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Where, when, and how many tuberculosis patients are lost from presumption until treatment initiation? A step by step assessment in a rural district in Zimbabwe

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ABSTRACT

Objectives: To describe the pre-diagnosis and pre-treatment loss to follow-up (LTFU) in the tuberculosis (TB) care cascade in Guruve (2015–16), a rural district in Zimbabwe.
Design: Guruve has 19 rural health centres (RHCs) and one district hospital. In this cohort study, persons ≥15 years of age with presumptive pulmonary TB were tracked from the facility presumptive TB registers to the laboratory registers; if laboratory diagnosed, they were tracked to the district TB register (contains details of all TB patients registered for treatment). Each patient was tracked for 90 days after registration as presumptive TB and for 90 days after laboratory diagnosis. Environmental health technicians transported sputum specimens from the health facilities to the laboratories ($n = 3$).
Results: Of 2974 persons with presumptive TB, pre-diagnosis LTFU occurred in 575 (19%, 95% confidence interval 18–21%). Associated factors included registration at a RHC, at a facility more than 2 km from the laboratory, and absence of an environmental health technician. Of 162 laboratory diagnosed pulmonary TB patients, pre-treatment LTFU occurred in 19 (12%, 95% confidence interval 8–18%).
Conclusions: The presumptive TB register was helpful to assess the pre-diagnosis gaps beginning from presumption. Pre-diagnosis LTFU can be reduced by placement of an environmental health technician at all facilities.

Introduction

Globally, an alarming 4.1 million persons with tuberculosis (TB) were missed in 2016. They were either not diagnosed or if diagnosed, not registered (World Health Organization, 2017). In order to end TB, persons with the disease need to be identified, investigated, and initiated on anti-TB treatment promptly. Gaps in the care cascade will result in continued transmission of TB bacilli (World Health Organization, 2017).

A systematic review of 23 studies reported pre-treatment loss to follow-up (LTFU) of laboratory diagnosed, bacteriologically confirmed TB patients ranging from 4% to 38%, and this was found to be common in studies from Africa (MacPherson et al., 2014). Among estimated TB patients in South Africa (2013), 18% were lost before TB diagnosis (Naidoo et al., 2017).

To understand the losses before TB diagnosis, it is important to study the care cascade in detail from presumption to the availability of test results. Pre-diagnosis LTFU among people with

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presumptive TB and its associated factors have been studied in presumptive multidrug-resistant TB (MDR-TB) but not in drug-susceptible TB (Chadha et al., 2011; Khann et al., 2013; Li et al., 2014; Shewade et al., 2016, 2017). In South Africa, the care cascade was studied among persons with presumptive drug-susceptible TB during the diagnostic process (from sputum receipt in the laboratory to testing) but not in the period before sputum receipt in the laboratory (Botha et al., 2008).

Zimbabwe has experienced a massive HIV-driven TB epidemic. In 2016, the estimated TB incidence (including HIV-associated TB) was 208 per 100 000 population, there were 5600 deaths from TB, and the case detection rate was 81% (World Health Organization, 2017). This means that one in five TB patients is missed by the national TB programme. The only study on this issue was conducted in 2006, which revealed a pre-treatment LTFU of 27% (Chadambuka et al., 2011). Information on pre-diagnosis and pre-treatment LTFU, including the assessment of the time interval from identifying presumptive TB to initiating TB treatment, will assist the Zimbabwe National TB Programme to take the necessary steps to increase case detection and reduce TB transmission.

This study was performed to assess the cascade of care among people with presumptive pulmonary TB, from registration as presumptive TB to laboratory diagnosis and treatment initiation in Guruve district, Zimbabwe in 2015-16. Specific objectives were to determine (1) LTFU and the delay before test result availability among people with presumptive pulmonary TB, (2) LTFU and the delay before treatment initiation among laboratory diagnosed pulmonary TB patients, and (3) factors associated with pre-diagnosis LTFU and pre-treatment LTFU.

Methods

Study design

This was a cohort study involving a records review of routine programme data.

Setting

General setting

Zimbabwe is a landlocked low-income country in southern Africa with an estimated population of 13 million (Zimbabwe National Statistics Agency, 2012). It is one of the 14 high TB, TB/HIV, and MDR-TB burden countries. Zimbabwe has 10 provinces, including Mashonaland Central Province, which is located in the north-eastern part of the country. Guruve is one of the eight districts in this province (World Health Organization 2017).

Zimbabwe National TB Programme

The implementation of TB care and prevention activities in Zimbabwe is guided by the current national TB strategic plan (2017–20), with one of the key strategies being to reach 80% of people with TB and place all of them on appropriate first-line, second-line, and preventive therapy by 2020. TB services are integrated into the general health care system (Ministry of Health and Child Care Zimbabwe, 2010, 2017b). Presumptive TB registers were introduced in 2007 and are maintained at all levels of public health facilities from the primary health care clinics upwards. These registers provide an opportunity to study pre-diagnosis LTFU among people with presumptive pulmonary TB in the programme setting (Ministry of Health and Child Care Zimbabwe, 2010, 2017b).

During the study period (2015–16), a TB symptom screening tool was used to identify people with presumptive pulmonary TB, which checked for the presence of at least one of the following symptoms: cough for 2 weeks or longer, fever, night sweats, and loss of weight. Sputum smear microscopy and chest radiography were the basis for the diagnosis of pulmonary TB (Ministry of Health and Child Care Zimbabwe, 2010). The Xpert MTB/RIF assay (Cepheid Inc, Sunnyvale, CA, USA) was offered only for people living with HIV, people with diabetes, persons treated previously for TB, health care workers, prisoners, miners/ex-miners, people living in other congregate settings, and known contacts of MDR-TB patients. From 2017, the Xpert MTB/RIF assay was recommended as the first-line diagnostic test for all people with presumptive TB (Ministry of Health and Child Care Zimbabwe, 2017b). Diagnosed TB patients are registered with a unique registration number, given standardized daily directly observed treatment-short course (treatment provided at all public health facilities), and monitored for treatment outcomes. TB laboratory tests and treatment are provided free-of-charge to patients (Ministry of Health and Child Care Zimbabwe, 2010, 2017b).

Study site

Guruve, a rural district with an estimated population of 128 000, has an HIV prevalence of 13.2% in the general population (among those 15–49 years of age) (Zimbabwe National Statistics Agency, 2012; Ministry of Health and Child Care Zimbabwe, 2017a). In 2017, the TB notification rates for new laboratory diagnosed TB and TB (all forms) were 87 and 105 per 100 000 population, respectively, and more than 90% of the notifications were among patients who were ≥15 years of age.

Guruve has a health executive team that oversees the provision of health services and in turn is supervised by the provincial medical directorate. TB services are coordinated by the district TB and leprosy coordinator.

There are 19 rural health centres (RHCs) in the district, all of which provide maternity services, and one district hospital with 80 beds. There are three laboratories, two performing microscopy services (Bepura and Kachuta RHCs) and one with the capacity to perform both microscopy and Xpert MTB/RIF tests (district hospital). Registered general or primary care nurses head the RHCs, which also have an environmental health technician (EHT). The EHT is responsible for TB contact investigations and weekly specimen transportation from RHCs to the nearest laboratory using a motor bike.

People with presumptive TB are identified by nurses at RHCs and both nurses and doctors at the district hospital. They are then recorded in the presumptive register at the health facility and each person is given a presumptive TB number. A sputum sample (two samples if sputum microscopy is performed and one in the case of Xpert MTB/RIF) is then collected. The dates of registration, sputum sample(s) collection, submission to the laboratory, and receipt of the results are documented in the presumptive TB register. The dates on which samples are received and examined are documented in the laboratory register. Laboratory staff inform the referring RHC nurse by telephone of a positive sputum test result and the nurse tracks the patient for prompt initiation of TB treatment. This is followed by registration in the facility TB treatment register, the details of which are updated in the district TB register (Ministry of Health and Child Care Zimbabwe, 2010, 2017b). TB treatment is offered at both the RHCs and the district hospital. Although most patients seen at the district hospital are referred from the RHCs, some attend the hospital directly as self-referrals.

People with presumptive TB who are not bacteriologically confirmed but for whom TB is highly suspected and/or there is no therapeutic response to regular antibiotics, are referred to the district hospital for further investigations.

Study population

All people ≥15 years of age with presumptive pulmonary TB entered in the presumptive TB registers at the health facilities in

Guruve from January 1, 2015 to December 31, 2016 were included in this study. Patients entered into the laboratory registers but not found in the presumptive TB register were included retrospectively. Patients with rifampicin-resistant TB were excluded from the study.

Data variables, sources of data, and data collection

Data were collected from September to December 2017 using a structured data collection form. Each person with presumptive TB was tracked for testing in the laboratory registers for up to 90 days. Each laboratory diagnosed pulmonary TB patient was tracked for treatment initiation for up to 90 days from the date of laboratory diagnosis. All people with presumptive TB with an initial negative result were also tracked for registration as clinically diagnosed pulmonary TB for up to 90 days from the date of laboratory testing of the sputum specimen. Tracking from one register to another was done using the presumptive TB number/laboratory number and/or name/age/sex if the former was not recorded. Duplication between or within the registers was identified by cross-checking the name, age, and sex of the study participants, and the first record to be chronologically added to the register(s) was considered while any other subsequent entries within a 90-day period were eliminated.

Sources of data were the presumptive TB register, laboratory (microscopy and Xpert MTB/RIF) register, laboratory result slips, TB treatment register, and district health system records. Baseline characteristics of the patients (age, sex, HIV status), facility level factors (distance to the laboratory, facility type, availability of an EHT, type of nurse in charge of the health facility), and dates at each step of care (presentation to health facility as presumptive TB, sample collection, sending of sample to the laboratory, sample receipt at the laboratory, sample testing, communication of the results to the referring facility, receipt of the results at the RHC, and if applicable, the date of treatment initiation) were collected. For microscopy, if two samples were collected, sent, and examined on different dates, the earlier date was captured. The registers were checked for documentation of the patients' cellular telephone numbers. The distance (in kilometres) between the health facility and the nearest laboratory was measured using the odometer of the vehicle that was used during data collection.

Operational definitions

A laboratory diagnosed pulmonary TB patient was defined as one having a positive result for either of the two tests, smear microscopy or Xpert MTB/RIF. Pre-diagnosis LTFU was defined as non-availability of test result (either smear microscopy or Xpert MTB/RIF) within 90 days of registration as presumptive pulmonary TB. We reviewed the treatment registers before categorizing a person with presumptive pulmonary TB as 'pre-diagnosis LTFU'. Pre-treatment LTFU was defined as non-registration for treatment within 90 days of laboratory diagnosis of pulmonary TB.

Analysis and statistics

Data were double-entered, validated, and analysed using EpiData (version 3.1 for entry and version 2.2.2.183 for analysis; EpiData Association, Odense, Denmark) for descriptive and unadjusted analysis. Multivariable adjusted analysis was done using Stata (version 12.1; StataCorp, College Station, TX, USA).

Key outcomes were the proportion and 95% confidence interval (CI) with pre-diagnosis/pre-treatment LTFU and median (interquartile range (IQR)) pre-diagnosis/pre-treatment delay in days. The number of laboratory diagnosed pulmonary TB patients lost before diagnosis was also estimated by multiplying the sputum positivity rate and the total number of people with presumptive pulmonary TB who underwent pre-diagnosis LTFU. The relationship between associated factors and pre-diagnosis/pre-treatment LTFU was summarized using relative risks/adjusted relative risks (95% CI). Adjusted relative risks were calculated using log binomial regression.

Results

Baseline characteristics

A total of 2974 people with presumptive pulmonary TB were included. The mean ± standard deviation age was 43.9 ± 16.5 years and 1607 (55.0%) were female. Of those with an HIV result, 58.5% (1327/2270) were HIV-positive. A total of 2133 (71.7%) patients presented at RHCs, 2384 (80.2%) at a facility with an EHT, and 1291 (43.0%) were registered at a facility situated within 2 km from the nearest laboratory (Table 1).

Cascade of care including pre-diagnosis and pre-treatment LTFU

The cascade from presumption to treatment initiation showing the number (proportion) at each step is depicted in Figure 1. Among 2974 people with presumptive pulmonary TB, a total of 575 (19.3%, 95% CI 18.0–20.8%) experienced pre-diagnosis LTFU (Figure 2). Of these 575 people, 140 (24.3%) were registered as

Table 1
Baseline characteristics of people (≥15 years of age) with presumptive pulmonary TB in Guruve, Zimbabwe (2015–16).

Variable	Number	(%)
Total	2974	(100)
Age in years		
15–44	1694	(57.0)
45–64	831	(27.9)
≥65	397	(13.3)
Missing	52	(1.7)
Mean ± SD	43.9 ± 16.5	
Sex		
Male	1365	(45.9)
Female	1607	(55.0)
Missing	2	(0.1)
HIV status		
Positive	1327	(44.6)
Negative	943	(31.7)
Unknown	704	(23.7)
Type of facility		
District hospital	861	(29.0)
Rural health centre	2113	(71.0)
Facility's nurse-in-charge		
Registered general nurse	2248	(75.6)
Primary care nurse	726	(24.4)
Environmental health technician placed at facility		
Yes	2384	(80.2)
No	590	(19.8)
Distance to diagnosing facility from referring facility (km)		
<2	1291	(43.4)
2–4	150	(5.0)
5–9	96	(3.2)
10–14	594	(20.0)
≥15	843	(28.3)
Median (IQR)	7.0 (0.0–18.0)	
Patient telephone number recorded in the presumptive TB register		
Yes	107	(3.6)
No	2867	(96.4)

TB, tuberculosis; SD, standard deviation; HIV, human immunodeficiency virus; IQR, interquartile range.

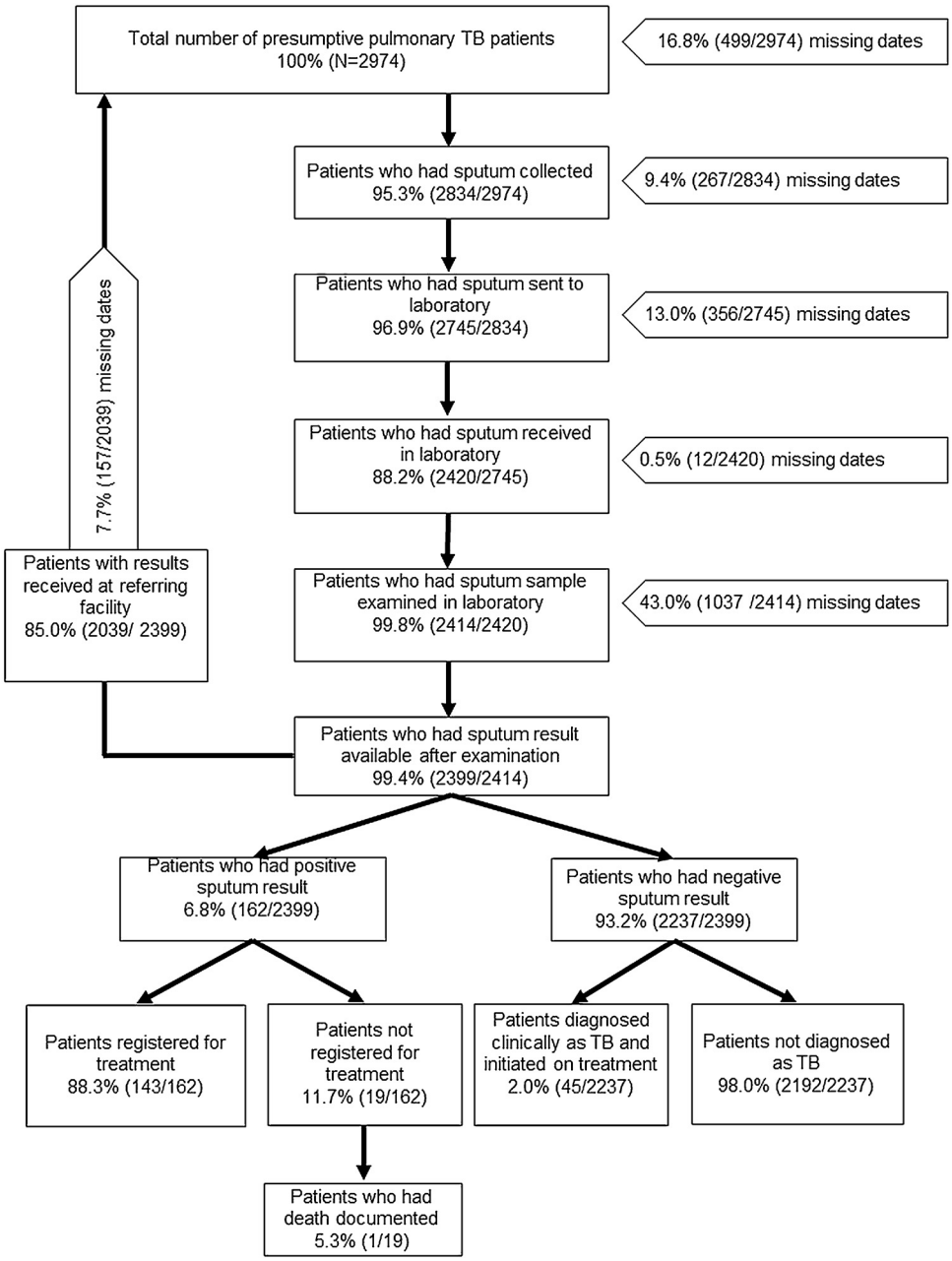

Figure 1. Flow chart of the cascade from presumptive pulmonary tuberculosis (TB) to treatment initiation in Guruve, Zimbabwe (2015–16).

presumptive TB but sputum was not collected, 89 (15.5%) had sputum collected but not sent, 325 (56.5%) had sputum sent but not received at the laboratory, six (1%) had a specimen received at the laboratory but not tested, and 15 (2.6%) had a specimen tested but the result was not available. Among the 1327 HIV-positive patients, 1053 (79.4%) had a sputum examination of whom 310 (29.5%) had the recommended Xpert MTB/RIF assay (data not shown).

Among the 2399 patients with sputum test results, the results for 2039 (85%) patients reached the health facilities and 162 were positive, giving a positivity rate of 6.7%.

Of the 162 persons with laboratory diagnosed TB, 19 (11.7%, 95% CI 7.6–17.6%) experienced pre-treatment LTFU (Figures 1 and 2). Pre-treatment death was documented in one laboratory diagnosed patient. During the pre-diagnosis period, an estimated 39 laboratory diagnosed pulmonary TB patients were 'lost'. Overall, an estimated 58 laboratory diagnosed pulmonary TB patients were lost.

Among patients with a negative sputum test result ($n = 2237$), 45 (2%) were found to have clinically diagnosed TB and all were registered for treatment (Figure 1).

Delays in the cascade

Documentation of dates at each step of the cascade was generally poor, with 1037 (43.0%) having a missing sputum examination date and 499 (16.8%) having a missing presumptive TB registration (Figure 1). These 499 patients were entered directly into the laboratory registers but not documented in the presumptive registers (retrospectively included in the cohort). Time intervals were calculated for each step where the dates were available (Table 2).

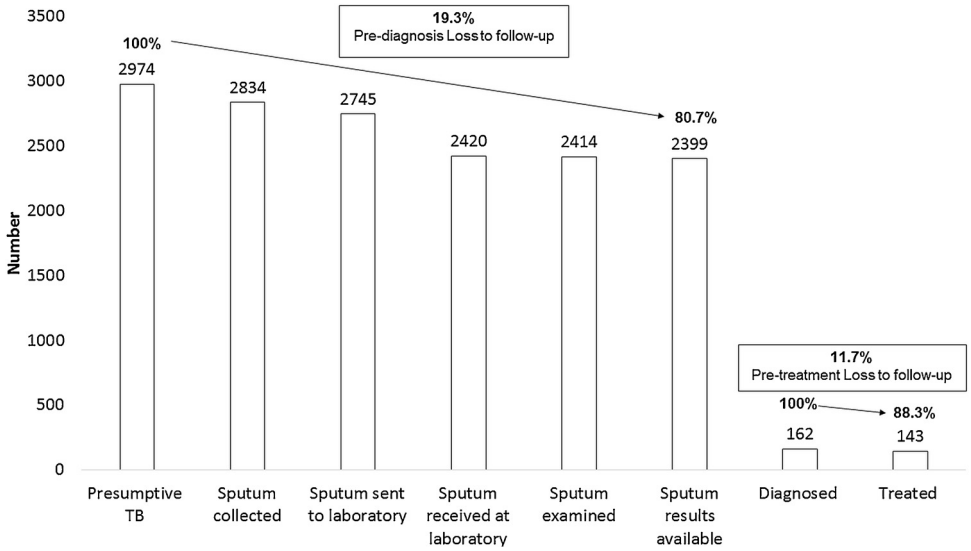

Figure 2. Pre-diagnosis loss-to-follow-up among people with presumptive pulmonary tuberculosis (TB) and pre-treatment loss-to-follow-up among laboratory diagnosed pulmonary TB patients in Guruve, Zimbabwe (2015–16).

Table 2
Time interval between each step of the cascade from presumptive pulmonary TB to treatment initiation in Guruve, Zimbabwe (2015–16).[a]

Variable	Number eligible	Assessed, *n* (%)[b]	Days, median (IQR)
Days to collect sputum specimen after presumptive TB registration	2834	2307 (81.4%)	0 (0–0)
Days to send sputum specimen to the laboratory	2745	2388 (87.0%)	1 (0–1)
Days to receive sputum specimen at the laboratory	2420	2055 (84.9%)	0 (0–1)
Days to testing after sputum specimen receipt at the laboratory	2414	1377 (57.0%)	0 (0–1)
Days to receive test result at the referring facility	2039	996 (48.8%)	0 (0–4)
Days to initiate treatment after the test result	188	122 (64.9%)	1 (0–3)
Days to receive sputum specimen at the laboratory after presumptive TB registration	2420	1910 (78.9%)	1 (0–4)
Days to testing at the laboratory after presumptive TB registration	2414	1143 (47.3%)	2 (0–5)
Days to receive test result at the referring facility after presumptive TB registration	2039	1882 (92.3%)	7 (2–12)
Days to initiate treatment (laboratory diagnosed pulmonary TB) after diagnosis	143	99 (69.2%)	1 (0–2)
Days to initiate treatment (clinically diagnosed pulmonary TB) after initial negative sputum examination[c]	45	23 (51.1%)	7 (2–21)
Days to initiate treatment (if TB diagnosed) after presumptive TB registration	183	159 (86.9%)	5 (1–11)

TB, tuberculosis; IQR, interquartile range.
[a] There were a total 2974 people with presumptive TB of whom 188 were diagnosed and initiated on TB treatment (143 had sputum-positive pulmonary TB and 45 had sputum-negative pulmonary TB).
[b] Row percentage, includes patients who completed the respective step of the cascade (as per Figure 1), eligible for the next step and whose respective dates were recorded.
[c] This interval does not represent 'delay in treatment initiation' after diagnosis, as the actual time of diagnosis could not be determined in this study.

Factors associated with pre-diagnosis and pre-treatment LTFU

Risk factors significantly associated with pre-diagnosis LTFU were registration at a health facility located more than 2 km from the nearest laboratory, registration at a RHC, absence of an EHT, unknown HIV status, and availability of the patient's phone number in the presumptive TB register (Table 3).

Pre-treatment LTFU was 13.6% (11/81) among patients tested using microscopy and 10% (8/80) among those tested using the Xpert MTB/RIF assay ($p = 0.48$). The type of test was not recorded for one laboratory diagnosed patient. No factors were significantly associated with pre-treatment LTFU (data not shown).

Discussion

In Guruve, pre-diagnosis LTFU among people with presumptive pulmonary TB was 19% and pre-treatment LTFU among laboratory diagnosed pulmonary TB patients was 12%. Programmatic factors significantly associated with pre-diagnosis LFTU were identified.

To our knowledge, this is the first study globally to assess the pre-diagnosis LTFU among people with presumptive pulmonary TB using a presumptive TB register in the programme setting. Specific points at which losses occurred were identified by taking advantage of the design of the presumptive TB register. Data were double-entered and validated, minimizing data entry errors.

Limitations

First, there were limitations in interpreting the pre-diagnosis and pre-treatment delays, including any sub-group analysis of these delays (say among patients from the district hospital and RHCs). A significant number of dates were missing at various steps of the cascade and the quality of documentation in the registers was poor. The most frequently missing date was 'the date of sputum examination' in the laboratory register. Routine recording of this date started only after August 2015. Almost one in five persons with presumptive pulmonary TB was entered directly into the laboratory register. Second, the analysis of factors associated with pre-treatment LTFU was limited by a small sample size. Finally, the presumptive TB registers at the time of the data collection did not capture death before treatment initiation. Reporting of only one death prior to treatment initiation may be an under-estimation that requires additional investigation in future studies.

Table 3
Factors associated with pre-diagnosis loss to follow-up among people with presumptive pulmonary TB in Guruve, Zimbabwe (2015–16).

Variable	Total assessed	Pre-diagnosis loss to follow-up		RR (0.95 CI)	aRR (0.95 CI)
	Number	*n*	(%)		
Total	2974	575	(19.3)	–	–
Age in years					
15–44	1694	356	(21.0)	Ref.	Ref.
45–64	831	146	(17.6)	0.84 (0.70–0.99)	0.86 (0.72–1.01)
≥65	397	68	(17.1)	0.82 (0.64–1.03)	0.94 (0.74–1.19)
Missing	52	5	(9.6)	0.46 (0.20–1.06)	0.53 (0.21–1.34)
Sex					
Male	1365	237	(17.4)	Ref.	Ref.
Female	1607	337	(210)	1.21 (1.04–1.40)	1.15 (0.99–1.33)
Missing	2	1	(50.0)	–	–
HIV status					
Positive	1327	281	(21.2)	1.10 (0.93–1.30)	1.12 (0.95–1.32)
Negative	943	182	(19.3)	Ref.	Ref.
Unknown	704	112	(15.9)	0.82 (0.67–1.02)	1.30 (1.05–1.60)[a]
Type of facility					
District hospital	861	64	(7.4)	Ref.	Ref.
RHC	2113	511	(24.2)	3.25 (2.54–4.17)	1.52 (1.05–2.22)[a]
Facility's nurse-in-charge					
RGN	2248	414	(18.4)	Ref.	Ref.
PCN	726	161	(22.2)	1.20 (1.02–1.42)	0.89 (0.74–1.07)
EHT at facility					
Yes	2384	393	(16.5)	Ref.	Ref.
No	590	182	(30.8)	1.87 (1.61–2.18)	1.31 (1.02–1.68)[a]
Distance to diagnosing facility from referring facility (km)					
<2	1291	109	(8.4)	Ref.	Ref.
2–4	150	45	(30.0)	3.65 (2.65–5.02)	2.69 (1.83–3.95)[a]
5–9	96	17	(17.7)	2.17 (1.34–3.53)	1.69 (1.01–2.83)[a]
10–14	594	160	(26.9)	3.49 (2.77–4.40)	2.40 (1.74–3.29)[a]
≥15	843	244	(28.9)	3.77 (3.03–4.69)	2.33 (1.64–3.31)[a]
Telephone number recorded in presumptive TB register					
Yes	107	37	(34.6)	1.84 (1.40–2.42)	1.40 (1.06–1.85)[a]
No	2867	538	(18.8)	Ref.	Ref.

TB, tuberculosis; RR, relative risk; aRR, adjusted relative risk; CI, confidence interval; HIV, human immunodeficiency virus; RHC, rural health centre; RGN, registered general nurse; PCN, primary care nurse; EHT, environmental health technician.
[a] $p < 0.05$.

Interpretation of the key findings

This study had several key findings. First, one in five persons with presumptive pulmonary TB was lost before laboratory investigations for TB were completed. Approximately two-thirds of these were lost between the sputum specimens being sent to the laboratory and their receipt at the laboratory. It is speculated that sputum rejection at the laboratory and challenges in specimen transportation are possible reasons. Documentation of specimen rejection by the laboratory technicians was not done during the study period; hence, it was not possible to quantify this problem.

Second, several programmatic factors related to specimen transportation were associated with pre-diagnosis LTFU among people with presumptive pulmonary TB. Being registered at a facility that was far from the laboratory or at an RHC was associated with pre-diagnosis LTFU. This is probably because specimen transportation was not required for patients registered at the district hospital or at the two RHCs that had sputum microscopy. In addition, transport covering long distances requires more resources thus increasing losses, more so if the EHT, who is responsible for specimen transportation, is not placed at the facility. There was no association between pre-diagnosis LTFU and the qualification of the nurse-in-charge. This suggests that both registered general nurses and primary care nurses were sufficiently competent in the management of people with presumptive TB in spite of the shorter training curriculum for primary care nurses.

Third, the findings for pre-treatment LTFU were consistent with those reported in a systematic review, which showed pre-treatment LTFU of 4–38%. However, the rate was lower than that reported previously in Zimbabwe (27% in 2006), in South Africa (22–25% in 2010–12), in India (22% in 2010–12 and 2015), in Cameroon (17% in 2009), and in Ghana (38% in 2009) (Chadambuka et al., 2011; Afutu et al., 2012; Claassens et al., 2013, 2017; Mehra et al., 2013; Mwansa-Kambafwile et al., 2017; Onyoh et al., 2018; Thomas et al., 2018). The pre-treatment LTFU is suggestive of insufficient attention paid to tracking all laboratory diagnosed patients so that they are promptly started on treatment. Furthermore, delays in specimen transportation, testing in the laboratory, and communication of test results play an important role. Long distance, long travel time, and urban location of treatment units were found to be associated with high pre-treatment LTFU in Cameroon (Onyoh et al., 2018).

Finally, a quarter of the people with presumptive TB had an unknown HIV status and only a third of those known to be HIV-positive had an Xpert MTB/RIF test. As per the guidelines of 2015–16, all HIV-positive presumptive TB patients should have been offered the Xpert MTB/RIF test.

Implications for policy and practice

The findings have key programmatic implications. First, identifying every single TB patient is of paramount importance in order to end TB (World Health Organization, 2015). A person with infectious TB is estimated to infect 10–15 other people in a year (World Health Organization, 2018). The district health executive team must thus make concerted efforts to strengthen specimen transportation, placing a motorized EHT at each RHC and monitoring the impact of these efforts on the proportion of pre-diagnosis LTFU.

Second, the district health executive team needs to strengthen documentation in all registers, including the recording of dates, so that the time intervals from one step to another in the care cascade can be monitored. For example, documentation in laboratory registers must include diligent recording of the presumptive TB number, dates of specimen receipt and testing in the laboratory, sending out of results, and documentation of the reasons in the case of specimen rejection.

Third, the district health team could consider documenting what happens to persons who are 'lost' in the facility presumptive TB registers. These interventions should be discussed during supportive supervision visits and performance review meetings. In addition, changes in the national guidelines should also be shared with health care workers in the district.

Fourth, in view of the low utilization of the Xpert MTB/RIF assay among people living with HIV and presumptive TB during the study period (2015–16), steps need to be taken to ensure effective expansion of Xpert MTB/RIF among all people with presumptive TB (recommendation since 2017).

Lastly, the programme needs to appreciate the primary care nurses (lower qualification than registered general nurse) as a great resource in TB care, as their input in one aspect of TB care did not differ significantly from that of their counterparts.

Future research

Similar studies to quantify pre-diagnosis and pre-treatment LTFU should be conducted in cities and other districts, including private health facilities, to estimate the magnitude of this challenge nationally. Future studies could also assess significant factors in the care cascades of persons with clinically diagnosed pulmonary and extrapulmonary TB.

Conclusions

In Guruve, a rural district in Zimbabwe, analysis of the TB care cascade revealed programmatic bottlenecks that resulted in patients being lost during the pre-diagnosis and pre-treatment phases. Addressing these bottlenecks will enable the programme to improve the TB case detection and treatment rates and move closer towards ending TB by 2035 (World Health Organization, 2015).

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Ethics approval

Administrative approval was obtained from the Mashonaland Central Provincial Medical Directorate. Ethics approval was obtained from the Medical Research Council of Zimbabwe and the Ethics Advisory Group of the International Union Against Tuberculosis and Lung Disease, Paris, France. As this study involved secondary data, a waiver for informed consent was sought and approved by the ethics committees.

Conflict of interest

None declared.

Author contributions

Conceived and designed the study: Admire S. Murongazvombo, Riitta A. Dlodlo, Hemant D. Shewade, Susumu Hirao, Valerie Robertson, Cremence Tshuma. Collected data: Admire S. Murongazvombo, Elijah Pikira. Developed data capturing tool and data entry: Admire S. Murongazvombo, Elijah Pikira, Riitta A. Dlodlo, Hemant D. Shewade. Data analysis and interpretation: Admire S. Murongazvombo, Riitta A. Dlodlo, Hemant D. Shewade, Cedric Zhanero, Rachael K. Taruvinga, Valerie Robertson, Susumu Hirao, Precious Andifasi, Cremence Tshuma. Prepared the first draft of the manuscript: Admire S. Murongazvombo, Elijah Pikira, Riitta A. Dlodlo, Hemant D. Shewade. Provided critical comments and final manuscript: all authors.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.ijid.2018.10.013.

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