

# An Assessment of the Knowledge, Attitudes Practices among Medical Laboratory Technicians on Biosafety Precautions in Selected Government Healthcare Institutions in Colombo District Sri Lanka

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## ABSTRACT

Medical Laboratory services are an essential part of the entire health system and laboratory staffs are at high risk for infections. But Sri Lanka shows lesser priority towards biosafety and biosecurity, lack of researches, training, national policies and legislation. The objective of this study is to assess the knowledge, attitudes and practices among Medical Laboratory Technicians (MLT) on biosafety precautions (BSP) in selected government healthcare institutions in Colombo district Sri Lanka. A descriptive cross-sectional study was conducted among medical laboratory technicians (MLTs) (n=315) on BSP using a pretested self-administered questionnaire. The questions were based on biosafety level of working laboratory, aerosol formation, cleaning up spills, disease transmission, international colour code of waste management and basic essentials requirements in laboratories to achieve biosafety. Attitudes were assessed by likert scale. Practices were assessed using clinical vignettes on BSP. Majority of MLTs had excellent knowledge (97.3% n=257), favourable attitude (90% n=210) and satisfactory level of practices (90.3% n=250). Satisfactory knowledge on BSP is significantly high in MLTs with less than 20 years' experience (P=0.02). Unfavourable attitude were significantly associated with MLTs over 40 years of age (P=0.01). Unsatisfactory level of practices of MLTs are significantly associated with age more than 40 years (P=0.04) and the

staff with no post graduate qualifications (P=0.04).

It is concluded that the overall knowledge, attitudes and practices of BSP among MLTT were satisfactory and the MLTT are prone to lose knowledge, attitudes and practices in time progression. This is mostly happened in Sri Lanka due to lack of new updates of professional knowledge. Therefore regular continuous professional education for MLTT are highly recommended emphasizing key areas of BSP.

**Key words:** "Knowledge ", "Attitudes", "Practices", "laboratory "and "Biosafety precautions".

## BACKGROUND

Bio safety (BS) was firstly addressed by Arnold Wedium in biological researched laboratory of US army in Fort Detrick Mayland, believed to be the father of modern BS. [1] In 1976, National Institute of Health in United States of America published the first guidelines of detailed safe microbiological practices (U.S. Department of Health and Human Services, 1999). Later in 2014, WHO guidelines were introduced to establish a safe and secure environment in and around every laboratory in the world. [2] In Asian region, India is one of the countries to establish written biosafety rules. [3] Medical Research Institute (MRI) and Castle Street Hospital

for Women (CSHW) has institutional BS committee while MRI has a focal point officer in BS. College of microbiologists prepare the manuals for medical laboratories on biosafety policy. Infection committee in each hospital have the responsibility of monitoring and evaluation of biosafety principals. [4]

Employees of clinical diagnostic laboratories are high risk of infection resulting direct contact with potential infectious material. Pathogenic microorganism can enter the employee or can release into environment causing biological hazard. [5] Laboratory services are an essential and fundamental part of all health system. [6]

The Ministry of health is the Stakeholders for bio safety and biosecurity in human health. Department of health and DDGHS (laboratory services) is the focal point for bio safety and biosecurity to the country. MRI has a focal point for bio safety and biosecurity but other institutions with clinical laboratory have not designated focal point biosafety officer. [7]

to Joint External Evaluation of International Health Regulations (JEEO IHR) revealed that Sri Lanka shows lesser priority towards biosafety and biosecurity, lack of researches, training, national policies and legislation. Further, Biosafety regulation in Sri Lanka is not documented so far. [8]

A large number of clinical laboratories are located in Colombo district reported in year 2015. (Register general department). 29% hospital beds out of entire country (8058/23388) are occupied by hospitals in western province excluding private sector. Highest percentages of investigations are done in above mentioned hospitals from entire country. Therefore this study was planned in this setting as the Colombo district which occupies 18% of entire bed strength from entire Island. [9]

Further, Sustainable Development goals (SDG) have highlighted the importance secure environment in working places. [10] The objective of this study is to

assess the knowledge, attitudes practices among Medical Laboratory Technicians (MLTT) on Bio Safety Precautions (BSP) in selected government healthcare institutions in Colombo district Sri Lanka.

## METHODS

The study was as an institution centred descriptive cross sectional study carried out from January 2018 to October 2018 using a study population of 315 MLTT working in the laboratories in the selected institutions. That included 51 MLTT from National Hospital of Sri Lanka(NHSL), 16 from Castle Street women's Hospital (CSHW), 12 from De Zoysa Maternity Hospital (DMH), 24 from Lady Ridgeway Hospital(LRH), 06 from National Eye Hospital (NEH), 12 from Infectious Disease Hospital (IDH), 33 from Sri Jayawardenepura General Hospital (SJGH), 36 from Apeksha Hospital Maharagama (AHM), 34 from Colombo South Teaching Hospital(CSTH), 06 from national Institute of Mental Health(NIMH), 06 from Mulleriyawa Base Hospital(MBH), 12 from Avisawella Base Hospital(ABH), 05 from Homagama Base Hospital(HBH) and 62 from Medical research Institute (MRI). MLTT working on permanent or temporary basis in the laboratories were selected as the potential participants. All MLTT on leave, released for training or not attending the duty during the study period were excluded from the study.

**Questionnaire** A structured self-administered questionnaire was developed using WHO biosafety manuals with the assistance of the experts. The questionnaire consisted of four parts. First part consisted with Socio demographic profile of MLTT such as Age, Gender, Ethnicity , Religion, Marital status, Highest educational qualification, Working place, Current position, Years of work experience in a laboratory, Years of experience at current section and Current section of work. The 2nd part consisted with 32 questions to assess the knowledge among MLTT on biosafety based on biosafety level of

working laboratory, aerosol formation, cleaning up spills, disease transmission, international colour code, and basic essentials requirements in laboratories to achieve biosafety. The 3rd part of the questionnaire was to assess the attitude level among Medical laboratory technicians on biosafety precautions. The 4th part consisted with three case scenarios or clinical vignettes to assess the practices. The “Vignettes are a valid tool for measuring the quality of clinical practice”.<sup>[11]</sup> These case scenarios which assessed biosafety practices were designed to imitate a real situation of a laboratory with real imagination of the incidence. The content validity of the questions and case scenarios were archived with the support of the consultant microbiologist who is the biosafety focal point to MRI, consultant haematologist DMH and a consultant in Medical Administrator and using WHO biosafety manuals. The questionnaire was Pre tested before use.

**Data collection** The Primary data collection was done by the principle investigator (PI) and an MBBS qualified medical officer. Ethical clearance and Administrative clearance was obtained prior data collection from institutional heads. With the intention of securing the accuracy of data, all data collection sessions were participated and lead by PI.

#### **Data Analysis**

Most of the questionnaires were formulated as stem framed questions. The questions were categorized as “Must Know”, “Better to know” and “Nice to know” questions which were given three, two and one mark respectively. The total cumulative mark score was calculated. The wrong answers and unknown answers were given no marks. The aggregation of all “Must Know” questions was the cut-off point to categorize the satisfactory and unsatisfactory knowledge.

There were nine attitudinal questions set to assess attitude of MLTT. Some were negatively phrased to avoid mechanical response and to assure thoughtful response from selected population. The six point Likert scale was used and MLTT had to decide on single response from Strongly Agree, Agree, and Slightly Agree, Slightly disagree, Disagree and Strongly Disagree. One individual should at least slightly agree for a positively framed question and slightly disagree for negatively framed question which carry 4 marks per each. The cut-off points to categorize favourable and unfavourable attitudes were categorized accordingly.

Three clinical vignette were used as in questionnaire<sup>[11]</sup> for assessment of practices. There were “must do”, “better to do” and “good to do” practices which carry 3, 2 and 1 marks respectively. This categorization done according to expert opinion using guidelines. Aggregation of marks of “must do practices” were taken to decide the cut-off mark to categorize satisfactory and unsatisfactory practices. The association of knowledge, attitudes, and practices with socio demographic variables was analysed using Chi square testing. Fishers’ exact test was used when numbers were small. A probability rate of less than 0.05 is considered as significance.

## **RESULTS**

Majority of MLTT are female (68.5% n=176). 26.1% (n=67) of MLTT are in age 21-30 years category and 20.6% (n=53) are above 51 years. Majority of MLTT were Sinhalese (92.6% n=229) and most of them were Buddhist (89.1% n=229). Overall response rate is 80.64%. 36.40% of MLTT are graduated and 62.10% of MLTT had diplomas. Of the participants, 0.8% of MLTT had the maximum qualification GCE ordinary level.

| Level of Performance          | Knowledge   | Attitudes | Practices   |
|-------------------------------|-------------|-----------|-------------|
| Unsatisfactory(Un favourable) | n=7,2.7%    | n=21,10%  | n=25,9.7%   |
| Satisfactory (Favourable)     | n=250,93.3% | n=189,90% | n=232,90.3% |

| Question  | Correctly answered |      |
|---|--------------------|------|
|   | No                 | %    |
| Q1 Identification of biohazard sign                                       | 239                | 93.0 |
| Q2 Identification of sample as potential source of infection              | 254                | 98.8 |
| Q3 Identification of correct Biosafety level of laboratory                | 105                | 40.9 |
| Q4 Knowledge about aerosol producing procedures                           |                    | 72.2 |
| Heating a wire loop   | 142                | 55.3 |
| Washing hand  | 137                | 53.3 |
| Pipetting   | 146                | 56.8 |
| Making smear  | 209                | 81.3 |
| Opening culture   | 236                | 91.8 |
| Streaking agar plates   | 196                | 76.3 |
| Centrifuging  | 218                | 84.8 |
| Record keeping  | 197                | 76.7 |
| Serum separation  | 197                | 76.7 |
| Q5 Knowledge about chemical used to clean blood spills                    |                    | 55.7 |
| Freshly prepared 1% hypochlorite solution                                 | 237                | 92.2 |
| Freshly prepared 0.5% phenol  | 81                 | 31.5 |
| Soap and water  | 153                | 59.5 |
| Lysol   | 102                | 39.7 |
| Q6 Knowledge about activities shouldn't be done in laboratories           |                    | 73.0 |
| Drinking water  | 213                | 82.9 |
| Having lunch  | 231                | 89.9 |
| Wearing home cloths   | 178                | 69.3 |
| Writing reports   | 199                | 77.4 |
| Applying cosmetics  | 222                | 86.4 |
| Reading newspapers  | 83                 | 32.3 |
| Q7 Knowledge about waste bin color codes                                  |                    | 82.4 |
| Infectious Sharps   | 176                | 68.5 |
| Blood sample  | 220                | 85.6 |
| Contaminated gloves   | 226                | 87.9 |
| Broken plain slides   | 225                | 87.5 |
| Q8 Knowledge about essential requirements to achieve laboratory biosafety |                    | 72.5 |
| Access only to the authorized people                                      | 249                | 96.9 |
| Locate close to OPD, Clinic and ward                                      | 86                 | 33.5 |
| Self-closing doors  | 210                | 81.7 |
| Biosafety sign pasted at the entrance                                     | 231                | 89.9 |
| Emergency eye wash facility   | 239                | 93.0 |
| High tech analysers   | 103                | 40.1 |

### **Knowledge on BSP**

The mean knowledge is 75.08% (SD=12.32) and majority of MLTT had satisfactory knowledge (97.3% n=250) (Table 1). Majority of MLTT ranging from 72.2%- 98.8% have correctly answered for the questions on BSP. Knowledge on correct Biosafety level of laboratory is 40.9%(n=105) while relatively average amount of people have correct knowledge of aerosol producing procedures such as Heating a wire loop(55.3%, n=142), Washing hand(53.3%, n=137), Pipetting(56.8%, n=146). Knowledge about aerosol producing procedure which is washing hands was correctly answered by 31.5%(n=81). Knowledge about the activity of not reading newspapers in laboratories was correctly answered by 32.3%(n=83).33.5%(n=86) of MLTT think that Laboratory shouldn't locate close to OPD, Clinic and ward and 40.1%(n=103) think that high tech analysers not essential to archive BSP. Satisfactory Knowledge on BSP was significantly higher in MLTT with < 20 years' experience (Fisher's Exact Test=0.02). But there is no significant association noted with age, gender, and post-graduation.

**Table 3: - Frequency distribution of MLTs on different aspects of attitudes on biosafety precautions**

| NO | Statement  | Favourable Attitudes |       |
|----|--|----------------------|-------|
|    |  | No                   | %     |
| Q1 | Hand washing is effective method of bio safety practice.               | 253                  | 98.44 |
| Q2 | PPE protect me from infection  | 213                  | 82.87 |
| Q3 | Taking lunch inside the laboratory room is acceptable*                 | 245                  | 95.33 |
| Q4 | Cutting finger nails inside the laboratory is safe*.                   | 214                  | 83.26 |
| Q5 | Wearing of hand gloves is necessary.                                   | 254                  | 98.83 |
| Q6 | Laboratory should be place closer to the Patient Care Centres and OPD* | 82                   | 31.57 |
| Q7 | Maintain records on injury/accident is important                       | 234                  | 91.05 |
| Q8 | Willingness to attend training programs on bio safety                  | 237                  | 92.21 |
| Q9 | Guidelines on bio safety are very useful.                              | 241                  | 93.77 |

\*Negatively framed questions

### Attitudes on BSP

Majority of MLTT (90% n= 189) showed favourable attitudes towards biosafety precaution (Table 1). About one third of the participants had an idea that laboratory shouldn't be placed closer to the Patient Care Centres and OPD(Table 3). According the table 4.5 unfavourable attitude of MLTT were significantly associated with age of over 40 years of service (P=0.01).

**Table 4 :-Frequency distribution of Laboratory workers on different aspects of Practices on biosafety precautions**

| Biosafety Practice  | Correctly answered |       |
|---|--------------------|-------|
|   | NO                 | %     |
| <b>Case scenario -1</b>   |                    |       |
| You receive a sample of blood at your laboratory. While you prepare slides blood spilled at your eyes and floor |                    |       |
| 1. You may wash your eyes with running water.   | 250                | 97.3% |
| 2. You may write the incidence at accident record register  | 209                | 81.3% |
| 3. Soak the floor with freshly prepared 1% hypochlorite solution and leave for at least 30 minutes              | 240                | 93.4% |
| 4. Only mop up with absorbent material/Mopping brush.   | 173                | 62.3% |
| 5. Cover spill with wadding   | 149                | 58.0% |
| <b>Case scenario -2</b>   |                    |       |
| You receive a sample of blood of a 45 years old patient from surgical ward?                                     |                    |       |
| 1. You may wear double gloves   | 169                | 65.8% |
| 2. You may wear sterile gloves  | 58                 | 22.6% |
| 3. You may wear gown  | 202                | 78.6% |
| 4. You may wear goggles   | 82                 | 31.9% |
| 5. You may wear hair cover  | 47                 | 18.3% |
| 6. You may wear boot  | 53                 | 20.6% |
| <b>Case scenario -3</b>   |                    |       |
| You get sample of blood from a 5 years old child from a paediatric ward. When you prepare slides                |                    |       |
| 1. You may do mouth pipetting in times  | 240                | 93.4% |
| 2. While centrifuging you may cover the sample and the machine  | 188                | 73.2% |
| 3. You may use standard operation procedure for testing   | 241                | 93.8% |

### Practice on BSP

**Table 5 :- Factors associated with level of knowledge (n=257)**

| Factor        | USK |     | SK  |      | P    | UFA |      | FA  |      | P    | USP |     | SP  |      | P    |
|---------------|-----|-----|-----|------|------|-----|------|-----|------|------|-----|-----|-----|------|------|
|               | No  | %   | No  | %    |      | No  | %    | No  | %    |      | No  | %   | No  | %    |      |
| <b>Gender</b> |     |     |     |      |      |     |      |     |      |      |     |     |     |      |      |
| Male          | 2   | 2.5 | 79  | 97.5 | 0.61 | 3   | 0.06 | 49  | 94.2 | 0.29 | 9   | 11  | 72  | 88.9 |      |
| Female        | 5   | 2.8 | 171 | 97.2 |      | 18  | 0.11 | 140 | 88.6 |      | 16  | 9.1 | 160 | 90.9 | 0.77 |
| <b>Age</b>    |     |     |     |      |      |     |      |     |      |      |     |     |     |      |      |
| <40           | 1   | 0.8 | 130 | 99.2 | 0.06 | 5   | 0.05 | 102 | 95.3 |      | 8   | 6.1 | 123 | 93.3 |      |
| >40           | 6   | 4.8 | 120 | 95.2 |      | 16  | 0.16 | 87  | 84.5 | 0.01 | 17  | 13  | 109 | 86.5 | 0.04 |
| <b>EXP</b>    |     |     |     |      |      |     |      |     |      |      |     |     |     |      |      |
| <20           | 2   | 1.1 | 183 | 98.9 | 0.02 | 19  | 0.12 | 139 | 87   | 0.11 | 21  | 11  | 164 | 88.6 |      |
| >20           | 5   | 6.9 | 67  | 93.1 |      | 2   | 0.04 | 50  | 96   |      | 4   | 5.6 | 68  | 94.4 | 0.13 |
| <b>APG</b>    |     |     |     |      |      |     |      |     |      |      |     |     |     |      |      |
| Yes           | 6   | 2.4 | 246 | 97.6 | 0.1  | 1   | 0.33 | 2   | 66.7 | 0.27 | 23  | 9.1 | 229 | 90.9 | 0.04 |
| No            | 1   | 25  | 3   | 75   |      | 20  | 0.1  | 186 | 90.3 |      | 2   | 50  | 2   | 50.0 |      |

USK-Unsatisfactory Knowledge; SK-Satisfactory Knowledge; UFA- Unfavourable Attitudes; FA-Favourable Attitudes; USP-Un Satisfactory Practices; SP-Satisfactory Practices; APG-Availability of Post Graduate Qualifications; EXP-Years of Experience; P- P value

The mean practices score is 67.32(SD=14.829). According to Table1, majority of MLTT had satisfactory level of practices (90.3% n=232). The clinical vignette and the responses of MLTT are described in table 4. In case scenario 2, wearing gloves(31.9%, n=58), wearing goggles (31.9%, n=82), wearing hair covers(18.3%, n=47) and wearing boots (20.6%, n=53) on blood sample handling has been identified as good practices by minority of the MLTT. The age Less than 40 years (P=0.04) and having a post graduate qualification (p=0.04) is significantly associated with the satisfactory level of practices of MLTT.

## DISCUSSION

Majority of MLTT had overall satisfactory knowledge of 97.3% (n=250). According to a cross sectional survey done among 19 laboratory technicians in Maharashtra province India in 2013 the overall average knowledge on BSP was found 75%. [12] But the outcome of this study is more accurate than the Indian study due to more representative higher number of sample size.

Only 40.9% (n=105) of MLTT had sound knowledge on, BS level their laboratories. Most hazardous incidences often occur due to lack of knowledge in the pathological condition of the sample. Considerable number of MLTT (27.7% n=69) did not know the aerosol producing procedures. Considerable number of MLTT (44.3%, n=163) do not know about chemicals used to clean blood spills. This may be associated with non-availability of SOPs in most of the institutions. A cross sectional study done in Karachi Pakistan among 253 laboratory technicians in 2008 revealed that 73.9 % (n=253) of laboratories are operated without written SOPs. [13]

Of all MLTs 17.1 % ( n=44) used to store and drink water inside the laboratory and 10.1 % (n=26) do not understand the risk of taking lunch inside the laboratory. In the same cross sectional survey done in Karachi, Pakistan 15% of lab workers did

not have the knowledge on the risk of having meals inside the laboratory. [14] Nearly one third of the MLTT (31.5 %, n=176) did not have sound knowledge on disposal of infectious sharps (Table 2). This shows poor knowledge on MLTT on important particular BSP. The knowledge on bio safety precautions is significantly high in MLTT less than 20 years of experience may reflect that newly passed out MLTT have more knowledge than others. This brings a notice of starting Continuous professional education for the medical professionals for updating their professional knowledge.

The overall attitude of MLTT was favourable at a level of 90% (n=210) on BSP (Table 3). Favourable attitudes positivity associated with the age less than 40 years (P=0.01). Continuous professional development (CPD) of the MLTs would be helpful to achieve accepted level of attitudes especially those age is more than 40years. In cross sectional survey done in Maharashtra India among 19 of laboratory technicians revealed that score of attitudes of laboratory technicians in pathology biochemistry and microbiology laboratories were 16.7%, 12.5%, 100% respectively. The cumulative percentage was 43.07% and the difference in attitude level in two studies may be due to sample size variation in two studies. [12]

An interventional survey was done among 80 laboratory personals in Malaysia in 2013, revealed high attitudinal score on occupational safety 78.8 % ( n=156) people similar to this study. [15]

Assessment of practices was carried out using the clinical vignettes which offer natural case demonstrations to simulate real situation of incident. [11] The practices of majority of MLTs are at a satisfactory level (90.3% n=257).

42.0%(n=108) MLTs do not practice to cover blood spills with wading which is considered as a method of reducing aerosol formation which bring the lab workers more vulnerable on infections. Wearing of personal protective equipment was found considerably poor among MLTT (22.6%-

31.9%) (Table 4). A cross sectional survey done in Yemen among 385 laboratory staff in 2015 revealed that only 32% (n=123) of workers had good safety practices.<sup>[16]</sup> But a across sectional study done among 230 employees in US army laboratories in Kenya, wearing of personal protective equipment like gowns, face shield, and goggles was 100 %.<sup>[17]</sup> This may be due to strict regulation of laboratories by US government. Unsatisfactory level of practices are significantly associated with age more than 40 years (P=0.04) and the staff with no post graduate qualifications (P=0.04). This concludes that CPD programs throughout the service period will improve the level of practices of BSP. Encouraging and motivation towards post-graduation and professional development may give positive impact towards the good practices of BSP. Heavy work load of MLTT during assessment, assessment of practice thorough clinical vignettes were limitations encountered during the research work.

## CONCLUSIONS AND RECOMMENDATIONS

The overall knowledge, attitudes and practices of BSP among MLTT were satisfactory. But some knowledge components such as aerosol producing procedures, some practices which shouldn't be done within laboratories and idea of locating a laboratory were poor among MLTT. The usage of personal protective equipment was found very poor among MLTT. Unsatisfactory knowledge was significantly higher in MLTT over 20 years' experience, unfavourable attitudes and unsatisfactory practices significantly associated with age of over 40 years of service. Further unsatisfactory practices were significantly high in those who don't have post graduate qualifications. Therefore it is evident that the MLTT are prone to lose knowledge, attitudes and practices when the time is progression. This is mostly happened in Sri Lanka due to lack of new updates of professional knowledge. Therefore regular

continuous professional education for MLTT are highly recommended emphasizing key areas of BSP.

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How to cite this article: Abhayaratne AJ, Samarasinghe YJ, Francis, UMGS et.al. An assessment of the knowledge, attitudes practices among medical laboratory technicians on biosafety precautions in selected government healthcare institutions in Colombo district Sri Lanka. *International Journal of Science & Healthcare Research*. 2020; 5(1): 78-85.

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