Assessment of Knowledge, Attitude and Practice of Chemical Safety Among Technical Staff and Trainees Working in Medical Laboratory of a Tertiary Care Hospital

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ABSTRACT

Safety of the laboratory workers has been the major concern as laboratory workers are being exposed to various health hazards in daily life. It is very essential for them to develop good knowledge and possess right attitude about chemical safety which will be reflected in correct practice of chemical safety in the laboratory. The aim of this study was to assess the knowledge, attitude and practice of chemical safety among laboratory technicians and technician trainees in a tertiary care hospital, using a self- administered questionnaire.

In this cross-sectional study conducted in Father Muller Medical College Hospital Laboratory, Mangalore, for a period of six months, eighty technical staff, medical laboratory technology interns (BSc MLT) and medical laboratory technology postgraduates (MSc MLT) were the participants. Knowledge, attitude and practice were assessed by a questionnaire on chemical safety. The obtained results were tabulated, and the percentage of responses under each criteria of the questionnaire were analyzed.

Technical staff had better knowledge of chemical safety (50% of the staff scoring > 90%) than BSc MLT interns (21.4% scoring >90%) and Postgraduates (41.7% scoring >90%). The attitude of the participants was found to be good with the variant degree of their response. Majority of the participants had good attitude towards the chemical safety, with average of 67.1% of the participants possessing strong attitude (strongly agreeing for safe practices) towards chemical safety and 32.9% possessing good attitude (agreeing for safe practices). Assessment of safety practice using a questionnaire revealed overall very good compliance (saying yes for the safety practice of working) with regard to chemical safety practice and much better practice among technicians (Average of 91% saying yes) than the interns (average of 71.2% saying yes) and postgraduate students (66.7% saying yes).

Periodic training, assessment and retraining are essential in the process of continual quality improvement regarding chemical safety.

Keywords: Hazard, Globally Harmonized System, Lab Technician, Chemical Safety

INTRODUCTION

Safety is foremost issue of concern for everyone exposed to potentially hazardous substances such as chemicals in the laboratory. In a hospital laboratory, the staff and students get exposed to chemicals frequently which may be corrosive, flammable, pyrogenic, oxidizing, and irritating and cause health hazards. Because of direct exposure to hazardous chemicals, technical staff are at high risk [1-3]. Exposure to non-infectious hazards such as cut, skin injuries, electric shock, fire, explosion and burns with corrosive chemicals and poisoning with toxic substances are also common [1]. The reasons for chemical-related accidents could be lack of knowledge and wrong attitude, which could be addressed by appropriate staff training [2,4].

It is important to have sufficient knowledge and training on chemical hazards, its effect and proper handling, care and management of chemicals used in laboratory. Along with the knowledge, attitude also is an important aspect which matters in the safe practices of technical staff working in the laboratory. Regular trainings, assessment, review and audits are the integral components in the chemical safety program of a laboratory. A safety-conscious staff, well informed about the recognition and control of laboratory hazards, is key to the prevention of incidents and accidents in the laboratory [1-6].

Student safety along with staff safety and its related measures should gain more attention, since many of them may live and study on campus where there is a risk of being exposed to various chemical hazards. [5] Sufficient knowledge about the use of equipment, safe work environment and safety regulations is influential to change the attitude of the employees to carry out the task safely and effectively. Awareness among staff and students in this safety aspect is most important and must be known and should be researched. [6] If the use of chemicals is not done with care it might cause a great harm to health. That is why it is crucial to have well equipped laboratory with proper safety facilities

to ensure the overall safety of laboratory and staff [7,8].

Well-equipped laboratory, safety training, and facility service alone are not sufficient enough to ensure the safety of the worker in the laboratory. Instead, it has to be evaluated frequently to assure the safety practices being taken in the laboratory. An audit is required as a process of review of chemical safety in laboratory, and for the implementation of corrective actions to assure the total quality of the laboratory [9].

There is paucity of studies in the Indian context which assess the knowledge, attitude and practice of chemical safety among technicians and trainees in the clinical laboratory of a tertiary care teaching hospital.

The main purpose of this study is to assess the knowledge, attitude and practice of chemical safety among laboratory technicians and technician trainees in a tertiary care hospital, using a self-administered questionnaire.

MATERIALS AND METHODS

Type of Study. Observational study.

Place and Duration of the Study: The present study was done at Father Muller Medical College Hospital, Mangalore for a period of six months from January 2021 to June 2021. The medical testing laboratory of this hospital is accredited by National Accreditation Body for Testing and Calibration Laboratories (NABL), and caters to the needs about 1,000 patients per day. The laboratory has clinical biochemistry, hematology, clinical pathology, histopathology, cytology and microbiology Sections. The laboratory has two outpatient sample collection centers within the premises of the hospital.

Study subjects: Total number of participants was 80. All the consenting staff and trainees of the laboratory were included. Technicians working in the laboratory (54), and BSc MLT interns (14) and MSc MLT students (12) who work as trainees in the laboratory were included in this study. Voluntary, informed consent was obtained from all of them. The study protocol was approved by Institutional Ethics Committee.

Inclusion and Exclusion Criteria: The staff and trainees of the laboratory were included. The staff who had the experience of 10 years or more than 10 years, and those who were in charge of the laboratory safety committee and chemical management team, were excluded from the study.

Study Tool: Self-administered questionnaire was used to assess knowledge, attitude, and practice of chemical safety, which was prepared by the study team. This questionnaire was devised by the corresponding author who is a senior faculty of Biochemistry and was the quality manager of the laboratory for five years, with the help of laboratory safety committee. The questionnaire was validated by five experts who are senior faculty of biochemistry, pathology, microbiology, quality cell of the hospital and one chemistry professor from an external institution. Only after that, the questionnaire was put into use. A copy of the questionnaire was provided to each participant and they were requested to respond to the questions in writing.

Knowledge of participants was tested on symbols of chemical safety, National Fire Protection Association (NFPA) diamond, chemical spillage management, storage, classification of chemicals based on globally harmonized system (GHS). Total number of questions were 16 and total marks for knowledge was 29.

Statistical Analysis: The obtained results were tabulated, and the percentage of responses under each criteria of the questionnaire were analyzed; data are presented in the form of table, bar graph and pi-chart. Marks obtained by Postgraduates, Interns and staff was calculated separately and mean and percentage of each category was calculated separately based on their percentage. Those who were under 50% marks (out of total 29 marks) were categorized as “Poor” or “not satisfactory”, knowledge with 51-60% were categorized as “Satisfactory”, those with 61-75% were included under “Good”, 76-90% as “Very Good” and those with >90% marks were categorized as “Excellent”.

RESULTS

The demographic details of study participants are presented in Table 1. The average of technical staff who participated in the study was 24.5 ± 5 years. Among the 80 participants, 68 were females and 12 were males. Among the participants, 43 (53.7%) had an experience upto 3 years while (26) 32.5% had experience of 3 to 6 years, and 11(13.7%) had experience of 6 to 9 years in the job. Majority (66, 82.8%) had received in house training on laboratory safety including chemical safety.

Average marks obtained by technicians, BSc MLT interns and MSc. MLT students is given in table/ figure 3. Overall, technicians had better knowledge of chemical safety than the BSc MLT interns and MSc MLT postgraduates (Fig. 1). The percentage of participants who scored “excellent” was 54% for technicians, 41.7% for MSc MLT students and 21.4% for BSc MLT interns. The average score of chemical safety knowledge for all participants together, was 72%.

On NFPA diamond, 28 (35%) of the participants answered correctly, 35 (44%) answered wrongly and 20(25%) did not answer. On GHS classification, 39 (48.7%) answered correctly, 4 (5%) answered wrongly and 46.25% did not answer (Table 2).

Attitude of postgraduates, interns and staff are tabulated

according to their response on each question separately in the form of numbers and percentage based on each category (Table 3). Overall, 92% of the participants showed responses in favour of chemical safety measures, evident from the strongly agree /agree responses for positive questions/statements, and strongly disagree/disagree responses for negative questions/statements (Table 4). Technicians showed the best adherence to chemical safety as per their responses to the questionnaire (91% score), followed by interns (75% score) and post graduates (70% score). The average score of all study participants together was 78% (Table 4).

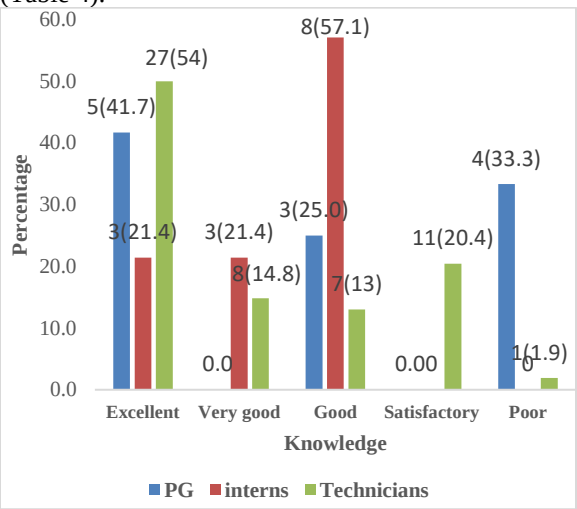

Fig. 1: Summary of knowledge assessment (Number and percentage of participants graded as scores; Percentage is given in parenthesis)

Table 1. Demographic details of study participants

Variable	Number	Percentage
Designation		
1. Intern	14	17.5
2. PG	12	15
3. Lab technician	54	67.5
Experience of working in the laboratory		
1. 0-3 years	43	53.7
2. 3-6 years	26	32.5
3. 6-9 years	11	13.7
Have you received training		
1. Yes	64	80
2. No	16	20
Source of training		
1. BSc MLT training	12	15
2. Attended specialized lab safety/chemical safety workshop	1	1.25
3. Periodic Training program of lab/hospital	66	82.5
4. Learnt from social media	1	1.25

Table 2. Response of participants on NFPA diamond and GHS classification

	Correctly Answered: Number and (Percentage) *	Wrongly Answered: Number and (Percentage)*	Not answered: Number and (Percentage)*
GHS	39 (48.7)	4 (5)	37 (46.25)
NFPA	28 (35)	34 (42.5)	17 (21.25)

Table 3. Attitude of the participants towards chemical safety

Q. No.	Question/ Statement	Designation	Strongly agree: Number and (Percentage)	Agree : Number and (Percentage)	Neutral : Number and (Percentage)	Disagree : Number and (Percentage)	Strongly disagree %: Number and (Percentage)
1	No need to wear PPE in Lab	Postgraduates	0	0	0	1 (8.3)	11 (91.6)
		Interns	2 (14.3)	0	0	0	12 (85.7))
		Technicians	5 (9.3)	1(1.9)	0	6(11.1)	42 (77.7)
2	Chemical hazards are not dangerous	Postgraduates	0	0	0	3(25)	9(75)
		Interns	0	0	0	1(7.14)	13(92.9)
		Technicians	0	3(5.6)	0	20 (37)	31 (57.4)
3	Chemical waste can be disposed in a sink with huge dilution of water	Postgraduates	0	0	3 (25)	3 (25)	6 (50)
		Interns	0	0	4(28.6)	0	10(71.4)
		Technicians	0	7(13)	9(16.7)	7(13)	31(57.4)
4	Only lab-in charge should know about the spillage kit	Postgraduates	0	0	0	2(16.6)	10(83.4)
		Interns	0	0	0	0	14 (100)

		Technicians	0	0	0	24.1	41(75.9)
5	Minor spillage of Chemical is negligible	Postgraduates	0	1(8.3)	0	5 (41.7)	6(50)
		Interns	0	0	0	3 (21.5)	11 (78.5)
		Technicians	0	0	1(1.9)	23 (42.6)	30(55.6)
6	Only employer should know about chemical safety	Postgraduates	0	2 (16.7)	0	3(25)	7(58.3)
		Interns	1(7.1)	0	0	4(28.6)	9(64.3)
		Technicians	2(3.7)	0	0	23 (42.6)	29(53.7)
7	Safety training is relevant	Postgraduates	10 (83.3)	0	2(16.7)	0	0
		Interns	12(100)	0	0	0	0
		Technicians	34(63)	20(37)	0	0	0
8	Chemical safety is concern of safety committee only	Postgraduates	0	0	0	7(58.3)	5(41.6)
		Interns	0	0	0	4(28.6)	10(71.4)
		Technicians	3(5.6)	3(5.6)	0	21 (38.9)	27(50)
9	All Staff should be trained in chemical safety	Postgraduates	12(100)	0	0	0	0
		Interns	14(100)	0	0	0	0
		Technicians	45(83.3)	9(16.7)	0	0	0
10	Need to use carrier box to carry chemicals	Postgraduates	9(75)	1(8.3)	2(16.7)	0	0
		Interns	13 (92.9)	1(7.1)	0	0	0
		Technicians	31(57.4)	17(31.5)	4(7.4)	2(3.7)	0
11	Only histopathology should learn in detail about chemical safety	Postgraduates	0	0	0	2(16.7)	10(83.3)
		Interns	0	0	0	0	14(100)
		Technicians	0	0	0	20(37)	34(63)
12	My lab section does not have hazardous chemical	Postgraduates	0	0	1(8.3)	3(25)	8(66.7)
		Interns	0	0	0	5(35.7)	9(64.3)
		Technicians	0	0	0	28(51.9)	26(48.1)
13	No need to worry about less hazardous chemicals	Postgraduates	0	0	0	3(25)	9(75)
		Interns	0	0	0	1(7.1)	13(92.9)
		Technicians	5(9.3)	0	5(9.3)	20(37)	24 (44.4)
14	Registers should be maintained in the storage area for the entry and exit of chemicals	Postgraduates	7(58.3)	5(41.7)	0	0	0
		Interns	7(50)	0	0	0	50

		Technicians	30(55.6)	23(42.6)	1(1.9)	0	0
15	Only lab in-charge is responsible for the arrangement of chemicals in the storage area	Postgraduates	1(8.3)	0	0	3(25)	8(66.7)
		Interns	0	1(7.1)	0	0	13(92.9)
		Technicians	5(9.3)	5(9.3)	0	14(25.9)	30(55.6)
16	Every staff should be trained on the use of eye wash	Postgraduates	12(100)	0	0	0	0
		Interns	13(92.9)	1(7.1)	0	0	0
		Technicians	40(74.1)	14(25.9)	0	0	0
17	Aprons have to be used only while handling spillages	Postgraduates	0	0	0	2(16.7)	10(83.3)
		Interns	0	0	0	5(35.7)	9(64.3)
		Technicians	0	0	0	25(46.3)	29(53.7)

* Percentage is given in parenthesis

Table 4: Adherence to safety practice in the laboratory by the participants

SN	**QN**	Designation	Yes : Number & (Percentage)*	No : Number & (Percentage)*	Sometimes : Number & (Percentage)*	Never : Number & (Percentage)
1	Do you wear PPE while handling chemicals ?	PG	11 (91.6)	0	1 (0.83)	0
		Interns	11 (78.6)	21.4(3)	0	0
		Technicians	42(77.8)	8 (14.8)	4 (7.4)	0
2	Do you keep chemicals in its proper place?	PG	10 (83.3)	2 (16.7)	0	0
		Interns	14(100)	0	0	0
		Technicians	54(100)	0	0	0
3	Do you use chemical hoods?	PG	7 (58.3)	0	5 (41.7)	0
		Interns	9 (64.3)	0	5 (35.7)	0
		Technicians	50 (92.6)	2 (3.7)	2 (3.7)	0
4	Do you check label on chemicals?	PG	7 (58.3)	0	5 (41.7)	0
		Interns	4 (28.6)	0	10 (71.4)	0
		Technicians	40 (74.1)	0	14 (25.9)	0
5	Do you check MSDS before opening chemical?	PG	7 (58.3)	0	5 (41.7)	0
		Interns	8 (57.1)	0	6 (42.9)	0
		Technicians	50 (92.6)	0	4 (7.4)	0

6	Do you make entry in the register in the storage area whenever bring or take chemicals from there ?	PG	5 (41.7)	2 (16.7)	5 (41.7)	0
		Interns	14 (100)	0	0	0
		Technicians	54 (100)	0	0	0
7	Do you always wear apron while working in lab?	PG	12 (100)	0	0	0
		Interns	14 (100)	0	0	0
		Technicians	54 (100)	0	0	0
Average Percentage response		PG	66.7	8.3	25	0
		Interns	71.2	7.1	21.4	0
		Technicians	91	2.6	6.9	0

DISCUSSION

The present study was conducted to assess the different aspects of chemical safety in a clinical laboratory. The study participants were technicians, MLT interns and MLT postgraduates. Overall, it was observed that the knowledge on chemical safety was good (average 72% score) and majority the study participants possessed good, positive attitude towards chemical safety. The audit of chemical safety practice done as per standards revealed compliance with regard to most of the safety aspects except for few partial compliances in wearing personal protective equipment, disposal of chemicals and knowledge of the contents of spillage kit.

It was observed that the technical staff of the laboratory had better knowledge of chemical safety when compared to the interns and post graduates. This could be due to continuous exposure of the staff to use of chemicals, periodic training and evaluation, and day to day management of chemical spillages [11]. Involvement in the process of safety was lacking among the students mainly due to their perception of "not an employee" and taking the laboratory postings as a part time affair. Only 35% of the study participants answered the question on NFPA diamond correctly while the percentage for GHS was 48.7%. These findings indicate the need to increase the periodicity of training on chemical safety in view of staff turnover. Abu-Siniyeh and co-workers observed that medical laboratory staff were more aware of the key aspects of laboratory safety compared to students [11].

A previous study on the knowledge of allied health science students on laboratory safety revealed moderate knowledge of students with an average score of 50% [12]. The students had had a good knowledge of safety laboratory practices, use of PPE and waste disposal but, their knowledge on chemical storage was moderate and knowledge on safety equipment and emergency procedures was poor [12]. Papadopoli *et al* in their study on chemical safety knowledge among research laboratory workers of Italy observed an overall good knowledge on hazardous chemicals by less than half of laboratory researchers (46%) and, also observed that correct knowledge was significantly more likely in younger researchers, in those handling a higher number of hazardous chemicals and in those with a higher number of years of training in the attended laboratory [13]. In this study, 92% of the study participants possessed the favourable attitude towards chemical safety. In a previous study, university students showed poor to fair attitude towards chemical safety and the attitude was not acceptable [4]. The perception of the staff or students on safety aspects plays the major role in safety practice.

The safety practice was assessed by a questionnaire. The assessment based on questionnaire showed overall chemical safety practice score of 78% indicating very good compliance. The technicians showed the best practice of chemical safety followed by interns and postgraduates (Table 4). In a study conducted on research laboratory workers, Papadopoli and co-workers observed that correct chemical safety practices were related to right attitude, adequate training and perceived exposure to chemicals [13].

The laboratory in which the present study was conducted, is accredited by NABL, is part of NABH accreditation of the hospital, periodic training on chemical safety is programmed and implemented, and also the syllabus of the university for MLT undergraduates and postgraduates has chemical safety included. These could be reasons for good knowledge, attitude, and practice of chemical safety among the study participants. The present study had the limitation of not assessing the chemical safety knowledge, attitude, and practice of staff and students working in other areas of the hospital and comparing the findings with those of laboratory staff and students posted in

the laboratory, with which the study could have become more valid. Also, the knowledge, attitude and practice of chemical safety among senior staff (>/= 10 years' experience) was not assessed in this study.

CONCLUSIONS

Knowledge, attitude, and practice of chemical safety are vital for the safe working environment in the laboratory. The chemical safety practices depend not only on the training received but, also on the experience gained in working with chemicals. Good knowledge and the right attitude promote safe working practices with regard to chemicals. Future studies involving all areas of the hospital and all categories of staff and students are required.

ETHICAL ISSUES

This research was approved by Father Muller Institutional Ethics Committee (FMIEC/CCM/471/2020; dated 12th December 2020). Voluntary informed consent was obtained from all participants.

CONFLICT OF INTEREST

None

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