

Assessment of Training on Culture and Drug Sensitivity Testing of *Mycobacterium tuberculosis* at a National Reference Laboratory

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Abstract

Background: Information on assessment and reporting of knowledge of trainees on solid culture and drug susceptibility testing of *Mycobacterium tuberculosis* after attending training program is not available in India.

Objective: To assess pre and post-test knowledge of trainees attending culture and drug susceptibility testing training programme in solid culture method

Methods: A total of 131 trainees in 26 batches were given a questionnaire before start of and at end of the training programme conducted between 2009-2015 at National Institute for Research in Tuberculosis, Indian Council of Medical Research, Chennai, India. The observed differences in mean scores in pre and post-tests between and within the groups on different subjects were tested by t-test.

Results: The average scores obtained by 131 trainees in pre and post-test were 64.18% and 87.97% respectively and the difference was significant ($p < 0.01$). The pre and post-test marks, obtained by the groups with higher and lower qualification and groups with more than 3 and less than 3 years of experience were significantly different with respect to biosafety procedures.

Conclusion: The knowledge of trainees improved significantly by the training programme. The computation and critical review of scores in training programmes can be made mandatory to assess trainees and facilitators for meaningful resource management.

Keywords: Pre-test; Post-test; Questionnaire; Training programme; NRL

Introduction

India accounts for one fourth of the global TB burden. In 2015, an estimated 28 lakh cases occurred and 4.8 lakh people died due to TB. The incidence of TB has reduced from 289 per lakh per year in 2000 to 217 per lakh per year in 2015 and the mortality due to TB has reduced from 56 per lac per year in 2000 to 36 per lac per year in 2015 [1]. Imparting appropriate training by the supervising National TB Reference Laboratories (NRL) to medical laboratory technologists is very important for the proficient performance of Intermediate TB Reference Laboratories (IRL) at the province level. In India, Six NRLs supervise the activities of 64 IRLs which includes accredited laboratories in public and private Medical Colleges and medical diagnostic centres, who provide support to the Revised National Tuberculosis Control Program (RNTCP) [2]. They organise periodic training to TB programme staff on external quality assessment of sputum microscopy, and culture and drug susceptibility test (DST) of *M. tuberculosis* using solid culture, liquid (Mycobacterial Growth Indicator Tube 960 system) culture and molecular methods for first and second line anti-TB drugs. The trainees include state TB officers, Directors of State TB Demonstration and Training Centres (STDC), Microbiologists of IRLs, Senior Tuberculosis Laboratory Supervisors

(STLSs) and laboratory technicians (LT). Though NRLs conduct regular training programmes on culture and DST, the training practices are not systematically documented and reported. National Institute for Research in Tuberculosis (NIRT) (Indian Council of Medical Research), Chennai is one of the NRLs in India and is also an accredited supra-national reference laboratory for TB under global supra-national TB reference laboratory network. It has been executing the duties of NRL and in addition it has documented the data on training practices on culture and DST programmes conducted over the last few years. Its experience in assessing the knowledge of trainees on conventional bacteriological culture and DST methods is presented and discussed in this paper.

Methods

The 131 trainees were from Microbiology Departments in Medical Colleges, RNTCP accredited IRLs, private medical diagnostic laboratories, and NRLs of Thailand, Sri Lanka, Myanmar and Ethiopia. They were RNTCP Consultant Microbiologists, Assistant Professors of Microbiology, Scientists, Senior Laboratory Technicians at IRLs and Laboratory Technical Assistants. The mean age of the trainees was 31 years. There were 70 males. Ninety one of the trainees had graduate degree (B.Sc) along with/without Certificate in Diploma in Medical Laboratory Technology and 40 with Doctorate/post-graduation in Microbiology (M.D/M.Sc/Ph.D). Fifty of the trainees were from

private sector laboratories and 81 from public sector laboratories. Fifty three of them had more than three years of experience and 78 of had less than three years of experience in TB laboratories/other medical diagnostic laboratories.

A 10 day scheduled training, following RNTCP recommendations, on culture and DST of *M. tuberculosis* using solid Lowenstein Jensen (LJ) medium was imparted at NIRT. The trainees were provided with details of training schedule and a training Manual on M tuberculosis Culture and DST (Central TB division, Ministry of Health and Family welfare, New Delhi, India) [3]. The training curriculum consisted lectures in the mornings followed by hands-on practical classes on culture techniques for isolation of *M. tuberculosis*, DST and identification of *M. tuberculosis* procedures in the afternoons. Power point presentations were used extensively to encourage interactive sessions. The content of the manual was read by trainees with appropriate explanations by trained facilitators where required.

As part of the training, a pre-test was conducted using a structured questionnaire, before starting the training programme. The questionnaire consisted of 50 multiple choice questions (MCQ) covering knowledge on *M. tuberculosis*, processing of biological specimens for culture of *M. tuberculosis*, identification of *M. tuberculosis*, DST methods, quality and performance indicators to be monitored in IRLs, and maintenance and biosafety practices in TB laboratories. Trainees were allowed 50 minutes to complete the questionnaire under supervision. The same questionnaire was given to the trainees at the end of the training. The key answers to the questions were discussed with the trainees. The answers of pre and post-test questionnaires were checked by senior laboratory technicians who were qualified with a master degree in Microbiology with 3 years of service. The scorings were finally verified and documented by RNTCP Consultant Microbiologists qualified with a doctoral degree. The trainers were certified with Training of Trainers (TOT) in *M. tuberculosis* Culture and DST methods.

Statistical analysis

A retrospective analysis of the performance of the trainees from consecutive 26 batches, conducted between July 2009 and February 2015, was undertaken. Data was entered and analyzed using SPSS statistical software (version 16). Each question carried 2 marks. A paired t-test was performed to compare the mean scores obtained by different groups like working sector, experience and qualification of trainees and for different subjects pertaining to general knowledge, Culture method, Identification procedures Drug susceptibility test, Qualitative indicators, Performance indicators and Biosafety were calculated. The observed differences in mean scores between the

groups and within the groups were tested for statistical significance by t-test and p value less than 0.05 was considered significant.

As this study was a retrospective analysis of performance of trainees in a training programme the ethical clearance was not sought from the Institute Ethics committee.

Results

The pre-test and post-test mean scores obtained by all the 131 trainees respectively was 61.51% and 85.56% (Table 1) and the observed difference attained statistical significance (P<0.01). The mean scores in different subjects by different categories of trainees in pre and post-tests are given in Table 2. The pre and post-test marks, obtained by the groups with MD/M.Sc/Ph.D qualification (66.4%, 86.0%) and the group with B.Sc with/without diploma in Medical Laboratory Technology qualification (55.3%, 79.4%), and groups with more than 3 (59.3%, 81.1%) and less than 3 years of experience in medical diagnostic laboratories (57.3%, 78.1%), were significantly different between the comparable groups, with respect to biosafety procedures and no statistical difference is observed in knowledge, Culture method, Identification procedures Drug susceptibility test, Qualitative indicators, Performance indicators (Table 2).

Category	Number of Trainees	Pre-test	Post-test
Sector	81	59.92	85.64
Public sector	50	61.91	86.30
Private sector			
Experience	53	62.19	86.24
>3 years	78	60.25	83.72
<3 years			
Qualification	40	65.80	87.52
MD/M.Sc/Ph.D	91	59.04	83.97
Degree with/without DMLT			
	131 (total trainees)	61.16 (mean)	85.56 (mean)

*Post-test scores are significantly different from pre-test scores in all six categories

Table 1: The mean scores in percentage obtained by different groups of trainees in pre and post-tests.

Subject	Test	Group (No. of trainees)					
		Public sector (81)	Private sector (50)	More than 3 Yr experience (53)	Less than 3 Yr experience (78)	MD/M.Sc/Ph.D (40)	BSc without DMLT (91)
General knowledge on TB	Pre	72.8	73.8	74.0	72.7	76.8	71.6
	Post	91.4	90.8	91.3	91.0	94.3	89.8
Culture method	Pre	65.7	67.2	67.2	64.5	72.0	62.7
	Post	88.8	88.1	88.1	86.0	88.0	86.4

Identification procedure	Pre	60.7	58.2	58.2	60.9	64.8	57.6
	Post	89.7	88.7	88.7	88.8	90.8	87.8
Drug susceptibility test	Pre	60.5	63.8	63.8	60.0	67.5	58.9
	Post	88.9	91.3	91.3	86.7	91.0	87.5
Quality Indicators	Pre	34.6	35.4	35.4	37.8	38.1	36.3
	Post	65.4	66.0	66.0	61.9	66.3	62.4
Performance Indicators	Pre	69.1	77.3	77.4	68.6	75.0	70.9
	Post	94.5	97.3	97.2	93.6	96.3	94.5
Biosafety	Pre	56.1	57.7	59.3*	57.3*	66.4*	55.3*
	Post	80.8	81.9	81.1*	78.1*	86.0*	79.4*

*The post-test and pre-test marks in maintenance and biosafety are significantly lower in trainees with less than of 3 years experience, trainees with graduate and diploma in DMLT than with trainees having more than 3 year's experience and trainees with MD/PhD

Table 2: The mean scores in percentage obtained by different groups of trainees in different subjects.

Discussion

The significant increase in the post-test scores (85.56%) obtained by the trainees and hence their knowledge could be attributed to the systematic training schedule, authentic conduct of modular reading and practical sessions, in addition to the extensive power point presentations on the subject matter and on the spot discussions with the trainees by experienced facilitators. Earlier studies in other training programmes had shown that use of power point presentations as a tool to provide educational intervention have significantly improved the post-training knowledge among the trainees [4-9].

A mean score of 61.51% obtained by the trainees even before start of the training might be due to the experience many of them had in TB laboratories. Most of the trainees, by the time they are nominated for the training, had undergone some experience at the IRLs. The significantly higher scores obtained, for the section-biosafety procedures, by the post-graduates over the undergraduates, both in pre (66.4% vs 55.3%) and post-test scores (86.0% vs 79.4%), could be due to their greater understanding of the subject matter and the responsibilities they own in those areas. The corollary could be the complacency of the undergraduates/subordinate staff as the subject matter did not come under their domain and so would not have attempted to understand in full.

It is mutually beneficial to the trainees and facilitators if the performance of trainees are reviewed before and after training. In general, investigation on training and analysis of data generated during the training have not been made mandatory for review of the performance of the facilitators and trainees. It has to be noted that knowledge gained in the training does not necessarily reflect the attitude and practice of the trainees in their home laboratories. Nevertheless, the performance and quality indicators in the trainees' laboratories can be monitored periodically, after imparting training, to assess the usefulness of the knowledge gained in the training programme.

It can be pointed out that the facilitators might have exhibited their highest enthusiasm to improve the knowledge of the trainees.

However, it can be countered that it is the trainees who had to be diligent in the teachings/training to acquire more knowledge.

In Conclusion, the knowledge of trainees improved significantly by the training programme. The results suggest that instant computation and analysis of performance data can be made mandatory to assess trainees and facilitators for meaningful resource management by TB programme managers.

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