospitals of Shiraz, Iran. *BMC Research Notes* 5(276):1-5
- Mashoto, K.O., Mubyazi, G.M., Mohamed, H. & Malebo, H.M. 2013a. Self-reported occupational exposure to HIV and factors influencing its management practice: a study of healthcare workers in Tumbi and Dodoma Hospitals, Tanzania. *BMC Health Services Research* 13: 276-281.
- Mashoto, K.O., Mubyazi, G.M., Makundi, E., Mohamed, H. & Malebo, H.M. 2013b. Estimated risk of HIV acquisition and practice for preventing occupational exposure: a study of healthcare workers at Tumbi and Dodoma Hospitals, Tanzania. *BMC Health Services Research* 13: 369-375.
- Matz, M. W. 2008. Understanding hazards and controls in healthcare. In: Fell-Carlson, D (ed.). *Working Safely in Health Care: A Practical Guide*. United States: Thomson Delmar Learning.
- Musa, S., Peek-Asa, C., Young, T. & Jovanovic, N. 2014. Needle stick injuries, sharp injuries and other occupational exposures to blood and body fluids among health care workers in a general hospital in Sarajevo, Bosnia and Herzegovina. *International Journal of Occupational Safety and Health* 4(1): 31-37
- Ndejjo, R., Musinguzi, G., Yu, X., Buregyeya, E., Musoke, D., Wang, J. S., Halage, A. A., Whalen, C., Bazeyo, W., Williams, P. & Ssempebwa, J. 2015. Occupational health hazards among healthcare workers in Kampala, Uganda. *Journal of Environmental and Public Health* : 1-9.
- Nimbalkar, S. 2013. Biological hazards: bloodborne pathogens. In Gorman, T., Dropkin J., Kamen, J., Nimbalkar, S., Zuckerman, N., Lowe, T., Szeinuk, Milek, D., Piligian, G. & Freund, *Controlling Health Hazards to Hospital Workers*. A. New Solutions 23(Suppl).

- Occupational Health Unit. 2007. Ministry of Health, Malaysia.
- Parker, G. 2001. *Introduction to occupational health*. In: Chambers, R., Moore, S., Parker, G. and Slovak, A. (eds.) *Occupational Health Matters in General Practice*. Oxon: Radcliffe Medical Press.
- Ramsay, J. D. 2005. A new look at nursing safety: the development and use of JHAs in the Emergency Department. *Journal of SH & E Research* 2(2):1-18.
- Rogers, B. 2003. *Occupational and Environmental Health Nursing: Concepts and Practice*. United States: Saunders.
- Tsing, G. C. C. & Koh, D. 2011. Clinical evaluation of occupational disorders. In: Guidotti, T. L. (eds.) *Global Occupational Health*. New York: Oxford University Press.
- Vanadzins, I., Matisane, L., Eglite, M., Martinsone, Z., Sprudza, D. & Bake, M. 2010. Development of the occupational health and safety situation among Latvian health care workers. *Proceedings of the Special Session in the Annual Meeting of the Baltic Sea Network on Occupational Health and Safety*. Tartu: Estonia.

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