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Are Laboratory Technicians Aware of Biomedical Waste Management and Biohazards?

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Original Research Article

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Abstract: Biomedical waste is hazardous to both humans and environment and is generated on a daily basis in almost all the laboratories. Minimization in production and appropriate disposal is equally important. The Ministry of Environment issued a notification on Biomedical Waste Management and Handling 1998 which dictated certain guidelines to manage and dispose of the biomedical waste. The purpose of this study is to see the level of awareness among laboratory technicians regarding biomedical waste as they handle and dispose most of the waste generated on a daily basis and play a key role in its management. This is a prospective cross sectional study conducted amongst a total of 36 laboratory technicians in Lata Mangeshkar Hospital, Nagpur, India. A predesigned questionnaire was used in order to asses technician's knowledge on different variables like color coding, occupational injuries etc. Statistical analysis was done and percentage and average score were calculated and shown graphically. The response to the study was good and all the technicians had a sound knowledge regarding the waste handling techniques and the potency of waste. Still there was a slight need of awareness in fields like occupational injury, condition of bags, waste segregation and transport protocols and special waste management teams. A lot of them did not receive any special training before joining the institute. They did attend training programs after joining. The study also shows that technicians working for 11-20 years were fully aware about the biomedical waste management and the ones working since 21-30 years had not updated their knowledge or work technique while those working since 1-10 years also were unaware about many factors. The level of awareness of a technician is 96.4167%.All the technicians had sound knowledge regarding biomedical waste but they lacked training and were not updated or oriented. Training programs are necessary in order to create proper awareness.

Keywords: Biohazards, Biomedical waste management, Immunization, Training programs, Color coding, Occupational Hazards.

INTRODUCTION

Biomedical waste is defined as the waste generated during the treatment, diagnosis, immunization, research activities and testing of drugs done on animals and human beings and is considered as one of the most toxic forms of waste produced [1]. 3 million tons of waste is generated in India and it grows annually by 8% [2-4]. Besides radioactive waste generated during radiological diagnosis, a more severe threat that persists is that of the pathogens detected and studied in a laboratory. It is ironic that the place that cures most of the diseases can be responsible for generating a large amount of wastes that are potentially fatal to environment and may severely affect public health. About 3/4th of the waste generated is harmless but the rest may be potentially harmful and if not handled properly can lead to an outbreak of a disease [4, 5].

An average laboratory gets about 100000 samples daily for testing and diagnosis for various diseases. Similarly a research establishment also takes no less than 15000 samples to test before announcement of any breakthrough regarding diagnosis and cure of the disease and these samples may include live viruses and bacteria that are much more fatal to the environment and public health as there is no cure available for them [6]. Thus it is important for any medical establishment to handle and dispose the waste produced in laboratories properly. Complete management depends on staff, planning, administration and a proper financing [7, 8]. The waste generated in laboratories mainly consists of blood, urine, feces, amniotic fluid, body tissues and such similar samples for their diagnostic examination; disposable items like needles syringes that are used for a variety of tests ranging from a simple blood glucose examination to a tumor biopsy

are equally responsible for spreading infections like hepatitis B, hepatitis C, HIV, tuberculosis which in turn affect both humans and the environment [9]. 21 million cases of hepatitis B, 4 million cases of hepatitis C and 30000 HIV cases are caused due to needle prick injuries which are a consequence of lack of awareness in the medical personnel collecting the sample [10-12].

The Ministry of Environment and Forests issued a notification on Biomedical Waste Management and Handling (Schedule 1) under Environment (protection) Act, Govt. of India in 1998 [13]. This act is very important as diagnostic tests are done at almost all medical establishments ranging from a primary healthcare center to a tertiary care hospital and are indispensable part and parcel of any medical establishment. There are two parts of this act one emphasizing on the ability of a technician to minimize the production of waste and the other focusing on the systematic method for handling and disposal of the waste [14]. The later one is of supreme importance as the most possible and likely threat of such waste is due to human error and it can be minimized. Under this act there are guidelines for proper waste disposal and also includes the methods and technologies like incinerator, autoclave, microwave systems etc to be used in order to dispose biomedical waste. An advisory committee is also appointed to keep check on this and train the healthcare facility towards better waste management [15]. The standard process of biological waste management according to this act includes:

- Segregation of waste from all the sites of generation
- Treatment of assorted waste and its sterilization
- Storage at a central storage site
- Transport from the central storage site to allocated place of disposal
- Final disposal [16]

Considering all these factors we tried to assess the awareness of laboratory technicians about biological waste management and biohazards.

MATERIALS AND METHODS

A prospective cross sectional type of study was conducted among lab technicians belonging to Departments of Central Pathology Lab, Blood Bank, Anatomy, Physiology, Biochemistry, Pathology, Microbiology, Forensic Medicine and Toxicology of N.K.P. Salve Institute of Medical Sciences and Research Centre, Nagpur. The study was conducted over duration of 2 months starting from 1st July 2017 to 31st August 2017 after getting the approval of ethics committee. The study was conducted on the subjects willing to take part in it. Subjects who were unwilling or unavailable were excluded from this study. A total of 36 willing subjects were given a predesigned, preselected questionnaire after properly informing them about the purpose of the study and taking their consent. Anonymity of all the technicians was maintained. The questionnaire was in English consisting of 15 specially drafted questions to test the awareness of technicians on the basis of diverse variables like training, disposal site, waste transport, risks of transmission, immunization, occupational injuries, collection, color coding etc. The work experience and level of exposure towards biomedical waste was recorded for comparison with their levels of awareness. Statistical analysis was done using parameters like percentage, mean etc. and then graphically represented.

RESULTS

Respondent's profile

As revealed in our study out of 36 respondents 12(33.34%) are male and 24(66.67%) are female. Most of the respondents i.e. 20 (55.56%) worked at the Central Pathology Laboratory and only 1 (2.78%) worked at Departments of Anatomy and Forensic Medicine and Toxicology each. Most of the technicians have a work experience in the range of 21-25 years (30.56%) and a very few of them had work experience of 11-20 years (5.56%). Technicians in CPL, Blood bank, Anatomy, Pathology are exposed to biomedical waste on a daily basis while the ones working in Physiology, Biochemistry or Forensic Medicine and Toxicology get exposed once or twice a week.

Table-1.1: respondent's profile

Variables	Frequency (%)
Gender	
Male	12(33.34)
Female	24(66.67)
Department	
Pathology	3(8.34)
Microbiology	4(11.12)
Biochemistry	3(8.34)
Blood bank	2(5.56)
CPL	20(55.56)
Anatomy	1(2.78)
Forensic Medicine and Toxicology	1(2.78)
Physiology	2(5.56)
Exposure to Biomedical Waste	
Daily	26
Four times a week	4
Twice a week	5
Once a week	1
Working Period	
1-5yrs	8(22.23)
6-10yrs	8(22.23)
11-15yrs	1(2.78)
16-20yrs	1(2.78)
21-25yrs	11(30.56)
26-30yrs	7(19.45)
Total	36

Knowledge and Practice regarding Biomedical Waste Management and Biohazards

Under this study a total of 36 laboratory technicians (20 from CPL and Blood Bank and 16 from other departments) were assessed based on the preselected variables. When the study was conducted in CPL and Blood Bank, it was seen that the subjects had complete and utter knowledge regarding most of the vital parameters like the ideal protocol to be undertaken in case of any occupational injury(100%), the infective potency of the biomedical waste collected(100%), proper methods and techniques used in order to handle the biomedical waste(100%), proper method to arrange the wrap up the waste bags(100%), the color coding that is used while collecting different types of biomedical waste(100%), the standard practices in segregation and collection of waste from all the possible sites of generation(100%) and the Biohazard management Act(100%). They also had working knowledge in other fields like use of personal protective gear (100%); proper ways to transport all the waste to central storage site (100%), the potential risk of spread of various diseases form the waste (100%). They recognized the international biohazard symbol (100%), knew about the special waste management teams (100%) and all of them were properly immunized (100%). A lot of the technicians were given orientation when they joined the institute (90%), and most of them did receive a proper training before they were appointed (90%).

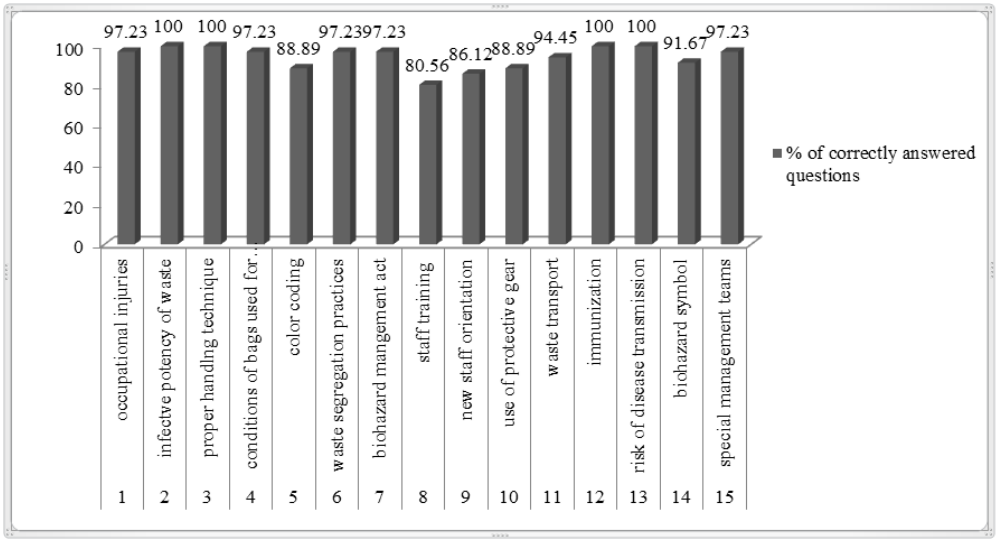
When the studies that were conducted in other departments like Pathology, Microbiology, Biochemistry, Anatomy, Forensic Medicine and Toxicology and Physiology, the results were very different. All the technicians were very well aware of some parameters like the infective potency of biomedical wastes(100%), ideal method to handle biomedical wastes before its treatment and disposal(100%), all of them were properly immunized(100%) and had a clear idea of the possible epidemiological and environmental hazard caused by this waste(100%). Almost all of the technicians knew about proper protocol in case of any occupational injury (93.75%), the condition of bags used for waste storage (93.75%), practices adopted by the laboratories for waste segregation (93.75%), the Biohazard management Act (93.75%) and the special waste management teams appointed in their laboratories (93.75%). There was very minute confusion among a few technicians regarding the biomedical waste transport protocols (87.5%). A very small group amongst all the subjects was not properly oriented when

they joined the institute (81.25%) but are aware of all the techniques and protocols but were not aware about the meaning of biohazard symbol (81.25%). Some of the technicians were not at all aware of the color coding used while collecting the biomedical waste (75%) and did not use any sort of protective gear while handling and disposing the waste (75%). A very few amount of technicians had received any sort of training before they were appointed at the laboratory (68.75%).

Table-2.1: department wise awareness of technicians

Sr. No.	Variable	Dept	correct answers	incorrect answers	frequency	%
1	occupational injuries	CPL	20	0	20	100
		other	15	1	16	93.7
2	infective potency of waste	CPL	20	0	20	100
		other	16	0	16	100
3	proper handling technique	CPL	20	0	20	100
		other	16	0	16	100
4	conditions of bags used for storage	CPL	20	0	20	100
		other	15	1	16	93.7
5	color coding	CPL	20	0	20	100
		other	12	4	16	75
6	waste segregation practices	CPL	20	0	20	100
		other	15	1	16	93.7
7	biohazard management act	CPL	20	0	20	100
		other	15	1	16	93.7
8	staff training	CPL	18	2	20	90
		other	11	5	16	68.7
9	new staff orientation	CPL	18	2	20	90
		other	13	3	16	81.2
10	use of protective gear	CPL	20	0	20	100
		other	12	4	16	75
11	waste transport	CPL	20	0	20	100
		other	14	2	16	87.5
12	immunization	CPL	20	0	20	100
		other	16	0	16	100
13	risk of disease transmission	CPL	20	0	20	100
		other	16	0	16	100
14	biohazard symbol	CPL	20	0	20	100
		other	13	3	16	81.2
15	special management teams	CPL	20	0	20	100
		other	15	1	16	93.7

All the technicians had a proper and working knowledge regarding the immunization programs, risk of disease transmission, infective potency of waste and the proper techniques to handle it. Almost all the technicians were sure about the protocol followed after any occupational injuries; condition of bags used to carry the biomedical waste, methods to segregate waste, Biohazard management Act and the special waste management teams in the hospital. Most of them had no doubts regarding the regular transport and disposal of waste. Only handful technicians did not know the meaning of biohazard symbol. Very few of them had unclear views regarding the color coding and use of protective gear while disposing and handling biomedical waste. Some of them were not given a proper orientation on their first day at job. A lot of the technicians had not undergone any special training or guidance program during their duty. The average score of a technician in the given questionnaire is 13.9321429 (out of 15). So the overall awareness of all the technicians combined is 96.4167%.

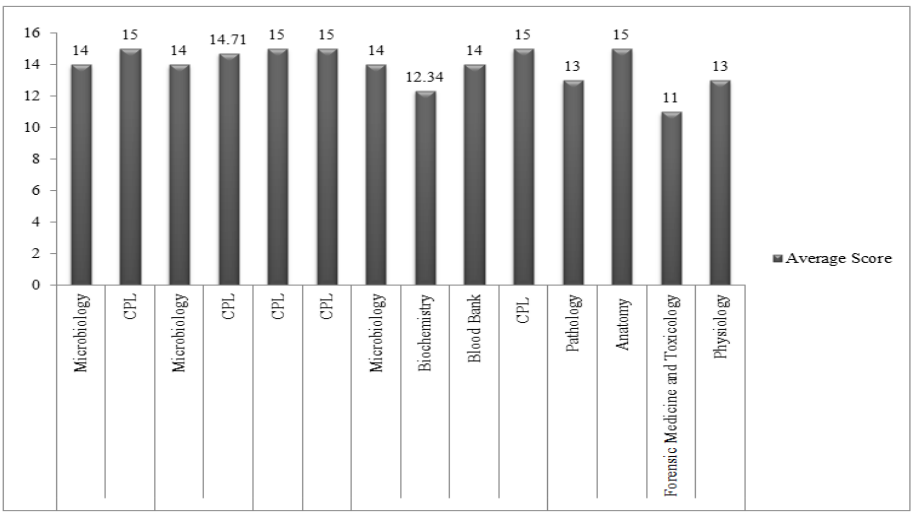


Graph-2.2: overall awareness of technicians

Awareness of laboratory technicians based on work experience

- Technicians with work experience of 1-5 years were studied in departments of Microbiology and CPL and had an average score of 14(93.34%) and 15(100%) respectively.
- Technicians with work experience of 5-10 years were studied in departments of Microbiology and CPL and had an average score of 14(93.34%) and 14.71(98.067%) respectively.
- Technicians with work experience of 11-15 years were studied in CPL and had an average score of 15(100%).
- Technicians with work experience of 16-20 years were studied in CPL and had an average score of 15(100%).
- Technicians with work experience of 21-25 years were studied in departments of Microbiology, Biochemistry, Blood Bank and CPL and had an average score of 14(93.34%), 12.34(82.267%), 14(93.34%), 15(100%) respectively.
- Technicians with work experience of 26-30 years were studied in departments of Pathology, Physiology, Anatomy, Forensic Medicine and Toxicology and had an average score of 13(86.67%), 15(100%), 11(61.11%), 13(86.67%) respectively.

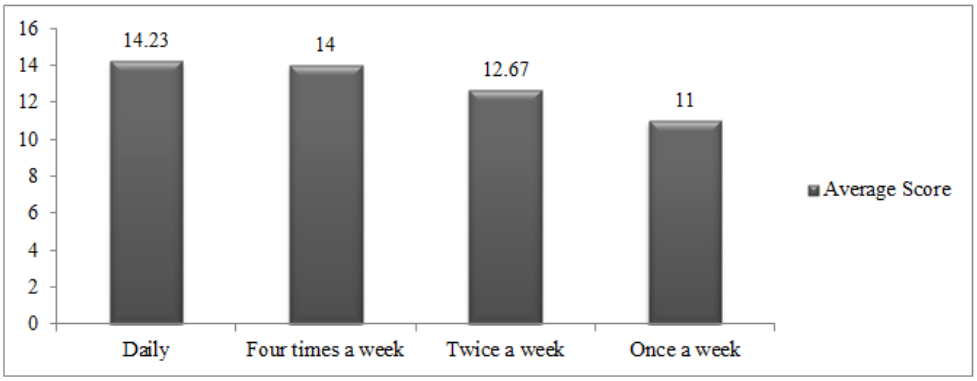
The newly joined technicians working since about 10 years had a pretty good idea about proper biomedical waste management but their concepts regarding one or two thing were unclear. Technicians working since 11-20 years had a very proper and sound knowledge with crystal clear concepts regarding biomedical waste management and its possible hazards. Technicians working since 20-25 years had a pretty good knowledge regarding the biomedical waste but on some levels presented a very few doubts regarding the study. Technicians with work experience of about 26-30 years displayed an average knowledge regarding the concepts of biomedical wastes and most of them were not properly updated regarding the upcoming trends and modern practices regarding biomedical waste management and biohazards.



Graph-3.1: awareness of technicians based on work experience

Awareness of technicians based on level of exposure

Technicians who were exposed daily belonged to departments of CPL, Blood Bank, Anatomy, Pathology and on an average scored 14.23(94.867%) while the ones exposed four times a week belonged to Microbiology department and had an average score of 14(93.34%). Technicians working at departments of Biochemistry and Physiology got exposed twice a week and scored about 12.67(84.467%) while the one working in department of Forensic Medicine and Toxicology scored 11(61.11%) as he was exposed only once a week. Technicians with a daily exposure to biomedical waste had an average score of 14.23 while the ones who were getting exposed once a week had an average score of 11.



Graph 4.1: awareness of technicians based on daily exposure to biomedical waste

DISCUSSION

The study clears up the fact that all the technicians were completely aware of the rules of biomedical waste management (100%) and fatalities caused by their transmission (100%). They were also aware about the Biohazard management Act (97.23%) and a fair idea about the meaning of biohazard symbol (91.76%). A lot of them also knew about the color coding of the wastes (88.89%) and were having a basic training (80.56%). When all the technicians were assessed based on their level of work experience it was noticed that subjects with experience of 1-10years were 96.18% aware while subjects between 11-20years of work experience were 100% aware and ones with experience of 21-30years were 87.92% aware. No statistical significance was observed on a gender wise analysis.

Similar observations were noted in a study conducted by Nazli S. N., *et al*. at Hospital Batu Pahat, Johor [9]. The level of training was 78%, knowledge about the rules and protocols followed during waste management and segregation was 93%. They were well aware about the risk of transmission of any disease from the waste (99%) and knew the meaning of biohazard symbol (92%). They also had a working knowledge regarding the color coding of biomedical waste collected (91%).

Another study which partially contradicts the results of our study was conducted by Kaur D. C., et al in a Rural Area near Pune [5]. The technicians had a very poor level of training (59.2%) and barely knew about the color coding (77.8%). They were very well

aware about the rules regarding biomedical waste management (79.8%) and also about the Biohazard management Act (93%). When they were analyzed based on their experience the results showed that the most senior technicians with experience of 21-30years had 100% knowledge about biomedical waste. While technicians with work experience of 1-10years showed awareness about 80.35% and ones with work experience of 11-20years were 66.67% aware.

Another contradictory study was conducted by Ananthachari K.R *et al*. among healthcare workers of Malabar College Teaching Hospital Calicut, Kerala [1]. Only 20.2% technicians had proper training, 55.95% actually knew about the complete rules and protocols that are followed regarding the biomedical waste collection and its ideal management. Only 64.2% of them were properly immunized according to the national immunization schedule. About 40% of them had an idea about the Biohazard management Act and 57.1% knew about the ideal color coding used at their laboratory while collection of biomedical waste. But most of them had an idea about the risks and fatal consequences in case of any leak or transmission of pathogens from the waste (77.38%).

Similar conclusion was also drawn in a study conducted by P. Madan, *et al*. among Medical Staff in Tertiary Care Hospital [2]. There the overall awareness in laboratory technicians was about 74%.

Conclusion and Recommendations

As a consequence of the above study and after a series of discussions the following conclusions can be drawn:

- All the technicians seem to be properly immunized, aware about the probable risks of disease transmission and potency of the waste. They also seem to know about the proper ways to handle the waste.
- Revision and proper guidelines are to be given so that the technicians are capable of handling occupational injuries in other departments.
- Boards and charts can be provided to make clarity to concepts of color coding and the bags supplied for waste collection should be properly sealed and safe in other departments.
- Guest lectures and talks should be given regarding Biohazard management Act and ideal waste segregation practices.
- Training programs for current staff and proper orientation schedule for newly joined staff should be done in CPL, Blood bank and all the other departments.
- Protective gears should be made easily available in all the laboratories and their use needs to be encouraged especially in other departments and waste collection and disposal should be done more frequently.
- A three monthly assessment and reinforcement of technique based on its results should be conducted by the special surveillance teams.

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