



Contents lists available at ScienceDirect

## Asian Pacific Journal of Tropical Disease

journal homepage: www.elsevier.com/locate/apjtd



Tuberculosis research

doi: 10.1016/S2222-1808(15)61029-5

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## Longer lead time of tuberculosis laboratory commodities in Amhara region, Ethiopia

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## ARTICLE INFO

## Article history:

Received 11 Jan 2016

Received in revised form 19 Jan 2016

Accepted 5 Mar 2016

Available online 18 Apr 2016

## Keywords:

Reagents

Consumables

Transportation

Ethiopia

## ABSTRACT

**Objective:** To evaluate the lead time of tuberculosis (TB) laboratory commodities in Amhara region.**Methods:** A cross sectional study was carried out in Amhara region from April 28 to May 26, 2014. A total of 82 health centers were recruited using simple random sampling technique. Data were collected using a structured questionnaire. Lead time of reagents and consumables was calculated using SPSS version 20.**Results:** A total of 20 (24.4%) health centers took more than two weeks to receive TB laboratory reagents from Woreda Health Office and the longest lead time was 1 to 2 month(s) in 10 (12.2%) health centers. Transportation delay of consumables was 5 times higher among Pharmaceuticals and Fund Supply Agency (odds ratio: 4.7, 95% confidence interval: 2.5–9.0) and 4 times higher among Woreda (odds ratio: 3.7, 95% confidence interval: 2.0–6.9) as compared to health center truck.**Conclusions:** One fourth of health centers had longer lead time of TB laboratory commodities as a result of transportation delay. Thus, decentralization of transportation with dedicated vehicles is recommended to shorten lead times.

## 1. Introduction

Tuberculosis (TB) remains a major public health problem worldwide. In developing countries, effective TB diagnostic and treatment-monitoring tools are serious challenges to combat the disease[1].

In Ethiopia, smear microscopy is the commonest tool used for diagnosis of patients with TB and to monitor the progress of treatment. The credibility, success and sustainability of the technique are crucial for the strength of the laboratory[2]. Reliable supplies are essential for quality-assured laboratory services to support the National Tuberculosis Control Program through the diagnosis of TB[3].

In order to guarantee uninterrupted supply, an effective distribution system is needed which relies on good system design and management. Such system should maintain a constant supply of TB diagnostic commodities with known frequency and lead time[4].

Inadequate technical and management capacity was commonly cited in barriers of supply chains for health commodities in developing countries and chains are complex and largely centralized[5]. To distribute commodities from central warehouses, transportation must be available whenever it is needed to fill regular or emergency orders. Hence, standby vehicles should be dedicated[6].

The Ethiopian laboratory logistics management information system was weak, consistently being hampered by poor communication. In addition, the distribution system for laboratory commodities was not systematically designed[7]. These problems are still existed.

To ensure sustainable TB diagnostic service, timely delivery of reagents and consumables is essential. Thus, this study was designed to evaluate the lead time of TB laboratory commodities among public health centers in Amhara region.

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Foundation Project: Supported by the Global Health Bureau, Office of Health, Infectious Disease and Nutrition (HIDN), US Agency for International Development, through TB CARE I under the terms of Agreement No. AID-OAA-A-10-00020.

The journal implements double-blind peer review practiced by specially invited international editorial board members.

## 2. Materials and methods

### 2.1. Study settings and design

A cross sectional study was carried out in public health centers in Amhara region, North West Ethiopia from April 28 to May 26, 2014. There are 801 health centers in the region. Ziehl Neelsen smear microscopy method was the most utilized tool for the diagnosis of TB. Health centers received reagents and consumables from Woreda Health Office and/or Pharmaceuticals and Fund Supply Agency (PFSA) every other month.

### 2.2. Study subjects, sample size and sampling technique

Health centers which provided TB diagnostic service using Ziehl Neelsen smear microscopy method were studied. The following parameters were taken into account during sample size calculation: prevalence of stock out due to inconsistent delivery (60.5%), 95% confidence interval and 10% margin of error [8]. Then 82 health centers were recruited. Simple random sampling technique was used to select individual health centers.

### 2.3. Operational definitions

Types of health center (A, B and C) were categorized by the regional health bureau according to their accessibility, expected service and the size of population it serves. A: health center that was very accessible served for a population greater than or equal to 40000 and delivered obstetrics and ophthalmic services in addition to routine health care. B: health center that was accessible and served for a population of 25000–39999. C: health center that was inaccessible and served for a population less than 25000. Reagents included 1% carbol fuchsin, 3% acid alcohol and 0.1% methylene blue. Consumables included frosted slides, immersion oil, filter paper, wooden applicator sticks, sputum cups, lens tissue, microscope lens cleaning solution and 95% ethanol.

### 2.4. Data collection procedures

Trained laboratory and pharmacy personnel interviewed health center employees working in the store using a structured questionnaire. The data collection mainly focused on lead time of reagents and supplies, transportation and management response. In this regard, lead time was the time between when new stock was ordered and it was received and available for use, and the lead time up to two weeks was acceptable standard in our setting.

### 2.5. Data processing and analysis

EPI Info version 3.5.1 was used for data entry and cleaning process. Frequency was calculated using SPSS version 20 for lead time of TB diagnostic reagents and consumables, and transportation. Odds ratios were computed for selected variables to determine associations. *P* value less than 0.05 was considered statistical significant. Tables and figures were used for the data presentation.

### 2.6. Ethical issue

The Ethics Review Committee of Amhara National Regional

State Health Bureau approved this study. Official permission was taken from the regional health bureau, and from each respective Zonal Health Departments, Woreda Health Offices and Health Centers. Respondents were informed of the objective of the study. Information found from each health center was kept confidential.

## 3. Results

### 3.1. Characteristic of health centers

A total of 82 health centers were enrolled, of which 36 (43.9%) health centers were Type A and 39 (47.6%) were Type B. A total of 43 (52.4%) health centers had anti-retroviral therapy service. Most (93.9%) of the personnel working in the store were pharmacy technicians and five were nurses (Table 1). In 10 health centers, laboratory heads were trained in logistics management information system.

**Table 1**

Characteristics of health centers in Amhara region, 2014.

Categories		No. of health centers	Percent
Type of health center	A	36	43.9
	B	39	47.6
	C	7	8.5
Profession of employees	Pharmacy technician	77	93.9
	Nurse	5	6.1
ART service	Yes	43	52.4
	No	39	47.6
Partner support	Yes	81	98.8
	No	1	1.2

ART: Anti-retroviral therapy.

### 3.2. Source of TB laboratory commodities

More than half (62.2%) of the health centers obtained TB laboratory consumables from Woreda Health Office and PFSA. A total of 23 (28.0%) health centers obtained only from Woreda and the remaining (9.8%) obtained from PFSA.

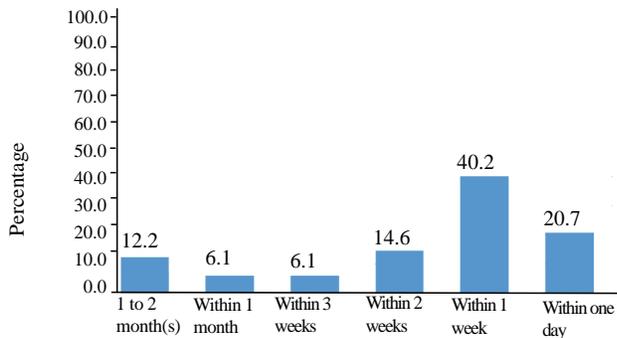
### 3.3. Lead time of reagents and consumables

Six health centers (7.3%) had delayed reports and/or orders of TB laboratory commodities to the higher level. A total of 26 (31.7%) health centers were usually run out either for acid alcohol, carbol fuchsin, methylene blue, sputum cup, applicator stick or frosted slide before resupplying. Service interruption was found in 22 (26.8%) health centers. The median duration of service interruption was 15 days, ranging from 2 days to 90 days in the previous quarter. Twenty (24.4%) health centers had emergency order from January 1-March 31, 2014. Fifty seven (69.5%) health center managers responded to the purchase of TB supply. The median duration of response was 10 days that ranges from a minimum of 1 day to a maximum of 90 days.

TB laboratory consumables were received from Woreda Health Office and PFSA within two weeks in 57 (77%) and 26 (44.1%) health centers, respectively.

A total of 20 (24.4%) health centers taken more than two weeks received TB reagents from Woreda Health Office. The longest lead

time was 1 to 2 month(s) in 10 (12.2%) health centers (Figure 1).



**Figure 1.** Lead time of TB reagents in Amhara region, 2014.

Transportation delay for consumables in PFSA, Woreda and health center truck was 66.7%, 60.6% and 30.0%, respectively. The delay was about 5 times higher among PFSA (odds ratio: 4.7, 95% confidence interval: 2.5–9.0) and four times higher among Woreda (odds ratio: 3.7, 95% confidence interval: 2.0–6.9) as compared to health center trucks.

#### 4. Discussion

In this study, one in four health centers had delayed delivery of TB reagents from Woreda Health Office, with longest lead time of 1 to 2 month(s) in 12.2% of health centers. This caused frequent stock out of reagent in health centers. Delayed reports and/or orders could contribute to the delayed delivery of reagents in our setting. Similarly, United States Agency for International Development (USAID) | Deliver Project revealed that delay in sending reports from one level to the next level increased lead time of health commodities in developing countries[9].

Frequent stock outs in this study brought service interruptions in quarter of health centers, with median duration of 15 days. Reports of longer lead times and frequent supply stock-outs could be a result of unplanned procurement and inadequate monitoring[5]. In addition, laboratories faced the shortage of staining reagents due to inconsistent supply[10]. Researchers recommended the shortening of lead times to ensure sustainability of supply[5].

Using Woreda trucks, a more centralized system, increased transportation delay by about four folds as compared to health center trucks. This is supported by a research conducted in Guatemala that showed centralization results in a low performance[11]. Resnick *et al.* also reported that double touch of intermediate warehouses increased transportation delay[12]. This could be because of the use of cars for multipurpose and supervisory visits might take precedence over commodity delivery, which could delay the movement of commodities[6]. Smaller sample size was the limitation of this study.

One fourth of health centers had longer lead time of TB reagents. The use of centralized truck quadrupled transportation delay of TB laboratory consumables. Hence, decentralization of transportation with dedicated vehicles is recommended to shorten lead times.

#### Conflict of interest statement

We declare that we have no conflict of interest.

#### Acknowledgments

The authors thank the Tuberculosis Research Advisory Committee of the Ethiopian Federal Ministry of Health for providing this

chance. We are also grateful to the Global Health Bureau, Office of Health, Infectious Disease and Nutrition, US Agency for International Development for financially supporting this study through TB CARE I under the terms of Agreement No. AID-OAA-A-10-00020. This study was made possible by the generous support of the American people through the USAID. The contents are the responsibility of the authors and do not necessarily reflect the views of USAID or the United States government.

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