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Factors affectinsg the utilization of Xpert MTB/RIF assay among TB clinic health workers in Addis Ababa

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ABSTRACT

Introduction: The diagnostic accuracy of Xpert MTB/RIF is well documented but underutilization is a major challenge in most high burden countries. This appears to be linked with insufficient knowledge of health professionals of using the tool. However, this has not been well studied.

Objective: Our objective was to assess the knowledge of health professionals on Xpert MTB/RIF assay and associated factors in detecting TB/TB drug resistance.

Methods: An institution based cross–sectional study was conducted from April 4 to June 5, 2015, in Addis Ababa that involved 209 healthcare providers working in TB clinics. Structured questionnaire through self-administered interview technique was used to collect the data. We asked them about Xpert on whether they are aware of its place in TB diagnosis, when and for whom it shall be used, its role in treatment monitoring, result interpretation and patient's registration that are diagnosed by Xpert MTB/RIF. We used binary logistic regression analysis to identify associated factors. Odds ratio with 95% CI was computed to assess the strength of the associations.

Results: Of the 209 participants interviewed, the majority 151 (72.2%) were nurses. More than a half of the respondents 114 (54.6%) had poor knowledge. Health professionals with age above 35 years (AOR = 6.253, 95% CI (1.1995, 19.604)) and those who read the Xpert guideline (AOR = 4.231, 95% CI (2.011, 8.900)) were more likely to have good knowledge on Xpert.

Conclusion and recommendation: This study revealed that the overall magnitude of knowledge status was found to be low. Health workers above 35 years and those who read the guideline on Xpert had higher knowledge status on Xpert. Distribution of national guideline on Xpert and assigning experienced clinicians in TB DOTs clinics are recommended.

1. Background

Despite control efforts since 1960s, Tuberculosis (TB) remains one of the major unresolved health problems in Ethiopia. The country is among the 30 high TB/ Multidrug resistant TB (MDR-TB) burden countries (HBCs) [1]. According to a report by the Federal Ministry of Health, TB is the sixth cause of mortality in Ethiopia [2].

Timely identification and appropriate treatment of infected patients is the key to controlling the global hazard of TB and drug resistant-TB transmission [3]. Health care providers play a major role in this respect. It is well known that, as most sub-Saharan countries do, the Ethiopian TB control program is mainly dependent on AFB smear microscopy in diagnosing TB. Advanced diagnostics such as culture and other robust molecular tools are limited to central or regional facilities and are inaccessible to the majority of patients [4]. But now this is changing; Xpert MTB/RIF is now recommended as a primary test in sites where the instrument is available.

The inefficiency of AFB smear microscopy in detecting most TB cases and the toll that is brought by HIV/AIDS and TB drug resistance particularly MDR-TB is being addressed aggressively by the government of Ethiopia [5]. As part of this task, MDR-TB treatment initiation and follow-up centers were established in most of the regions. Side by side, culture facilities were established in the regions. The national TB control program started implementing the Xpert MTB/RIF platform in 2012 and adopted the guideline in 2014 [6]. Health facilities in Addis Ababa are one of the beneficiaries of this opportunity. Implementation and

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efficient utilization of new diagnostics such as Xpert, however, requires the right knowledge by all stakeholders involved in the control efforts of TB and drug resistant TB. A report by MOH, indicated that Xpert utilazation rate in Addis Ababa to be 35% which is a bit higher than the national [25%) (Annual review meeting report July 2016). However, this has likely changed. In fact the utilisation rate nationwide has jumped to 61% nationally.

Literatures on knowledge of specific TB diagnostics are lacking. However, there are studies conducted in Ethiopia and other countries which looked into the overall knowledge of healthcare providers on TB and TB management. Many of them reported the poor knowledge of healthcare providers on TB and national guidelines resulted in a poor case management [7–10]. A more pronounced knowledge gap was observed among private healthcare professionals of developing countries [11,12].

Despite the placement of Xpert MTB/RIF instruments, there was no study conducted on how this tool is being utilised: whether the healthcare professionals are aware of its place in TB diagnosis, when and for whom it shall be used, its role in treatment monitoring, result interpretation and patient's registration that are diagnosed by Xpert MTB/RIF etc. Knowledge gaps on such aspects would pave way for its underutilisation and improper use.

Therefore, our objective was to assess the knowledge of health professionals regarding the role of Xpert MTB/RIF assay in TB diagnosis and drug resistance. We also assessed factors associated with the knowledge status of health professionals working at 103TB clinics and involved in making a diagnosis and initiate treatment of TB in Addis Ababa regarding Xpert MTB/RIF assay.

2. Materials and methods

2.1. Study design and setting

An institution based cross sectional study was conducted in Addis Ababa city health facilities from April 9 and June 4, 2015.

The study was conducted at 103 (67 Public and 36 private) TB clinics that are under the Addis Ababa city administration health bureau. According to Addis Ababa city administration health bureau, there are 68 public and 39 private DOTs providing health facilities in Addis Ababa. On average, there are 2 health professionals working in one health facility.

All healthcare providers involved in clinical practice at health facilities in Addis Ababa served as source population.Our study population were health professionals in TB clinics who deliver care and treatment services for TB patients in Addis Ababa city administration. All health professionals working at TB clinics and involved in making a diagnosis and initiate treatment of TB during the time of data collection were included.

According to the national TB guideline, clinicians order the Xpert test while the test is performed and reported by the lab technician/technologist. The final decision to put the patient on treatment is made by the clinician.

2.2. Data collection procedure

A self-administered structured questionnaire adapted from reviewing different literatures and guidelines was used to collect the data. The questionnaire has socio-demographic, knowledge and few practice related questions to identify the importance and possible challenges. The questionnaire was pretested and revised for clarity and accuracy prior to study implementation.

2.3. Data quality control

Information regarding the importance of the study and how to properly answer the questions was introduced to the respondents by the supervisors before data collection. The returned questionnaires were checked daily for completeness by the supervisors and the principal investigator. Descriptive statistics was performed to handle incorrectly coded data, missing values and outliers.

2.4. Data processing and analysis

Each completed questionnaire was checked for completeness before data entry manually. Then the data was coded & entered in to a computer by using EPI info version 7 and clean-up was made to check accuracy, consistency. Any error identified was corrected. Finally, data was exported to SPSS version 20 for further clean up, recoding and analysis.

Data analysis was done by using SPSS version 20. Crude and adjusted odds ratios with 95% CI were calculated to determine the strength of association between response variable and predictor variables. P-value less than 0.05 was considered as a level of significance. Descriptive and summary statistics were employed.

Crude odds ratios (COR) with 95% confidence intervals (CI) were calculated using bivariate logistic regression analysis. Variables having p-value of less than or equal to 0.2 (to control the possible confounder) were fitted to multivariate logistic regression so as to assess the presence and strength of association. Hosmer–Lemeshow goodness-of-fit test was used to check the assumption of the model.

2.5. Operational definition

Knowledge on Xpert MTB/RIF assay: health workers' knowledge/knowing about Xpert MTB/RIF assay, its use in detecting TB and drug resistance, what specimen is used to detect TB, the patients eligible to be diagnosed by Xpert MTB/RIF, the TB/MDR-TB diagnostic algorithm that includes Xpert MTB/RIF and the specimens used for the test knowledge related question was asked and a right answer was given a value of 1 and a value of 0 for those incorrect answers. The score was classified into 2 levels according to the Blooms' cut off point, as follows: Good knowledge $\geq$60% and Poor knowledge $<$60%.

2.6. Ethical consideration

Ethical clearance was obtained from the University of Gondar Research and Ethics Committee and Addis Ababa Regional Health Bureau Ethics Committee. Furthermore, letters of support addressed to health offices of the ten sub cities and the study sites were obtained from Addis Ababa regional health bureau and the respective health offices of sub cities, respectively. Consent was obtained from the study participants. Confidentiality was ensured by eliminating personal identifiers from study questionnaires.

3. Results

3.1. Socio-demographic characteristics of participants

The study involved 209 health professionals who were working in TB DOTs clinics and involved in making a diagnosis and initiate treatment of TB with a response rate of 97.7%. The participants were from 103 (36 private and 67 public) DOTs providing health facilities of Addis Ababa city administration.

Majority, 151 (72.2%) of the participants were nurses by profession of which 119 (79.3%) had Diploma and 32 (21.2%) had Bachelor of Science degree. The median (± SD) age of the participants was 28 (8.35%) with a minimum of 20 and maximum of 60 years old.

The majority of respondents, 138 (66%) were from public health facilities. Over half of the study participants 107 (51.2%) had less than one year experience of working in TB clinics. Ninety six (45.9%) of the study participants were trained on TB in which Xpert was included as one of the training component (Table 1).

Table 1
Distribution of the respondents by socio-demographic characteristics.

Variables	Characteristics	Number (N = 209)	Percentage (%)
Facility type	Private	71	34.0
	Public	138	66.0
Age	20 to 24	42	20.1
	25 to 29	87	41.6
	30 to34	32	15.3
	35+	48	23.0
Sex	Male	100	47.8
	Female	109	52.2
Level of Educati-on	Diploma	119	56.9
	Degree and above	90	43.1
Profession	Nurse	151	72.2
	Health officer	41	19.6
	Pharmacist + Physician + Public Health Specialist	17	8.1
Years of service	1 to 3 years	66	31.6
	4 to 6 years	74	35.4
	Above 6 years	69	33.0
TB related years of service	Less than 1 year	107	51.2
	2 to 3 years	49	23.4
	Above 3 years	53	25.4
Training on Xpert	No	113	54.1
	Yes	96	45.9

3.2. Xpert awareness and source of information

Most of study subjects 181 (86.6%) responded that they have heard about Xpert. TB guidelines/manuals 101 (58.8%), TB workshops 84 (48.3%) and health workers 47 (27.0%) were their main source of information. Majority of the respondents, 134 (64.1%) know Xpert is found in Addis Ababa, did not know it is found in the mobile TB clinic 127 (60.8%) and know that it is given free of charge 159 (76.1%) in public facilities of Addis Ababa (Table 2).

3.3. Knowledge of healthcare providers regarding Xpert

The overall proportion of respondents who had good knowledge about Xpert was 95 (45.6%) lower than that of respondents who had poor knowledge 114 (54.6%) with a mean score of 9.16 (SD ± 3.79).

More than three fourth of (77.5%) the respondents knew that Xpert detects both TB and rifampicin drug resistance. Only 44 (21.1%) of the respondents knew that Xpert is not used to monitor treatment response. Similarly, only 48 (23%) of the respondents knew that treatment response and progress of TB patients is monitored by either smear microscopy or culture. Fifty five percent (115) of the study participants knew the national TB diagnostic algorithm that includes Xpert. Large proportion of the respondents missed patients eligible for Xpert. The larger numbers of correctly answered questions were 78.9%, 81.8%, 82.3% and 83.1%, regarding registration of a TB case detected by Xpert, sensitivity of Xpert when compared to smear, shorter turnaround time of Xpert compared to culture and identifying sputum as the preferred specimen for Xpert, respectively (Table 3).

3.4. Factors associated with knowledge of Xpert

Variables such as health facility type, age, training and Xpert guideline reading were statistically associated with the good knowledge on Xpert at p–value <0.2 in bivariable analysis. But there was no significant difference in Xpert knowledge score by respondents' sex,TB related years of service, level of education, profession and years of service ($p > 0.05$).

In multivariable analysis age category and ever reading the Xpert guideline were statistically significant at a p-value <0.05 with good knowledge status on Xpert.

Those health professionals who have been working in TB DOTs clinics and involved in making a diagnosis and initiate treatment of TB, aged above 35 (AOR = 6.253, 95% CI (1.995, 19.604)) had a significant relationship with having good knowledge on Xpert when compared to individuals aged 20–24 years old. . Furthermore, those who read the Xpert guideline (AOR = 4.231, 95% CI (2.011, 8.900)) were more likely to have good knowledge on Xpert than those who did not read the guideline (Table 4).

Table 2
Respondents' awareness and source of information about Xpert.

	Characteristics	Frequency	Percent
Have you ever heard of Xpert?	No	28	13.4
	Yes	181	86.6
Know that Xpert is found in Addis Ababa	No	75	35.9
	Yes	134	64.1
Know that Xpert is found in the mobile TB clinic	No	127	60.8
	Yes	82	39.2
Price of Xpert test in public health facilities of Addis Ababa	Free of charge	159	76.1
	Reasonably priced	22	10.5
	Somewhat expensive	28	13.4
Source of information	Newspapers and magazines	11	6.3
	Radio	15	8.6
	TV	15	8.6
	TB Guidelines/manuals	101	58.0
	Medical Textbooks	24	13.8
	TB workshops	84	48.3
	Billboards	1	.6
	Brochures, posters and other printed materials	11	6.3
	Health workers	47	27.0
	Family, friends, neighbours and colleagues	13	7.5
	Teachers	14	8.0

3.5. Xpert use for TB diagnosis

Over half of the respondents 109 (52.2%) did not order Xpert for TB diagnosis. The main reasons mentioned were 'Do not know the criteria used' 55 (50.5%) and 'Test not found in the facility' 35 (32.1%). Among participants who had access to Xpert (n = 100), all (100.0%) stated that they had used this assay for the analysis of sputum, 13.6% for pleural fluid, 5.8% for gastric aspirates, 2.9% for cerebrospinal fluid samples, 1% for fine needle aspirates, and 1.9% for blood or serum. A significant proportion of respondents 90 (43.1%) had put patients on treatment based on Xpert test result (Table 5).

4. Discussion

We found that more than half of the health professionals working in TB clinics and involved in making a diagnosis and initiate treatment of

Table 3
Number and percentage of healthcare providers who answered correctly on Xpert knowledge questions (n = 209).

Knowledge item		Frequency	Percent
What does Xpert detect?		162	77.5
Xpert used to diagnose both *PTB and **EPTB		128	61.2
A TB case detected by Gene Xpert is registered in the TB register as case		165	78.9
Xpert is more sensitive than smear microscopy		171	81.8
Xpert gives test result in a shorter time than culture		172	82.3
Xpert is used to monitor treatment response and progress		44	21.1
Do you know the national TB diagnostic algorithm that includes Xpert?		115	55.0
Who are eligible for Xpert?	Presumptive ***MDR-TB case	149	71.3
	TB symptomatic individuals from high risk groups	96	45.9
	Vulnerable groups	61	29.2
	HIV positive presumptive TB cases	105	50.2
	Extrapulmonary presumptive TB cases	40	19.1
	Children under 14 years of age	55	26.3
Management of presumptive TB patients with drug resistance detected by Xpert		104	49.8
Treatment response of patients detected by Xpert are monitored by smear and/or culture		48	23.0
Does a negative Xpert result always exclude TB?		125	59.8
What specimen is best to diagnose PTB using Xpert in adults?		175	83.7

*Pulmonary Tuberculosis, **Extrapulmonary Tuberculosis, ***Multidrug Resistant Tuberculosis.

TB in Addis Ababa have low knowledge of Xpert. Furthermore, being older than 35 years and reading guidelines were related to good knowledge in Xpert. This implies to the need for more work on awareness creation, training as well as continuous skill development scheme of new diagnostics such as Xpert.

The finding of this study suggest that despite Xpert platform implementation in Addis Ababa for over three years, less than half of the health workers at TB clinics had received TB training that included Xpert at the time of this study. This may have had a dire effect on patient diagnosis and management. This is because only well trained health workers can treat their patients well [13]. Previous studies have reported that periodic training and supervision can increase knowledge of health workers [14,15]. Training in relation to Xpert has focused on

Table 5
Distribution of respondents on the use of Xpert for TB detection and management.

Variable		Frequency	Percent
Have you ever ordered Xpert for TB diagnosis?	No	109	52.2
	Yes	100	47.8
	Total	209	100
Specimen used	Sputum	103	100
	Pleural fluid	14	13.6
	Gastric aspirates	6	5.8
	Cerebrospinal fluid	3	2.9
	Fine needle aspirate	1	1
	Blood/serum	2	1.9
	Other	0	0
	Total	129	125.2
Reason for not using Xpert?	Test not found in the facility	35	32.1
	Far distance	6	5.5
	Do not know the criteria used	55	50.5
	I do not know it is important	7	6.4
	Other	6	5.5
	Total	109	100
Treated patients based on Xpert result	No	20	9.6
	Yes	90	43.1
	Total	110	52.7

Table 4
Analysis of respondents' characteristics related with Xpert knowledge score.

Variable		Knowledge		COR(95% CI)	AOR (95% CI)
		Good Knowledge	Poor Knowledge		
Facility type	Public	68 (59.6%)	70(73.7%)	2.069 (1.157, 3.700)	1.338 (0.678, 2.641)
	Private	46 (40.4%)	25 (26.3%)	Reference	Reference
Ever trained by NTP on Xpert	Yes	77 (67.5%)	36 (37.9%)	.255 (0.142, 0.458)	1.752 (0.839, 3.655)
	No	37 (32.5%)	59 (62.1%)	Reference	Reference
Age	20 to 24	17 (17.9%)	25 (21.9%)	Reference	Reference
	25 to 29	43 (45.3%)	44 (38.6%)	1.981 (0.931, 4.177)	.927 (0.357, 2.406)
	30 to 34	20 (21.1%)	12 (10.5%)	5.246(1.789, 15.381)	2.172 (0.962, 4.902)
	35+	15 (15.8%)	33 (28.9%)	.664 (0.284, 1.550)	6.253 (1.995, 19.604)*
Ever read the national guideline on Xpert	Yes	35 (36.8%)	83 (72.8%)	5.759 (3.099, 10.703)	4.231 (2.011, 8.900)**
	No	60 (63.2)	31 (28.2%)	Reference	Reference

** p–value < 0.001, * p–value < 0.05.

laboratory staff members who operate the machine and perform the assay. There is a need to sensitize clinical staff members on Xpert to enable them use the results to inform treatment. Often, clinicians continue to want smear, culture, and drug susceptibility test results, even in the presence of an Xpert test result [16].

On the other side, many of the respondents indicated that TB guideline/manuals and TB workshops as their main source of information. This may indicate the government's commitment and relative efficiency in at least availing TB guidelines/manuals and organizing TB workshops as a means of transferring knowledge to the health workers.

We found an overall low level of knowledge regarding the importance and use of Xpert in TB diagnosis; some important gaps in knowledge were also identified. The fact that majority of the respondents knew what Xpert detects, TB case registration detected by Xpert, its high sensitivity, provision of result in short time and the best specimen for the test is encouraging. However, knowledge gaps on the issues of the roles of Xpert on monitoring treatment response and progress, tools to monitor treatment response of cases detected by Xpert require attention . These gaps may reduce the effective roles of healthworkers in TB management which in the end affects patients' treatment outcome.

The situation where only 21.1% of respondents were aware that Xpert is not recommended to monitor treatment outcome is a tremendous challenge to the control program. This void in knowledge in turn could lead to inappropriate diagnosis wasting the cartridges which otherwise could have been used for the appropriate patient who is in need. Furthermore, it could give a false result, bias the health workers' decision and expose the patient to unnecessary treatment. Molecular tests, including Xpert, are not suitable for monitoring patients during treatment because these tests detect DNA from both viable and non-viable bacilli [17]. Similarly, the lack of knowledge of healthcare workers on how to monitor TB cases detected by Xpert is a big concern and may pose the problems mentioned above.

Only 50% of the respondents replied that presumptive TB cases with drug resistance detected by Xpert should be put on second line anti-TB treatment. This knowledge gap could lead to delay in the patient's treatment thereby resulting in the deterioration of the patients' health and further transmission of drug resistant tuberculosis [18] endangering the overall control efforts of the disease. Similarly, a huge knowledge gap was observed by the fact that only 60% of study participants indicated that a negative Xpert result does not always exclude TB. Researches have indicated that despite the high sensitivity and specificity of the tool, it does not always exclude TB and require further clinical management and another diagnostic test, including a repeated Xpert test using a different sputum specimen [19].

Despite the incorporation of Xpert in the national TB and MDR-TB diagnostic algorithm, only 55% of the respondents knew it. Subsequently, majority of the study participants were not aware of patients eligible for diagnosis of TB by Xpert. Previous studies conducted in different regions of Ethiopia have reported failure to adhere to the national TB diagnostic criteria [20,21]. Partly, the reason for the non-adherence could be the poor knowledge of the healthcare workers on the national diagnostic algorithm. These knowledge gaps may again limit the efficiency of healthcare workers in TB management.

Based on characteristics such as sex, years of service, level of education, profession, working in private or public facility, training, there is no evidence from this study to suggest that there was any statistically-significant difference amongst participants with regard to their knowledge of Xpert. However, we found out that individuals who were relatively younger age group (<35 years) were associated with poor knowledge on Xpert. Experience in managing TB patients was reported to affect standard management of TB patients [7] which include proper diagnosis. Furthermore, our study indicated that individuals who did not read the national guideline on Xpert had an insufficient level of knowledge as compared with those who read the guideline. This observation suggests that there is a need to distribute the national guideline on Xpert to TB clinic workers and ensure that they have understood the contents through workshops or trainings.

Almost half of the respondents said that they had ordered Xpert for TB diagnosis.On the contrary to the WHO recommendation, which approved Xpert to be used primarily to analyse sputum samples, a large proportion of participants had used the Xpert to analyse different extrapulomonary specimens. Moreover, Xpert was recommended to be used as initial test for cerebrospinal fluid for patients suspected of TB meningitis. Additionally, Xpert was recommended for testing specific non-respiratory (lymph nodes and other tissues) specimens from patients suspected of having extrapulmonary TB. However, these recommendations do not apply to other biological samples (including stool, urine and blood) [17]. Hence, judicious selection and use of specimens is mandatory.

The fact that 50% of the participants who did not use Xpert mentioned 'Do not know the criteria used' shows the lack of regular training of health workers which further entails the limited use of Xpert in TB diagnosis. Besides, it raises the importance of distributing the Xpert guideline and job aids to all sites.

Furthermore, 90% of the participants who have ordered Xpert have said that they used the test result for patient management. This is a very encouraging finding for the TB control program. On the contrary, a study conducted in Eastern European countries [22] reported that a large proportion of participants who had access to the Xpert were not using test results for clinical management decisions on a regular basis. This was particularly mentioned for resistance results.

5. Limitation of the study

Data for this study was gathered with a self-report questionnaire which has its own weaknesses such as proneness to respondents' bias. Furthermore, this study is conducted in Addis Ababa and its findings may not represent the situation in other regions of the country.

6. Conclusion

This study revealed that the overall magnitude of knowledge status of healthcare workers on Xpert was found to be low. Health workers above 35 years and those who read the guideline on Xpert had higher knowledge status on Xpert. Distribution of the national guideline on Xpert and assigning experienced clinicians in TB DOTs clinics are recommended.

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