Does task shifting in tuberculosis microscopy services to non-certified technicians in Afghanistan affect quality?

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Setting: Tuberculosis microscopy centres in 30 provinces in Afghanistan.

Objective: To compare the quality of sputum smear examinations in microscopy centres with microscopists who are fully certified as laboratory technicians with those performed in centres with technicians who do not have such certification (high school graduates).

Design: Cross-sectional record review of sputum smear microscopy slides examined by technicians and cross-checked by trained assessors as part of routine external quality assurance between July and September 2009.

Results: Of 129 non-certified technicians, 118 (91%) were stationed in rural health centres compared with 217/257 (84%) certified technicians. From 386 microscopy centres, 7313 slides were cross-checked. Of 257 microscopy centres with certified technicians, 42 (16%) had at least one slide with a major error compared to 23 (18%) of 129 microscopy centres staffed with non-certified technicians. The difference was not statistically significant (OR 1.11, 95%CI 0.64–1.94). The number of slides showing major errors was also similar between the centres with both certified and non-certified technicians.

Conclusion: This study confirms the deployment of non-certified microscopy technicians to peripheral health centres throughout the country and that their performance with sputum smear microscopy is similar to that of certified technicians with 3 years of training.

Afghanistan remains one of the 22 high tuberculosis (TB) burden countries, and TB continues to be a major global public health problem in the country.¹ An effective health system with adequate resources and health infrastructure is a prerequisite for successful TB control.² Unfortunately, in Afghanistan, more than two decades of war have had a disruptive effect on all aspects of the health sector,³ and shortages and maldistribution of certified laboratory technicians have posed a serious challenge to the National TB Control Programme, particularly at the peripheral levels where care is delivered.⁴ Task shifting, which involves the re-assignment of specific tasks from highly qualified health workers to health workers with shorter training and fewer complementary qualifications, is one approach that may improve laboratory performance, especially in relation to TB microscopy services.

To address human resource challenges in the laboratory setting, the Afghanistan National TB Control Programme (NTP), Kabul, Afghanistan, in collaboration with national and international non-governmental organisations such as the Bangladesh Rural Ad-

vancement Committee (BRAC), has shifted tasks normally undertaken by certified laboratory technicians to high school graduates. These graduates have received theoretical and practical training as microscopy technicians at various TB diagnostic centres, following which they have been deployed to TB microscopy centres around the country, where they are designated non-certified technicians.

The present study was undertaken to examine how this task shifting has worked, with particular reference to the performance of sputum smear microscopy for the diagnosis of smear-positive pulmonary TB. Specific objectives were to determine 1) the distribution of certified and non-certified microscopy technicians between health centres and hospitals, and 2) the quality of sputum smear examination between certified and non-certified laboratory technicians using results obtained from routine quality assurance records.

STUDY POPULATION, DESIGN AND METHODS

Study design

This was a retrospective cross-sectional study conducted within the NTP setting in Afghanistan.

Setting

Country setting

Decades of conflict and human displacement have had a severe impact on Afghanistan's health sector. Health infrastructure has been damaged throughout the country, health workers have disappeared without being replaced, and the demand for health care has increased at an exponential rate. Lack of human resources, in both quality and quantity, is a serious problem for the health care system in Afghanistan. According to the World Health Organization, for every 1000 heads of population there are 0.18 physicians, 0.2 nurses and 0.02 pharmacists.⁵ Shortages of certified health workers along with poor geographical distribution are ongoing, cross-cutting issues. These shortages are further compounded by the concentration of health professionals in the major cities at the expense of hard-to-reach areas.

Tuberculosis services

TB microscopy diagnostic and treatment services are provided through a network of 534 microscopy centres distributed throughout 34 provinces in the country; these are divided as follows: 88 basic health centres, 333 comprehensive health centres, 57 district hospitals, 30 provincial hospitals, 5 regional hospitals and 21 specialised hospitals. Of the 534 microscopy units in the country, almost 40% are staffed with the

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KEY WORDS

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non-certified technicians, who are usually high school graduates who have received theoretical and practical training in TB microscopy. This training comprises 1 month of theoretical classes, which include sample collection, making smears, staining, fixing and examination methods and the concepts underlining acid-fast bacilli (AFB) staining. This is then followed by 2 months of practical work in a laboratory under the mentorship and supervision of qualified laboratory technicians.

External quality assurance system

Every quarter, up to 20 slides that have been used for smear microscopy are collected randomly for external quality assurance (EQA) from each microscopy centre. The slides are collected by an assessor during the quarterly laboratory technicians review meeting at the provincial level. The slides are cross-checked at eight regional centres by trained personnel, and details are recorded in a standard slide collection sheet. The national guidelines for quality assurance identify both high false-positive (HFP) and high false-negative (HFN) as major errors.

Study population

Between July and September 2009, presumptive TB patients submitted sputum smears for examination at microscopy centres. EQA results of this work were obtained and assessed in this study.

Data variables, sources of data and data collection

Data on the certification of the laboratory technicians and their place of work were collected from the Human Resource Database of the Ministry of Public Health, Kabul, Afghanistan. The same data were collected from the database for the Provincial TB Coordinators and the implementing partners of the Basic Package of Health Services to ensure data validity. The type of health facility where the laboratory technicians worked was also recorded per the classification of the Afghanistan Ministry of Public Health.

Data on smear microscopy were collected from the routine registers, records and reports for all 386 laboratories that were kept at eight regional centres. Data from the remaining 148 laboratories in four provinces could not be accessed due to security issues. The following data were included in the quarter: the number of slides examined by each health facility, the number for which the reading of AFB was the same between assessor and microscopy technician, and the number of false-positive and false-negative slides. These data were aggregated at the regional level, entered into an electronic system (Microsoft Excel, Microsoft, Redmond, WA, USA) that is compatible with internet facilities available in eight regions, and sent to the central level, where the numbers were compared with the respective report for that quarter, which had been sent to the Central Unit of the NTP.

The main determinant variables were the level of certification of the laboratory technicians, which were defined as follows: certified: laboratory technicians who had completed the 3-years training curriculum of the Institute of Health Science of the Afghanistan Ministry of Public Health; non-certified: laboratory technicians who had not undertaken the 3-year institutional training curriculum but who instead received theoretical and practical training at TB diagnostic centres.

The main outcome variable was the frequency of major errors in EQA results reported per the Afghanistan NTP (Guideline for TB microscopy),⁶ determined as follows: HFP: the number of slides among the samples collected from each TB microscopy laboratory initially reported as 1+ to 3+ AFB that were found to be negative by the cross-checker; HFN: the number of slides among samples collected from each TB microscopy laboratory initially re-

ported as negative that were found to be 1+ to 3+ positive by the cross-checker.

Analysis and statistics and sample size

The performance of work for the laboratory technicians was compared against their certification background. The rate of HFP and HFN slides was compared between the certified and non-certified technicians. Statistical analysis was performed using SPSS, v 13 statistical software (Statistical Product and Service Solutions, Chicago, IL, USA). Results from centres with certified and non-certified laboratory technicians were compared using the χ^2 test, with odds ratios (ORs) and 95% confidence intervals (CIs) where appropriate, and the χ^2 test for trend. Levels of significance were set at 5%.

Ethics

The study protocol was approved by the Institutional Review Board of the Ministry of Public Health, Kabul, Afghanistan and the Ethics Advisory Group of the International Union Against Tuberculosis and Lung Disease, Paris, France.

RESULTS

The distribution of microscopy technicians according to type of health facility, such as basic health centre, comprehensive health centre and hospital, in the 30 provinces of Afghanistan, is shown in Table 1. There was an increasing trend of more non-certified technicians working in basic health centres compared with comprehensive health centres and hospitals (χ^2 test for trend 13.7, $P < 0.001$).

Results were obtained for 386/534 (72%) microscopy centres in the country, as described in the Methods. A total of 7313 slides were collected for EQA, with on average 19 slides per microscopy centre. Of the 386 microscopy centres, 65 (16.8%) had at least one slide identified with a major error after cross-checking. The flow of sputum smears and EQA results in relation to whether there was a certified or non-certified laboratory technician are shown in the Figure.

Of the 257 microscopy centres staffed with certified microscopy technicians, 42 (16.3%) had at least one slide with a major error compared to 23 (17.8%) from the 129 microscopy centres staffed with a non-certified microscopy technician; the difference was not statistically significant (OR 1.11, 95%CI 0.64–1.94, $P = 0.407$). Table 2A shows the number and percentages of microscopy centres reporting major errors (1, 2, 3, 4 or more) by certified and non-certified laboratory technicians; Table 2B shows the pattern of HFN results and Table 2C the pattern of HFP results between certified and non-certified laboratory technicians.

TABLE 1 Certification of laboratory technicians by type of health facility in 30 Afghan provinces, July–September 2009

Facility type	Certified technicians* n (%)	Non-certified technicians† n (%)	Total (n = 386) n
Basic health centres	57 (53)	51 (47)	108
Comprehensive health centres	160 (70)	67 (30)	227
Hospitals	40 (78)	11 (22)	51

*Laboratory technicians with 3 years institutional training from the Institute of Health Science of the Ministry of Public Health, Kabul, Afghanistan.

†Laboratory technicians who received theoretical and practical training at TB diagnostic centres.

FIGURE Flow of sputum smears for external quality assurance study of the performance of microscopy technicians undertaking TB sputum smear examination in 30 provinces of Afghanistan, July–September 2009. *Laboratory technicians who had undergone 3 years of institutional training from the Institute of Health Science of the Afghanistan Ministry of Public Health, Kabul. †Laboratory technicians who received theoretical and practical training at TB diagnostic centres. ‡No major errors (HFP or HFN) reported. §Major errors (HFP or HFN) reported. TB = tuberculosis; HFN = high false-negative; HFP = high false-positive.

DISCUSSION

The principal findings from this observational study are that an increasing proportion of non-certified microscopy technicians worked in health centres rather than in hospitals compared with certified technicians; however, the differences in the quality of performance and the number of major smear microscopy errors between the two types of technicians were not statistically significant.

Sputum smear microscopy remains the mainstay of TB case detection in most developing countries, including Afghanistan, and this requires the resources of skilled microscopy technicians, who are either in short supply or often unwilling to work in rural areas.^{7,8} As a post-conflict country, Afghanistan faces a severe shortage of certified health personnel, and security issues along with difficult and mountainous geographical terrain pose further challenges to the deployment and decentralisation of certified health workers, particularly to rural and hard-to-reach areas. To meet these challenges, Afghanistan has invested in the training of high school graduates as non-certified laboratory technicians who have largely been deployed to staff the laboratories of the peripheral

level health services. It was reassuring to find that the quality of performance, as judged by major errors, including the number and proportion of HFN slides and HFP slides, was similar between certified and non-certified microscopy technicians. This means that serious misdiagnosis at the laboratory level would be unlikely if the country made more use of non-certified laboratory technicians.

The strengths of this study were that it was country-wide and included all the slides collected for quality assurance during the study period from centres accessible for evaluation. The certifications of microscopy technicians were obtained from the human resource database of the Ministry of Public Health, and were checked and matched with the certification profile available at the provincial level.

Limitations of the study are due to the operational nature of the study and the security issues that prevail in Afghanistan. It is possible that those centres not evaluated could have more non-certified technicians and worse EQA results than those that could be evaluated.

The findings from this study will influence the human resource policy decisions of the Afghanistan Ministry of Public

TABLE 2 A) Microscopy centres reporting major sputum smear microscopy errors by level of certification of microscopy technician in 386 laboratories in 30 provinces of Afghanistan, July–September 2009

Certification of laboratory technicians	Microscopy centres reporting				
	Major errors*				
	No errors n (%)	1 n (%)	2 n (%)	3 n (%)	≥4 n (%)
Certified†	215 (83)	30 (12)	8 (3)	4 (2)	0 (0)
Non-certified‡	106 (82)	12 (9)	6 (5)	2 (2)	3 (2)
Total	321 (83)	42 (11)	14 (4)	6 (2)	3 (<1)

TABLE 2 B) Microscopy centres reporting HFN sputum smear microscopy slides by level of certification of microscopy technician in 386 laboratories in 30 provinces of Afghanistan, July–September 2009

Certification of laboratory technicians	Microscopy centres reporting				
	HFN				
	No errors n (%)	1 n (%)	2 n (%)	3 n (%)	≥4 n (%)
Certified†	233 (91)	19 (7)	5 (2)	0 (0)	0 (0)
Non-certified‡	111 (86)	9 (7)	4 (3)	2 (2)	3 (2)
Total	344 (89)	28 (7)	9 (2)	2 (1)	3 (1)

TABLE 2 C) Microscopy centres reporting HFP sputum smear microscopy slides by level of certification of microscopy technician in 386 laboratories in 30 provinces of Afghanistan, July–September 2009

Certification of laboratory technicians	Microscopy centres reporting			
	No errors <i>n</i> (%)	HFP		
		1 <i>n</i> (%)	2 <i>n</i> (%)	3 <i>n</i> (%)
Certified†	237 (92)	14 (5)	3 (1.5)	3 (1.5)
Non-certified‡	123 (95)	5 (4)	1 (1)	0 (0)
Total	360 (93)	19 (5)	4 (1)	3 (1)

*HFP or HFN sputum smears reported among samples that had been rechecked.

†Laboratory technicians with 3 years institutional training from the Institute of Health Science of the Ministry of Public Health, Kabul, Afghanistan.

‡Laboratory technicians who received theoretical and practical training at tuberculosis diagnostic centres.

HFN = high false-negative; HFP = high false-positive.

Health, who should now be able to accept the presence of microscopy technicians with lower institutional certification in the health delivery system. It provides useful information for locations facing similar challenges in providing quality services for those seeking care for symptoms suggestive of TB. The study will also be used as a matrix to identify areas in the country where there is a higher frequency of false-positive and false-negative di-

agnoses for further interventions, and this may involve refresher training for technicians and an increased frequency of supervision and on-the-job training.

In conclusion, this study confirms that non-certified microscopy technicians have been deployed to peripheral health centres through the country and that their performance is on a level similar to that of certified technicians with 3 years of training.

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Contexte : Centres d'examens microscopiques de la tuberculose dans 30 provinces d'Afghanistan.

Objectif : Comparer la qualité des examens de frottis de crachats entre les centres où les microscopistes sont des techniciens de laboratoire diplômés et ceux où ils ne le sont pas (titulaires du bac).

Schéma : Etude transversale des registres des examens microscopiques des lames de frottis de crachats examinés par les techniciens et vérifiés par des examinateurs formés à l'assurance de qualité externe de routine entre juillet et septembre 2009.

Résultats : Sur 129 techniciens non diplômés, 118 (91%) étaient affectés dans des centres de santé ruraux comparés à 217 (84%) sur 257 techniciens diplômés. Sur 386 centres de microscopie, 7313

lames ont été vérifiées. Sur 257 centres de microscopie pourvus de techniciens diplômés, 42 (16%) avaient au moins une lame comportant une erreur grave contre 23 (18%) dans 129 centres de microscopie pourvus de techniciens non diplômés – la différence n'était pas significative (OR 1,11 ; IC95% 0,64–1,94). Le nombre de lames comportant des erreurs graves était également similaire parmi les centres pourvus des deux types de techniciens.

Conclusion : Cette étude confirme le déploiement de techniciens en microscopie non diplômés dans les centres de santé périphériques à travers tout le pays et montre que leur performance en matière d'examens de frottis de crachats est similaire à celle des techniciens diplômés après 3 années de formation.

Marco de referencia: Los centros de microscopia de la tuberculosis (TB) en 30 provincias de Afganistán.

Objetivo: Comparar la calidad del examen microscópico del esputo entre los diferentes centros con microscopistas debidamente acreditados como técnicos de laboratorio y los centros con técnicos que no cuentan con esta acreditación (bachilleres).

Método: Se llevó a cabo un estudio transversal mediante el análisis de los registros de las baciloscopias examinadas por los técnicos y una nueva verificación por asesores capacitados, en el marco del sistema ordinario de garantía externa de la calidad, entre julio y septiembre del 2009.

Resultados: De los 129 técnicos no acreditados, 118 (91%) operaban en centros de salud rurales, en comparación con 217 (84%) de los

257 técnicos acreditados. Se verificaron de nuevo 7313 baciloscopias de los 386 centros de microscopia. De los 257 centros que contaban con técnicos certificados, en 42 (16%) se observó como mínimo un frotis con un error grave de lectura, en comparación con 23 casos (18%) en los 129 centros con personal no acreditado; esta diferencia no fue estadísticamente significativa (OR 1,11; IC95% 0,64–1,94). El número de baciloscopias que presentaron errores graves también fue análogo en los centros con personal técnico de ambos tipos.

Conclusión: Los resultados del presente estudio confirman el despliegue de técnicos en microscopia no certificados hacia los centros periféricos en todo el país, cuyo desempeño es equivalente al desempeño de los técnicos que reciben la acreditación tras 3 años de capacitación.