The Republic of Uganda

The Uganda National Tuberculosis Prevalence Survey, 2014-2015

Survey Report

Acknowledgements

Many people and institutions have contributed to the conceptualization, proposal development, field work, data analysis, report writing, and final editing of this TB national prevalence survey report. Our thanks go to the Global Fund against AIDS, Tuberculosis, and Malaria (GFATM), which funded the survey; WHO and US-CDC, which provided technical assistance; the Ministry of Health (which provided the oversight; the Steering Committee and the Technical Working Group); Makerere University School of Public Health (which provided the overall management); the implementation team (both from the centre and those recruited at the survey sites, the regional and district TB focal persons, the district health officers, the local council members where we conducted the study); and the respondents. We are very grateful to all of them. In particular, we acknowledge the tremendous support from the Director General of Health Services Dr. Jane Ruth Aceng; the Director Clinical and Community Services Prof. Anthony Mbonye; the Commissioner Disease Control Dr. Alex Opio; the Program Manager NTLP Dr. Frank Mugabe from the Ministry of Health; and the Technical Working Group members under NTLP. We convey our gratitude to Dr. Ikushi Onozaki (WHO); Dr. Wilfred Nkhoma (WHO-AFRO); Marina Tadolini (WHO consultant); Charalampos Sismanidis (WHO); Irwin Law (WHO); Emily Bloss (US-CDC); Julia Ershova (US-CDC) for their international technical assistance. We thank Dr. Kaggwa Mugagga; Dr. Abel Nkolo from the WHO country office; Dr. Jim Arinaitwe and Dr. Vincent Bagambe from the Country GFATM office in Ministry of Health for their dedication and advice.

The survey would not have materialized had it not been for the support of the Dean; Makerere University School of Public Health; Prof. William Bazeyo; the Chairperson of the survey implementation committee Prof. David Serwadda, the members of the administration, different committees and finance management unit at the School of Public Health. We also acknowledge the contribution of Prof. Fred Nuwaha who steered the first part of the concept and proposal formulation. The consultants Dr. Martin Okot Nwang, Dr. William Worodria, Dr. Harriet Kisembo, Dr. Richard Omara, Dr. Zelidah Muyinda, Dr. Moses Joloba, Dr. Joseph Imoko, Dr. Simon Kasasa and Dr. Jayne Tusiime are also acknowledged.
The survey demanded commitment, dedication, and sacrifice. The people that met every week and sometimes more than once a week helped to share the burden. In a special way, my thanks go to Bruce Kirenga the Co-PI, Samuel Kasozi the Survey Coordinator and the field team leaders, Dr. Ronald Anguzu, Rachael Tumwebaze and Dr. Annet Nagudi. Your cooperation, innovativeness and commitment made the entire exercise worthwhile.
To all those not mentioned in name, especially to all the survey participants, you are dearly acknowledged and your contribution will bear fruit in all those that will make use of the report.

Prof Anthony K. Mbonye
AG. DIRECTOR GENERAL HEALTH SERVICES

Foreword

I am delighted to present this report on the findings of the first ever national tuberculosis (TB) prevalence survey in Uganda. This report represents a great milestone in the history of TB control and research in Uganda. The TB burden has continued to cause an enormous health challenge to the people of Uganda and is a big public health challenge to the health system in Uganda. Additionally, TB presents an economic challenge and impacts negatively on the livelihood of our people. The WHO estimates that there are more than three million people currently being missed by the TB programs globally. This therefore means that understanding the true burden is critical to devise policies and strategies to eliminate and eventually eradicate TB.

My government is committed to conducting locally relevant research to respond effectively to the health needs of the citizens. National TB prevalence surveys, such as this one, are one way of improving disease estimates for planning and Implementation.

This survey was conducted throughout the country in both rural and urban areas. All regions of the country were reached. It was scientifically conducted with utmost ethical consideration by our own Makerere University, School of Public Health in close collaboration with the National TB and Leprosy program. I wish to express my sincere gratitude to the competent team of local experts. I want to sincerely applaud the support we received from our development partners especially WHO, US-CDC, for the overall technical assistance we received and continue to receive. The survey also followed the laid down international procedures in accordance with the WHO recommendations on conducting national TB surveys. This survey would not have been possible without the enormous financial investment by the Global Fund to ensure that this high-quality research was conducted as prescribed.

This report highlights the burden of TB and identifies gaps for improving TB and TB/HIV co morbidity. It underscores the importance of understanding epidemiological profiles of the disease in Uganda. It is my hope that developed strategies will be meaningfully scaled up so that by the time a follow up survey is conducted; the burden will have reduced significantly. I urge all stakeholders, to work with the Government through the National TB and Leprosy Control Program to ensure the findings in this report are used to devise appropriate interventions which will help the country to find missed cases.

Finally, I congratulate the Government of Uganda, the Ministry of Health and the team of investigators for this landmark achievement in the history of our country, after 55 years of independence.

Hon Dr. Jane Ruth Aceng
HON. MINISTER OF HEALTH

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List of acronyms and abbreviations

AFB	Acid-Fast Bacilli
BCC	Behavior change communication
BCG	Bacillus Calmette Guerin
B+	Bacteriologically confirmed
C+	Culture positive
CD/EPTB	Clinically diagnosed/ extra pulmonary tuberculosis
CDC	Centers for Disease Control and Prevention
CDR	Case detection rate
Co-PI	Co-Principal Investigator
CXR	Chest X-ray
DGHS	Director General Health Services
DHO	District Health Officer
DMU	Data management unit
DST	Drug susceptibility testing
DTLS	District Tuberculosis and Leprosy Supervisor
EA	Enumeration area
EDC	Electronic data capture
FTL	Field Team Leader
GLRA	German Leprosy Relief Agency
HCT	HIV counselling and testing
HH	Household
HIV	Human Immunodeficiency Virus
HSD	Health Sub-District
IUATLD	International Union Against Tuberculosis and Lung Diseases
LC	Local Council
L-J	Löwenstein-Jensen
MakSPH	Makerere University School of Public Health
MDG	Millennium development goal
MoH	Ministry of Health
MOP	Manual of operations and procedures
MOTT	Mycobateria other than tuberculosis
MTB/RIF	Mycobacterium tuberculosis/rifampicin
NA	Not applicable
NALC	N-Acetyl L-Cysteine
NTLP	National Tuberculosis Leprosy Program
NTRL	National Tuberculosis Reference Laboratory
PI	Principal investigator
PIN	Personal identification number
PPS	Proportionate to population size

PTB	Pulmonary tuberculosis
RPMT	Regional performance monitoring team
RTLP	Regional Tuberculosis and Leprosy Focal Persons
S+	Sputum smear-positive
S-	Sputum smear-negative
SC	Survey coordinator
SD	Standard deviation
SDV	Source document verification
SIT	Site implementation team
TB	Tuberculosis
TSR	Treatment success rate
TWG	Technical working group
UBOS	Uganda Bureau of Statistics
UN	United Nations
UNION	International Union Against Tuberculosis and Lung Diseases
VHT	Village Health Team
WHA	World Health Assembly
WHO	World Health Organization
ZN	Ziehl-Neelsen

Executive summary

Uganda faces a high burden of tuberculosis (TB), but accurate estimates of the burden of TB in the country were unavailable. A national prevalence survey was therefore conducted from October 2014 to July 2015 to achieve the primary objective of estimating the prevalence of bacteriologically confirmed pulmonary TB (PTB) in the population aged ≥15 years in Uganda. In addition, the survey sought to estimate—

- The prevalence of smear-positive bacteriologically confirmed PTB in the population aged ≥15 years;
- The proportion of the survey participants with symptoms suggestive of PTB;
- The proportion of participants with radiological abnormalities suggestive of PTB;
- The prevalence of HIV among presumptive and confirmed TB cases; and
- The prevalence of tobacco smoking among survey participants.

Furthermore, the survey aimed to assess the extent to which participants with TB or those with symptoms suggestive of PTB had sought care, and, if so, from which providers. It also aimed to determine reasons why respondents with symptoms suggestive of PTB did not seek care from within the healthcare system.

Participants were screened using a combined-symptom questionnaire and chest X-ray strategy. Respondents with a cough lasting two weeks or more and/or any abnormality in the lungs according to chest X-rays were asked to provide sputum for TB testing. They were also tested for HIV. TB testing was conducted at the National TB Reference Laboratory (NTRL), where all samples underwent direct Ziehl-Neelsen (ZN) sputum smear microscopy.

Positive smears were confirmed using Xpert MTB/RIF to guide treatment decisions, and samples underwent a culture using the Löwenstein-Jensen (L-J) medium. A TB identification test was carried out for all positive cultures, and MTB culture isolates underwent drug susceptibility testing (DST) for resistance to first-line TB drugs. All chest X-ray (CXR) films were read by radiologists to determine prevalence of radiological TB. Survey TB cases were defined using evidence from the laboratory, clinical and radiology findings by a panel of expert pulmonologists, microbiologists, and radiologists.

A total of 41,156 participants in 70 clusters selected across the country were surveyed. Of these, 17,486 (42.5%) were males and 23,670 (57.5%) were females. The mean age of survey participants was 33.5; 5,144 participants (12.5%) fulfilled criteria for providing sputum samples and 4,844 (94.2%) of those selected provided sputum samples.
In total, 160 prevalent TB cases were diagnosed, including 66 with smear-positive TB. The prevalence of sputum smear-positive (S+) TB and bacteriologically confirmed (B+) TB among survey participants aged 15 years and older was 174/100,000 population,

(95%CI:111-160) and 401/100,000 population, (95%CI: 292-509), respectively. The prevalence was higher among males than females. Among males, the prevalence of S+ TB and B+ TB stood at 314/100,000 population and 734/100,000 population, respectively. For females, prevalence stood at 70/100,000 population and 179 per 100,000 population, respectively.

The most affected age group for S+ TB was 35-44 years (294/100,000 population), while for B+ it was those aged 55-64 years (636/100,000 population. The prevalence of S+ is 169/100,000 population in rural areas vs. 191/100,000 population for urban areas, while the prevalence of B+ is 370/100,000 population in rural areas vs. 504/100,000 population in urban areas. After adjusting for all age groups and extra-pulmonary TB (as these were not part of the survey) the prevalence of TB was found to be 253 (95% CI: 191–315**),** equivalent to 87,000 TB cases (95% CI: 65,000-110,000) per year. The prevalence to notification ratio overall was found to be 1.2—higher for males (1.5) than for females (0.7)—and was highest in the 15-24 age group (1.7).

The prevalence of any cough was 21.6% (8906 participants), while that of a cough lasting two weeks or more was 6.6% (2714 participants). The prevalence of active TB as interpreted by radiologists was 739/100,000 (95% CI 658-829). Out of the 2714 participants who reported a chronic cough, 61.0 % had sought care—38.3% from public health facilities and 21.5% from private places, including health facility and pharmacy. The survey established that very few of those who sought care were asked to provide sputum (10.3%) and take a CXR (6.0%). The main reasons for not seeking care were: ignored illness (31.1%), self-treated (31%); hindered by cost (16%) and long distances (5.4%). The survey established that 61 participants were on TB treatment at the time of the survey while 812 were previously treated for TB.

This survey has established that TB prevalence is higher than had been previously reported, and about half of TB cases are missed each year considering that the TB program notifies about 41,000 TB cases per year. Smear microscopy, the main TB diagnostic test in the country, misses about 60% of the cases, and CXR picked about 50% of the confirmed TB cases. These two findings point to a need to update the country TB screening and diagnostic algorithms. The much higher TB prevalence in men and the highest prevalence to notification ratio among the adolescents and young adults point to the need to develop strategies to diagnose TB in these sub-populations.

1. INTRODUCTION

1.1 Geography and demography

Uganda is a landlocked country located in East Africa covering a surface area of 241,038 sq. km. It is bordered by South Sudan to the North, Kenya to the East, the United Republic of Tanzania and Rwanda to the South, and the Democratic Republic of Congo to the West. The capital city is Kampala and English is the official language. Uganda's climate is typically tropical, with two rainy and two dry seasons a year.

The 2014 national census estimated the population of Uganda to be 34.9 million people, with 48.7% of the population under 15 years of age. About 82% of the population lives in rural areas, while 18% lives in urban areas. The proportion of males to females is 1:1 and life expectancy is 56 years for males and 59 years for females.

1.2 Uganda National Tuberculosis Leprosy Program (NTLP) and health service delivery

The NTLP is a disease control program under the department of the National Disease Control of the Ministry of Health (MoH). The NTLP operates on three levels, namely the national level (also referred to as the central unit), the regional level; and the district level. The NTLP is charged with performing the national core function of TB and leprosy control through 1) the establishment of countrywide quality diagnosis and treatment of TB and leprosy; 2) coordination and supervision of the implementation of TB and leprosy prevention and care services; and 3) prevention and management of leprosy-related disabilities.

The central unit of the NTLP is headed by a program manager. The program manager is supported by a number of officers who coordinate the following units: Prevention and Health Promotion; Monitoring and Evaluation; Care and Treatment Services; Laboratory Services and Policy; and Regional TB and Leprosy services. These units each employ focal officers for specific program functions.

At the regional level, management and supervision of TB and leprosy services is performed by the Regional TB and Leprosy Focal Persons (RTLP). There are currently 12 regions which are aligned to the 12 MoH Regional performance monitoring teams (RPMT) structure.

At the district level, the District Health Officer (DHO) is responsible for the management of health service delivery, including TB and leprosy prevention and care services. The DHO assigns a district health team member the responsibility of overseeing TB and leprosy care and prevention services in the district. The assigned person is referred to as the District TB and Leprosy Supervisor (DTLS). At the Health Sub-district (HSD) level, a medical officer or other administrator is responsible for the management of health service delivery, including TB and leprosy care and prevention services. A health worker, referred to as the HSD Focal Person, is assigned the responsibility of overseeing TB and leprosy care and prevention services at the HSD level. At the district, HSD and health facility level, TB and leprosy care and prevention services are integrated into the general health services.

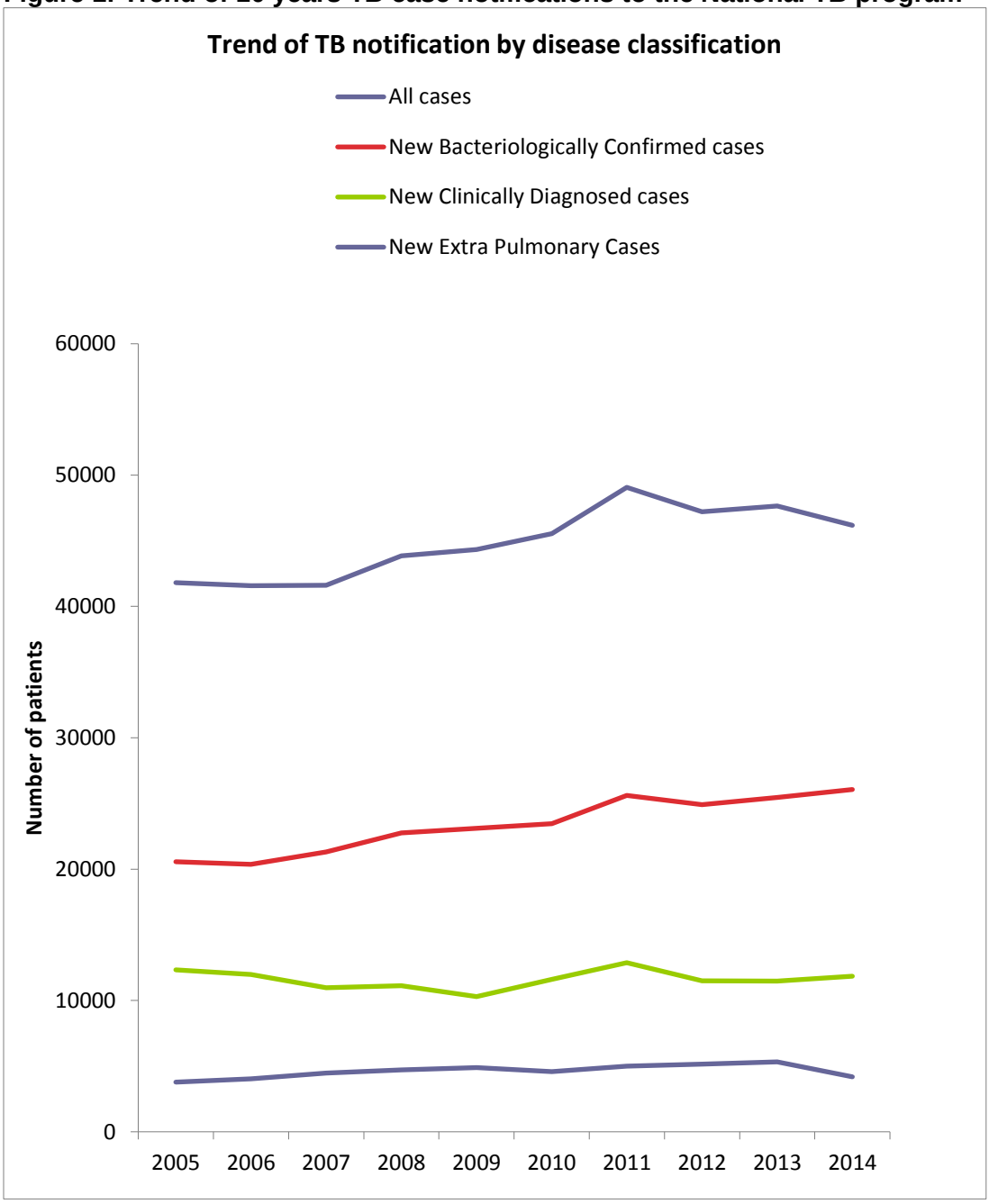
1.3 Burden of TB in Uganda

Like other Sub-Saharan countries, Uganda continues to notify thousands of TB cases. The number of notified cases has been progressively declining (see Figure 1). Furthermore, Uganda is one of the few former 22 high-burden TB countries that met all three TB Millennium Development Goal targets, halving the incidence, prevalence, and mortality of TB in 2015 from 1990 levels.

In 2014, surveillance data estimated TB prevalence at 159/100,000 population; incidence at 161/100,000 population; and TB-related mortality at 12/100,000 population[1]. In the same report, the HIV/TB co-infection is reported as 45% compared to the general population HIV prevalence of 7.3%[2]. [3]

[1] World Health Organization. Global TB Report 2015.
[2] Uganda AIDS Indicator Survey, 2011.
[3] This is based on the 81% of 2010 TB cohort that was tested for HIV

Figure 1: Trend of 10 years TB case notifications to the National TB program



1.4 Statement of the problem

Before the survey, the estimates of the TB burden in Uganda were based on mathematical modelling and did not necessarily accurately reflect the burden of the disease in the country. The level of uncertainty was high, with prevalence ranging between 93 and 306 (average 193) per 100,000 population[4] (WHO Global TB Control Report, 2011). Furthermore, routine TB surveillance in Uganda is still incomplete: the system does not capture patients who self-medicate, use traditional healers and/or private health providers. The recording and reporting of those who seek care from formal health facilities is also not complete, and the vital registration system that collapsed in the 1970s has yet to be revived.

Thus, Uganda did not yet have an accurate estimate of its TB disease burden that NTLP could use to objectively measure progress towards the global and national targets. In addition, Uganda had limited data on the number of people who were current or former smokers. Tobacco smoking is a major risk factor for a number of respiratory and non-respiratory diseases, and TB risk is increased fourfold among smokers and former smokers[5].

1.5 Study Justification

The MDG targets for TB incidence, prevalence, and mortality were set to be achieved by 2015. In addition, the World Health Assembly (WHA) and the Global Stop TB Partnership set the case detection rate (CDR) and treatment success rate (TSR) targets at 70% and 85%, respectively[6]. Differences between national and global estimates for Uganda and the commitment of the NTLP to the MDG target of halving TB mortality and prevalence by 2015 relative to 1990 levels highlighted the need to derive an accurate estimate of the TB burden.[7, 8] Indeed, the MDG supplement to the *Global TB Report 2013* indicated that Uganda had attained the TB MDG target prior to the 2015 target year. The prevalence survey would at least confirm whether the country has indeed halved the prevalence of TB or not.

[4] World Health Organization. Global TB Control Report, 2011.
[5] Bates MN, Khalakdina A, Pai M, Chang L, Lessa F, Smith KR. Risk of tuberculosis from exposure to tobacco smoke: a systematic review and meta-analysis. Arch Intern Med. 2007; 167(4): 335-42.
[6] These have since been modified to "case detection rate all TB cases" and "annual treatment success rate of 90% among new smear-positive cohorts"
[7] World Health Assembly. WHA Resolutions, 1991.
[8] United Nations. Millennium Development Goal Indicators, 2006.

To plan effectively, monitor the impact of interventions, and assess progress towards the WHA and MDG targets, NTLP needed epidemiological information about the burden of TB.[9] This could be derived from population-based TB disease surveys, which could provide an opportunity to accurately measure the prevalence of bacteriologically confirmed TB.[10] This data could also be used to establish a baseline against which to measure future trends of TB burden in the country. Furthermore, the survey provided NTLP an opportunity to assess the completeness of its surveillance system by establishing what proportion of survey TB cases had already been detected by the routine health system. The prevalence of tobacco smoking was included in this study so as to determine the number of TB patients who smoke tobacco, and to estimate the prevalence of tobacco smoking in general.

[9] Attaran, 2005.
[10] World Health Organization. *Assessing prevalence of TB through population-based surveys.* 2007.

2. OBJECTIVES AND METHODOLOGY OF THE SURVEY

2.1 Objectives

2.1.1 Primary Objective

The primary objective of the survey was to estimate the prevalence of bacteriologically confirmed pulmonary TB (PTB) in the population aged ≥15 years in Uganda.

2.1.2 Secondary objectives

- To estimate the prevalence of smear-positive bacteriologically confirmed PTB in the population aged ≥ 15 years in Uganda.
- To estimate the prevalence of symptoms suggestive of PTB among those aged ≥15 years.
- To estimate the prevalence of radiological abnormalities suggestive of PTB among those aged ≥15 years.
- To estimate the prevalence of HIV among presumptive and bacteriologically confirmed TB cases.
- To assess the extent to which participants with TB disease or those with symptoms suggestive of PTB have sought care and, if so, from which providers.
- To identify reasons why respondents with symptoms suggestive of PTB did not seek care from healthcare system.
- To update population-based estimates of the burden of disease using results from the prevalence survey in combination with in-depth assessment of surveillance and programmatic data and other survey data.
- To estimate the prevalence of tobacco smoking in the population aged ≥15 years in Uganda.

2.2 Methodology

2.2.1 Survey design

This survey was a cluster-based cross-sectional, nationwide population-based design. There were 70 clusters planned for the survey.

2.2.2 Study population

The study population consisted of respondents aged 15 years and above from a nationwide sample. The survey was limited to those aged 15 years and above for a number of reasons: it

is uncommon to find smear and culture-positive TB in children below 15 years; it is difficult to collect sputum samples from children; and conducting mass chest X-ray screening on healthy children raises ethical concerns. Furthermore, interpreting results of tuberculin surveys to assess the annual risk of TB infection in children is challenging in settings like Uganda, where BCG coverage and HIV prevalence are high.

2.2.3 Sample size

The sample size was based on the formula

$$n = Z^2 * (1-P)/D^2*\mu$$

in which n is the number to be surveyed, P is the prevalence, μ is the mean prevalence and D is the degree of precision.

Based on the 2009 WHO estimated PTB prevalence among respondents aged 15 years and above of 269/100,000[11] and a precision of 25%, the required number, n, to be examined was $(1.96^2 * (1-0.00269)/0.25^2 x 0.00269) = 22,769$.

This sample size was adjusted to cater for an expected participation rate of 85% and design effect of 1.5 (22,769/0.85 x 1.5) yielding a final sample size of 40,180. These were guided by findings of other studies carried out in the country[12], and previous TB prevalence surveys.

2.2.4 Sampling procedure

The entire country was included in the sampling frame. The village—the census enumeration area (EA)[13] as combined by Uganda Bureau of Statistics (UBOS)—was the final sampling unit. A list of villages with their respective populations was available through the 2014 UBOS Census Report, and UBOS was directly responsible for cluster selection.

Villages to be surveyed were selected from all over the country in a single-stage systematic cluster sampling strategy with probability proportionate to population size (PPS) as in EPI survey methodology.[14] The villages were stratified by rural and urban settings to ensure a representative and precise overall estimate of prevalence. PPS was used to allow for self-

[11]This is based on the 2009 WHO estimated prevalence of smear-positive TB of 200/100,000 and a lower limit of 70 i.e. 200*0.7/100,000 among general population and of (200*0.7/100,000)*0.52 for those 15 and above
[12]The participation rates in these studies ranged from 90.4%–94.7% and the design effect from 1.303 to 1.3.
[13] Uganda Bureau of Statistics. *Census Report*, 2002.
[14] Lemeshow, 1985.

weighted analysis of survey results while selection from all over the country was used to allow for generalization of conclusions.

For this stud an EA consisting of one or a group of villages was taken as a cluster. The rural–urban dichotomy was considered during the sample design and all urban areas as officially gazetted by the Ministry of Local Government. The urban-rural stratification was not for purposes of providing urban-rural estimates, rather to ensure representation of urban-rural characteristics in the sample. Thirty clusters were selected from the urban EAs, and 40 clusters were selected from rural areas. In each of the selected EAs, 580 participants who were 15 years of age or older were to be interviewed (range 550-680).

2.2.5 Sampling unit selection

In this study, the final sampling unit (cluster) comprised 580 eligible respondents[15], derived by dividing the sample size (40,180) by the number of clusters (70).[16] The larger the number of clusters sampled, the smaller the design effect.

For practical purposes, a minimum of 550 and a maximum of 680 eligible respondents was taken as the acceptable cluster size. If a village with less than 550 eligible respondents aged ≥15 years was sampled, the survey team was to link it to a nearby village to achieve the target cluster size. If the addition of the second village resulted in a total number of eligible respondents exceeding the cluster size, the second village was divided into equal blocks, and the blocks needed to achieve the cluster size within the range of those in the survey. The starting block was randomly selected by the village leader and then blocks were added in a clockwise manner around the original block until the required cluster size was achieved.

If a village was bigger than the cluster size (more than 680): the village was divided into equal blocks. The village leader randomly picked the first block to be included and then blocks would be added in a clockwise manner, until the cluster size of not more than 680 was achieved. All eligible respondents in selected blocks were invited to the survey.

2.2.6 Screening strategy

For this survey, all eligible, consenting respondents aged 15 years and above (including the pregnant women, elderly and handicapped) were screened using a combined symptom questionnaire and chest X-ray strategy, illustrated diagrammatically in Figure 2 below.[17]

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[15] Experience gained from prevalence surveys in countries in Asia and African countries shows that a cluster size of 500 – 600 can comfortably be completed in 5-6 days

[16] 40,180/70 = 580

[17] WHO, 2007.

Respondents with a cough lasting two weeks or more and/or any abnormality in the lung on chest X-ray[18] were eligible for sputum collection, and were asked to submit two sputum samples (a spot and an early morning sample). They were considered presumptive TB respondents. Respondents who did not have a chest X-ray taken (due to sickness, disabilities, refusal or other reason) were also eligible to submit sputa, even if asymptomatic.

All respondents eligible for sputum collection were also eligible for HIV testing. They underwent voluntary HIV counselling and testing (HCT) using rapid tests according to the Uganda Ministry of Health guidelines[19] if they consented to do so. HIV-positive participants were referred to the nearest health facility for continued counselling and care according to national guidelines.

This screening strategy had the limitations of not measuring extrapulmonary TB in adults and TB in children <15 years. Symptom screening to identify TB patients also had a lower sensitivity in people infected with HIV.

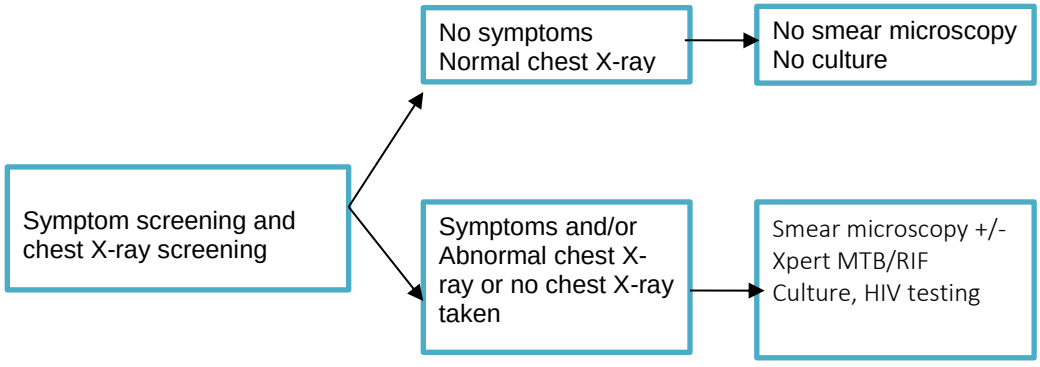


Figure 2: Diagrammatic representation of a combined symptom and chest X-ray screening strategy

2.2.7. Inclusion and exclusion criteria

[18]One X-ray centre were set up per cluster. Three mobile simple, robust, and easy to operate and maintain locally conventional chest X-ray units were procured. Each was operated on a 5.5 kW generator also procured for the purpose. A conventional system with an automated developer was used as this had advantages over conventional systems with a conventional developer. The developing process was faster and technical errors were less critical. An estimated 90-200 X-rays were taken, developed (auto-developer) and read per day.

[19]Uganda National Policy Guidelines for HIV Counseling and Testing. 2003 [cited 2012 August 2]; Available from: www.who.int/hiv/pub/guidelines/uganda_art.pdf.

Inclusion and exclusion criteria were applied to define the eligible population that contributes towards the target cluster size. Ultimately, all eligible individuals were classified as either present or absent. Present individuals were further classified as having consented and participated in the survey, or as not having consented—and therefore not participated—in the survey.

Inclusion criteria:

- Sampling frame/Cluster level: All regions and all populations, including mobile populations of the country were included in the survey sampling frame.
- Household (HH) level: Households within selected clusters identified to be a part of the survey operations
- Individual level—
    - Respondents aged ≥15 years
    - Permanent residents of the HH who had spent at least one night in the HH in the last two weeks prior to census day, or temporary visitors who had arrived in the HH at least 14 days before the census day[20]
- Examination level: Informed consent provided, or provided by a guardian if <18 years.

Exclusion criteria:

- Sampling frame/cluster level: No clusters were excluded based on insecurity or inaccessibility.
- Household level: Residents of institutions like prisons or jails, military and diplomatic compounds, hospitals, schools, universities and dormitories, orphanages, monasteries, and refugee camps.
- Individual level—
    - Subjects <15 years old
    - Permanent resident who had not lived in the household in the last 14 days before the census (i.e. people who travelled for more than 14 days before the census)
    - Temporary resident (visitors) who had lived in the enumeration area for less than 14 days prior to census day.
- Examination level: Persons who were unable to provide consent or whose guardians could not provide consent (e.g. severe physical or mental disability impairing ability to provide informed consent, or age<18 years without consent from an older guardian or parent).

[20]Census happened on first day of survey operations

2.2.8 Survey TB case definitions

The survey defined cases as—

- Definite Smear-positive (S+) TB case:
    - Smear-positive in at least one sample and culture MTB positive in at least one sample; OR
    - Smear-positive in at least one sample, and Xpert-positive in at least one sample
- Definite Smear-negative culture-positive (S-C+) TB case:
    - S Smear negative, strong culture positive (> 10 colonies) according to the WHO classification in at least one sample (unless cross-contamination is strongly suspected based on laboratory register); OR
    - Smear-negative, weak culture (<10 colonies) in two different samples; OR
    - Smear-negative, weak culture in one sample AND Xpert-positive in another sample; OR
    - Smear-negative, weak culture in one sample AND Xpert-positive on the same sample AND CXR consistent with TB; OR
    - Smear-negative, weak culture in one sample, Xpert-negative/NA AND CXR consistent with TB; OR
    - Smear-negative, culture not positive/NA/MOTT, Xpert-positive and CXR consistent with TB

2.2.9 Case definition

Cases were classified as bacteriologically confirmed or otherwise—

- *Bacteriologically confirmed:* Either culture positive or Xpert MTB/RIF positive.
- *Bacteriologically negative, but central chest X-ray reading strongly suggestive of TB disease:* These persons were not counted as prevalent TB cases in this study, but were to be referred for case management.

Cases were also classified according to whether they had been detected as TB cases by the health system before the survey or not; and whether they were new or retreatment cases, as follows—

- *TB case undetected by health system:* Person identified by the survey to be a TB case who had not yet been diagnosed of TB before the survey;
- *TB case detected by health system and on treatment at the time of the survey:* Person identified by the survey to be a TB case that had been diagnosed with TB by health system and is/was receiving anti-TB treatment.

- *TB case detected by health system and not on treatment at the time of the survey:* Person identified by the survey to be a TB case that had been diagnosed with TB by the health system but had not yet received anti-TB treatment.
- *Previously treated TB case, not on treatment at the time of the survey:* Person identified by the survey to be a TB case who had previously had treatment for TB and who was not receiving treatment with anti-TB drugs at the time of the survey.
- *Previously treated TB case, on treatment at the time of the survey:* Person identified by the survey to be a TB case who had previously had treatment for TB and who was being treated with anti-TB drugs at the time of the survey.

Patients confirmed by the medical panel as having active TB were sent to the survey coordinator, who in turn contacted the District Health Officer, the District TB supervisor and the patient about the diagnosis of TB. The District TB Supervisor was responsible for ensuring that the patient is treated. The survey coordinator performed a telephone follow-up with the patients and the District TB Supervisor to ensure that the patients were treated.

2.2.10 Statistical analysis

A detailed data analysis plan was made with close involvement of the survey epidemiologist team and international experts from the WHO and CDC. All analysis was done in STATA v.12. To start, all data were cleaned in Epi Info™ software Version 3.5.1[21] through testing for completeness and consistency of the "core"[22] data on source documents, including the questionnaires, X-ray reports, and laboratory results forms. Descriptive statistics were used to summarize sample and participation characteristics. The estimate from the best fit model was used for the prevalence of TB from this survey as per published recommendations.[23] Prevalence estimates were adjusted to cater for all forms of TB and TB in all ages based on estimated child TB (2014 data only) and extrapulmonary TB notifications (2009-2014), and UN population estimates (2015). A chi-square test (χ^2) was used for comparison of categorical variables. The two-sided Fisher's Exact test was also used when appropriate.

[21] Centers for Disease Control and Prevention. Epi Info™: Version 3.5.1. Atlanta: 2008

[22] Core data included cough of 2 weeks or more, abnormality in the lung fields, smear, Xpert and culture results as well as central CXR reading data

[23] Floyd et al. Analysis of tuberculosis prevalence surveys: new guidance on best-practice methods. Emerging Themes in Epidemiology 2013, 10:10

3. SURVEY IMPLEMENTATION

3.1 Survey period

Field data collection commenced in October 2014 and ended in July 2015. Laboratory investigations for microscopy, culture, DST and Xpert MTB/RIF ended in November 2015. Data cleaning, analysis was completed in December 2016. Pre-field work survey preparation activities were initiated in 2009, and field work began in October 2014. The 2009-2014 period covered activities such as concept development, proposal development; grant application for funds, tools and standard operating procedures document development, training, and pilot testing.

3.2 Survey organization

3.2.1 Organogram

For the purposes of managing and coordinating the survey, the organization of the survey was arranged as represented in the organogram (see Figure 3).

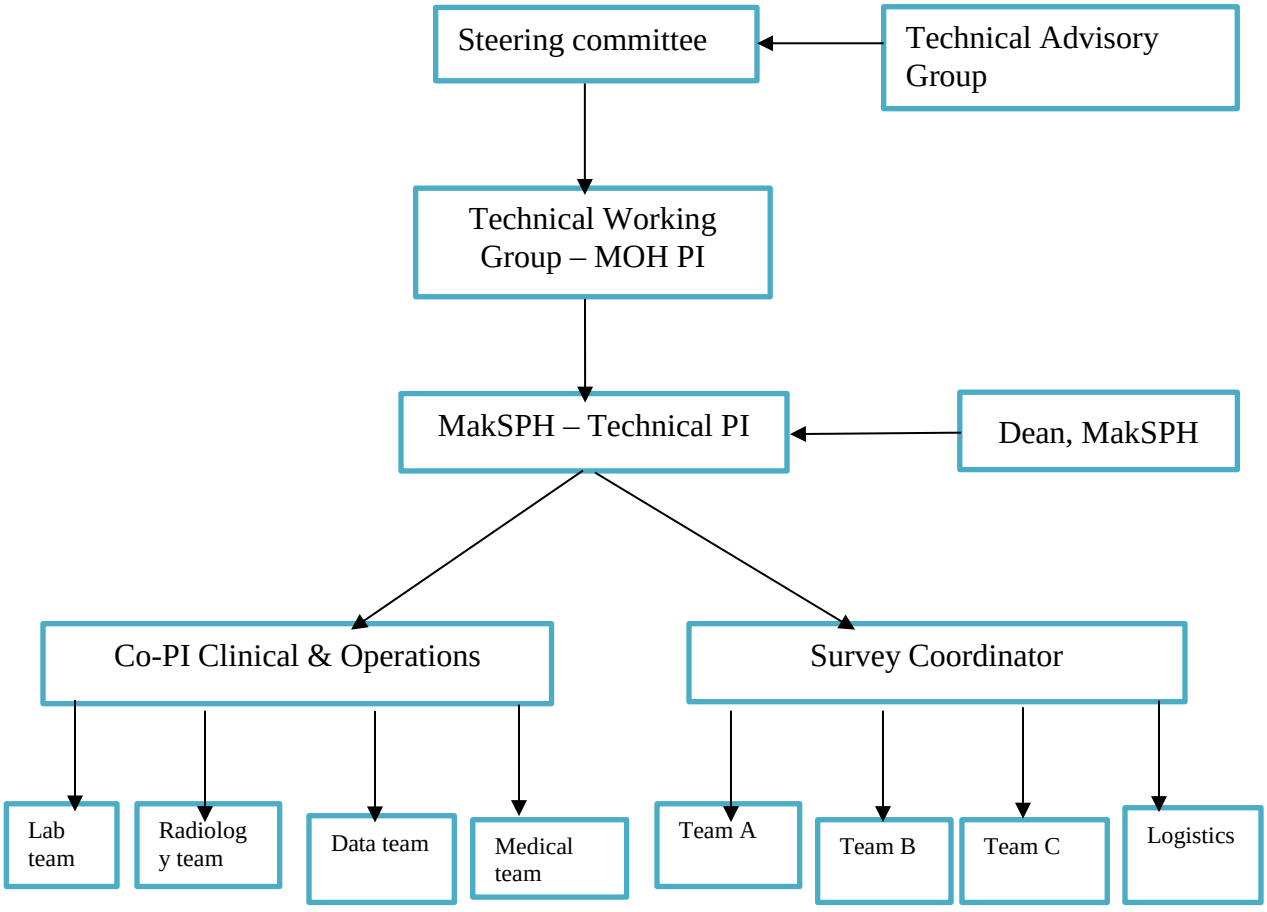


Figure 3: Survey Organogram

3.2.2 Steering committee

The Steering Committee (SC) was composed of the Director-General of the MOH, the Director (Clinical and Community) at the MOH, the Commissioner for National Disease Control (NDC), and institutional representatives of: the WHO, the UNION, CDC, UBOS, GLRA, and Dean School of Public Health. The SC was chaired by the Director-General of Health Services (DGHS). The NTLP Program Manager (MOH Principal Investigator), the MakSPH principal investigator and the co-principal investigator attended the SC. The SC was planned to meet on a quarterly basis or whenever there were issues that needed attention. The SC was responsible for resource mobilization, advocacy, and policy direction.

3.2.3 Technical Working Group (TWG)

A TWG composed of members responsible for the technical and scientific input into the study was appointed by the Director-General of Health Services. The TWG was composed of national TB experts in survey, laboratory, radiology and epidemiology to provide timely technical advice to the Survey Implementing Team. The TWG main role was to advise the SC and Survey implementing Team on technical issues in preparation and execution of the survey, and in data management including analysis and reporting. The TWG also participated in training and quality assurance activities and field monitoring. The TWG planned to meet approximately once a month.

3.2.4 Makerere University School of Public Health (MakSPH)

Makerere University School of Public Health was contracted to implement the survey on behalf of the Ministry of Health. The Dean's office was responsible for the appointment of all survey personnel and finance management.

3.2.5 Principal investigator, co-principal investigator and Unit and Survey Coordinator

The overall supervisor was the principal investigator. All central level activities, including data management, medical panel, laboratory, radiology, quality assurance, and data analysis were coordinated by the co-principal investigator, while the survey coordinator arranged all field activities and logistics.

3.2.6 Survey Field Teams

The survey coordinator was directly in charge of the field teams. Three field teams were formed to collect data in the clusters. The teams worked in rotation, with two teams in the field collecting data, while one team was back at the center for a week resting. During that period, the team did maintenance and logistics preparations. Resting teams also responded to data queries generated by the data management team.

Each of the three field teams was headed by a Field Team Leader (FTL). The FTLs were directly responsible for the implementation of the fieldwork. The FTL roles included—

- Leading the field team;
- Visiting (second pre-visit) the selected clusters before the fieldwork (during breaks);
- Being responsible for logistics and organization during the fieldwork;
- Coordinating the day-to-day fieldwork;

- Communicating with local and district authorities on issues regarding the fieldwork; Compiling the field report; and
- Reporting any problems in implementing the survey protocol in the field.

Each field team consisted of a fixed and a flexible team member. The fixed part consisted of approximately 14 members from the central level, and its team members remained the same for all clusters. The flexible part consisted of 11 staff from the district, parish, and village levels recruited to assist the field operations. The flexible component differed from cluster to cluster and allowed for adaptation to local circumstances, while the fixed component guaranteed standardization of survey procedures across clusters.

For the average cluster size of 550-680 persons of $\geq$15 years, it was estimated that field-work would last one week per cluster, and would take approximately 10 months to complete 70 clusters. To make clear what was expected of each field team member, a field manual of operations and procedures (MOP) detailing all activities was written and carried by each FTL.

The fixed part of the field team consisted of the following members:

- Field Team Leader (1)
- Data checker (1)
- Receptionist (1)
- Census and Interviewers (3)
- Radiographer (2)
- Radiograph reader (1)
- Laboratory technician (1)
- HCT counsellor (1)
- Electrical/Biomedical Technician (1)
- Drivers (2)

The flexible part of the team was drawn from the selected area (district and cluster). These were:

- Clerk/Local TB Focal Person (1)
- Radiology assistant (1)
- Laboratory technician/laboratory assistant from the regional/district TB team (1)
- DTLS (1)
- Community leader (e.g. LC Chairman) (1)
- Assistants/Village health team (VHT) (for pre-census, census, receptionist, interviewer) (5)
- Security staff (2)

3.3 Survey preparations

3.3.1 Procurement of equipment and consumables

The procurement in this survey was carried out according to Uganda government standard procedures and rules. Initially, the MoH handled procurement of vehicles, X-ray processors, some computers, and generators. This equipment was handed over to the School of Public Health when a contract to implement the survey was awarded to the School of Public Health. The School of Public Health finalized the procurements.

Although all foreseeable procurements were done before the survey or shortly into the survey, some consumables were procured during the survey because they ran out. Procurements were also undertaken for equipment that either were worn out or broke down—notably the X-ray processors, which were replaced all together. All the generators broke down, and other generators had to be hired halfway through the survey to be used until the end.

3.3.2 Recruitment

Prior to start of the survey, all budget negotiations, major procurements, and protocol were finalized, and survey personnel were recruited. The Makerere University School of Public Health managed the recruitment.

3.3.3 Training with field survey manual

Recruited fixed field team members underwent a didactic training and field training during the simulation and pilot to standardize survey implementation and ensure quality data collection. The didactic training had two phases: a general modular survey team training and a technical training conducted separately for the different areas of work (i.e. laboratory staff, radiology staff, data management, etc.). This was followed by hands-on training in survey simulation and piloting.

The general survey training was a two-day training. Topics covered included rationale, objectives, design of the survey, cluster identification (map reading) and the roles and responsibilities of various team members, data collection.

Technical training lasted one week. It was aimed at building capacity for laboratory and X-ray technicians, as well as for data management staff in specialized activity areas. For radiographers, topics covered included X-ray taking and reading procedures; for laboratory personnel, topics included sputum sample collection, transportation, and processing

procedures, sputum examination, HIV counselling testing procedures, recording and reporting, and survey data management. Simulation and pilot testing followed the theoretical aspects of technical training.

3.3.4 Pilot of the survey

Three clusters in a district not selected for the main survey were selected for piloting. The pilot was conducted from 21st–27th September, 2014. Each team piloted for one week in a separate cluster. This approach allowed each team to have a full experience of a survey before the real survey could start. This also allowed the central teams to receive real data to pilot their systems. Sputum samples were sent to the laboratory and were analysed. The radiologists interpreted films. All data both central and field were checked, double entered, and cleaned. Medical panel decided the cases from the pilot. The epidemiology team performed analysis. The central quality control procedures were also tested. The questionnaire and SOPs were adjusted following the pilot in final preparation for the survey.

3.3.5 Field survey preparations

To prepare each of the study clusters, two pre-visits were made: the first was by the Survey Coordinator, who conducted the visit one to three months prior to the cluster operations, while the second was by the Field Team Leaders (FTLs) three to four weeks prior to the survey. In all study clusters, the Survey Coordinator (SC) met with district authorities, as well as sub-county and local leaders, and informed them about the survey. They discussed and carried out a visit to the cluster, during which the SC assessed the feasibility of carrying out a survey in that village. In addition, the SC obtained information on the availability of phone network, electric power, and water supply, as well as preliminary information on potential survey base, accommodation and catering services for the field survey team. No cluster was found to be inaccessible.

During second pre-visits, a FTL met with the DTLS and local leaders and informed them about the survey procedures, decided the location of the survey base, identified, and trained local health workers and community leaders—including members of village health teams (VHTs)—to assist in the survey. In addition, the FTL provided the local authorities with household (HH/census) registers, requested them to prepare a household registry, and assessed the most convenient time for carrying out the survey.

During this visit, the FTL, in collaboration with village officials and VHTs, mobilized communities to participate in the survey through meetings informing them of the purpose, target groups, procedures, benefits and risks of the survey. In addition, the FTL informed the local leaders/VHTs of the timing of the survey and the survey base where participants need to go for interview, X-ray and sputum collection as agreed upon during mobilization

sessions. During these pre-visits, the local leaders/VHTs assisted the FTLs to find accommodation and mechanisms for obtaining meals for field survey team during the survey.

After the second pre-visit, a list of all residents in all households in the selected village(s) was developed by community leaders in preparation for the survey. This population information was used to develop precise local plans and computation of the proportion of children below 15 years of age.

3.4 Field survey activities

At the time of the survey in the cluster, a survey base was set up within the cluster at a location priory selected during the second pre-visit. The base had all the necessary stations to accomplish the tasks in the survey. The tasks began with the arrival of participants at the survey base and ended after participants had provided sputum samples and when the data checker was satisfied with the completeness of the data collected. The organization of the survey base is shown in Figure 4 below.

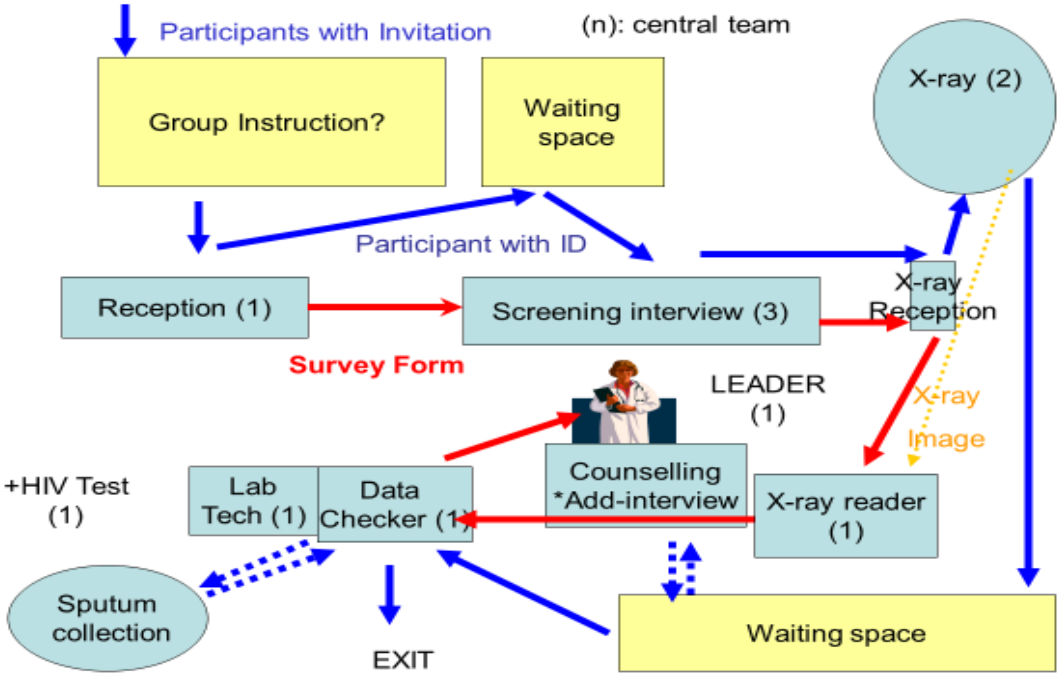


Figure 4. Organization of the field survey base

3.4.1 Enumeration

Using the knowledge and skills acquired during second pre-visits, local council 1 (LC1)

/VHTs completed enumeration of all HH members in each of the study clusters. This enumeration captured names, age, sex, occupation of HH members. The other information on residency and eligibility of HH members was determined and completed by the census unit during day one of the survey. Again, information regarding attendance and consent of respondents was entered in HH registers and a pre-printed PIN as appeared on the individual questionnaire was applied in the space for serial number during the survey. Finally, reasons for absence or ineligibility of respondents were captured in the remarks column of the HH register during the census.

3.4.2 Census

In each of the selected study clusters, the field team arrived on Day 0 (a Sunday for rural and a Thursday for urban clusters) and received household registry from the LC1 leaders/VHTs. They would then visit each household making a census and inviting the eligible participants. Then, the FTL crosschecked and cleaned the HH registry to include new members who came to the HH, and deleted those who died or moved away from the HH with the help of LC1 leaders/VHTs, thereby updating and finalizing the enumeration HH list. The FTL ascertained that the HH list included all household members, and that the number of residents 15 years and above was within the required sample size of 550-680.

Census was undertaken on Day 1 by the census unit (comprised of a FTL, counsellor, receptionist, and interviewers). The census unit visited and assigned each of the HHs a HH number which was pinned on the front door of each the HH in the cluster. Thereafter, HH members including children were assigned a personal identification number (PIN), derived by combining the cluster number (2 digits), household number (3 digits) and a serial number (2 digits). Then, eligible HH members (residents aged ≥15 years who spent at least one night in the HH in the last two weeks prior to census day or temporary visitors who arrived in the HH at least 14 days before the census day) were issued with survey invitation cards (bearing their PIN) which they brought to the survey base at a designated date and time.

3.4.3 Screening with interview

At the survey base, different field stations were set up to conduct survey activities. These included waiting/reception area, interview, CXR, field laboratory, sputum collection and HIV testing in that order. The HIV testing station was set nearby the sputum collection station to reduce stigmatization associated with HIV testing. Data collection was undertaken on Days 2 to 5, and all invited eligible HH members received group instruction on the benefits of participating in the survey, the potential risks involved, and the survey procedures upon arrival. Each participant was led to the reception area, where information

including his/her name, sex and the PIN on the survey card was validated against the HH/census registry collected on Day 1 and ensured that the correct respondent was interviewed. A receptionist registered the participant's attendance in the survey HH register and issued two consent forms and a survey questionnaire, which a flexible team member took together with the respondent to an interviewer. A trained interviewer then obtained consent (for minors 17 and under, consent was obtained from guardians), retained a copy of signed consent forms and at the same time the respondent was issued with a copy.

The interviewer then administered a 5-10-minute structured questionnaire covering identification data, symptoms, healthcare-seeking behavior, history of current and past TB treatment and tobacco smoking to this respondent. Respondents with a cough for two weeks or more were then referred for sputum collection and HIV testing. In each of the study clusters, field operations lasted one week.

3.4.4 Screening with chest X-ray

A mobile chest X-ray (CXR) unit was set up at the CXR station. All respondents, regardless of interview results, were led to this restricted CXR area, where a radiographer validated that the respondent before him was the one indicated on the survey invitation card. Then the radiographer recorded the identification data of the validated respondent on the CXR films. The radiographer took the CXR of those who consented and noted those who declined under remarks. Each film was labelled with the same PIN as reflected on the individual survey invitation card prior to the X-ray procedure.

Conventional portable mobile X-ray machines were employed while direct CXR with full-size postero-anterior films were used. As a precaution, women wore lead aprons while X-ray personnel used radiation monitors on top of lead aprons and lead shields. Chest radiographs were developed in the field using automated X-ray processors. The results were then read and provided to respondents before they left to ensure that a repeat CXR could be done if necessary. One radiograph reader interpreted the radiographs in the field, either as normal or abnormal, specifying whether abnormality was in the lung field or other abnormality (such as cardio vascular diseases, goiter or injury). Respondents with any abnormalities in the lung field were then referred to data checker, who checked for completeness of data on all study tools before referring the respondent to the FTL who instructed the respondent to go to the field lab for sputum collection.

Respondents with any acute illness such as pneumonia, pneumothorax, large pleural effusion and suspicious malignancies were immediately referred to the routine health system using a standardized referral form for appropriate management. In some cases, a second CXR was taken and provided to respondents before they were referred.

At the end of field clusters operations, all field radiographs were sent to the central level and were re-read by radiologists. Results of the CXR central reading were then provided to the medical panel at central level that used this information, along with other data, to ascertain the TB status of study respondents.

3.4.5 Sputum collection and HIV testing

All respondents with cough for two weeks or more and/or CXR abnormalities in the lung field, as well as all those who did not take chest X-ray (i.e. refused or were exempt), were directed to a sputum collection location within the survey base after they received clear instructions from trained laboratory personnel on procedures for sputum production and collection. Two sputum samples were collected; one spot sample on the same day the respondent was interviewed and a morning sample the following day. If a respondent did not return the next day, a member of the flexible team traced him/her at home and collected the sample. The sputum specimens were then placed in an ice box as soon as possible. Falcon tubes which are rigid plastic containers with screw caps that could be sealed were used for sputum collection. All spot and early morning sputum samples were labelled on the container with the same PIN as recorded on individual questionnaire and the sputum collection/ transportation register. The field lab technician maintained a sputum collection/transportation laboratory register indicating the specimen (spot or early morning), date collected and date sent to NTRL. A copy of the same register was plucked and transported with the samples to the NTRL.

All respondents who were eligible for sputum collection—including asymptomatic and CXR exempt—were tested for HIV directly in the field after consenting. The Uganda Ministry algorithm for HIV counselling and testing was followed. Therefore, pre- and post-test counselling was carried out while Determine, Stat-Pack and Uni-Gold HIV test kits were used in series. All respondents undergoing HIV counseling and testing (HCT) had HIV results recorded in the HCT register and in the HIV testing section of the individual survey questionnaire. HIV results were issued to respondents on site using MoH results slips and all HIV-positive respondents were referred to the nearest health facility offering chronic care and follow-up. HIV-negative participants were counselled about HIV infection prevention.

3.4.6 Transportation of specimens

All collected sputum samples were triple packaged (using cotton wool, ziplocked plastic bag, and plastic leak-proof falcon tubes) and transported to the NTRL in cooled boxes for TB smear microscopy and culture within 72 hours of sputum collection. Posta Uganda was used as a courier to transport samples, as this has been an established method for

transporting specimens from all over the country to the NTRL for routine surveillance of drug-resistant TB since 2008. Commercial buses were used to ship samples in areas where Posta courier services were not available.

3.5 Laboratory procedures

3.5.1 Specimen receiving at the laboratory

At NTRL, all specimens were received triple packaged with ice packs to maintain the cold chain in transport boxes. Shipment forms and sample request forms also were also sent along with samples to the central laboratory. Sample boxes were opened in a biosafety cabinet and details on sample container matched with those on request forms. Participant and sputum quality details were entered in an electronic laboratory information system to assign a unique serial identifier.

3.5.2 Smear making and staining

A direct smear was prepared for each spot and morning sample and stained using ZN technique.

3.5.3 Microscopic examination

Smears made were examined in line with WHO/IUATLD guidelines.[24]

3.5.4 Quality checking of slides

NTRL employed quality control of slides through blinded re-checking and re-reading by a supervisor.

3.5.5 Culture

At the NTRL, samples were first decontaminated using the 1.5% NaOH NALC method and then processed. Each sample was inoculated on two slopes of Löwenstein-Jensen (L-J) medium, incubated at a temperature of 37°C and monitored weekly for growth for a period of up to eight weeks. A culture was only reported negative if there was no growth after eight weeks. For the positive cultures, identification of MTB was done based on presumptive phenotypic appearance of colonies on the medium, and confirmed using TB antigen test SD Bioline®. Isolates were tested for resistance to rifampicin, isoniazid, ethambutol and streptomycin using the L-J proportional method, in concentrations of 40 µg/ml for

[24] http://www.theunion.org/what-we-do/publications/technical/laboratory-diagnosis-of-tuberculosis-by-sputum-microscopy-the-handbook

rifampicin, 0.2 μg/ml for isoniazid, 2.0 μg/ml for ethambutol and 4.0 μg/ml for streptomycin.

3.5.6 Xpert MTB/RIF

Each eligible participant with at least one positive smear microscopy result had their samples tested by Xpert MTB/RIF. Xpert MTB/RIF testing was also undertaken for participants whose spot and morning sputum samples had contaminated cultures. For quality control purposes, 321 participants with CXR suggestive of active TB with negative cultures had their stored samples tested with Xpert MTB/RIF but these results are not reported.

3.6 Central reading of CXR

Three radiologists certified by the National Medical Association Board, each with more than a decade of experience, reviewed all radiographs using a standardized interpretation form, based on the US CDC guidelines for evaluating a CXR medical examination.[25] The radiographs were evaluated for quality and any abnormality, pulmonary or extrapulmonary. All abnormal chest radiographs (as per the field CXR result) were independently read by two radiologists. A third radiologist adjudicated whenever there were differences in interpretation, and these differences were resolved by consensus. All normal X-rays were read a single time. Radiologists were blinded to all clinical and laboratory data.

Radiologists categorized films as follows: normal, active TB disease suggestive, inactive/healed TB, and extrapulmonary abnormalities (e.g. cardiovascular, muscle, bone, etc.). Active TB was assigned when any of the following findings were detected: infiltrate, consolidation, cavity(/ies), nodule(s) with poorly defined margins, pleural effusion, hilar or mediastinal lymphadenopathy, and/or miliary nodules. Inactive/healed TB was assigned when any of the following were present: linear fibrotic band within the lung, calcification, discrete nodule(s) without calcification, atelectasis with volume loss or retraction in the upper lobe, or upper lobe bronchiectasis. If an abnormality requiring urgent attention was detected at the central level, the SC was informed and he requested the DTLS to trace and refer the participant to routine health system for case management to ensure that the respondent accessed care at the referral facility.

A joint panel of experts (radiologist, pulmonologists, and microbiologists) reviewed all films of participants with at least one positive laboratory result (smear microscopy, Xpert MTB/RIF or culture showing MTB), and all those who the medical panel had classified as

[25] U.S. Centers for Disease Control and Prevention. Instructions to Panel Physicians for Completing CHEST X-RAY AND CLASSIFICATION WORKSHEET (DS-3024) f. http://www.visa-21.com/ds-forms-instructions.pdf

cases. Those participants with abnormal chest X-rays that had been initially classified as inactive TB were then re-classified as active TB.

3.7 Survey case ascertainment and management of TB cases

Cases of TB among survey respondents were identified by a medical panel composed of two consultant pulmonologists and one consultant radiologist. The medical panel was constituted on October 23, 2014.

The medical panel met once a week during the period of the survey to review investigation results of survey respondents, and also considered presumptive TB patients. The panel reviewed the records of those participants with presumptive TB as long as they had a CXR suggestive of TB or a positive laboratory result. A survey respondent was considered a presumptive TB patient if he/she—

- Had a history of cough lasting 14 or more days;
- Had a central chest X-ray film reading reported as abnormal (active TB suggestive, inactive/healed TB, other abnormality needing follow up or other abnormality not needing follow up); or
- Had a combination of both of the above.

The survey project's data department handed over complete records of these presumptive TB respondents to the medical panel on the meeting day on a cluster-by-cluster basis. The complete records consisted of (i) Field Survey Questionnaire (ii) Chest X-ray report together with the respective chest X-ray film and (iii) Mycobacterial Investigation results (the sputum AFB smear, Xpert MTB/RIF, and Mycobacterial culture together with species identification). During the meetings, the records of the presumptive TB respondents were reviewed on an individual basis. The findings per individual presumptive TB respondent were correlated/matched with the case definitions provided in the protocol for purposes of identifying TB cases in the Uganda TB Prevalence Survey.

The presumptive TB respondents who were confirmed as TB patients were assigned to specific case definitions stipulated in the TB Prevalence Survey Protocol. A final case reporting form was filled indicating the category of the TB participant. This final case reporting form (Survey TB Case Ascertainment Form) was then handed to the data department. At the end of the survey, Ugandan and international TB and radiology experts reviewed all the cases and concluded on the final TB cases which were used in the analysis.

3.8 Data management process

3.8.1 Data receiving

The pen-and-paper system was used for most data collection. The exception was for laboratory data, which was sent electronically direct to the data management unit (DMU). After going through quality control procedures (see Section 3.9) all survey data were sent to the DMU, where each field team was assigned to a specific pair of data entrants (Figure 5). Two data entrants were also assigned to enter central CXR data and medical panel data. Into total there were 8 data entrants.

Data from the laboratory was sent as a password-protected Excel sheet to the data manager who converted it to Epi Info™ format. Details of data cleaning and archiving are contained in the data management manual.

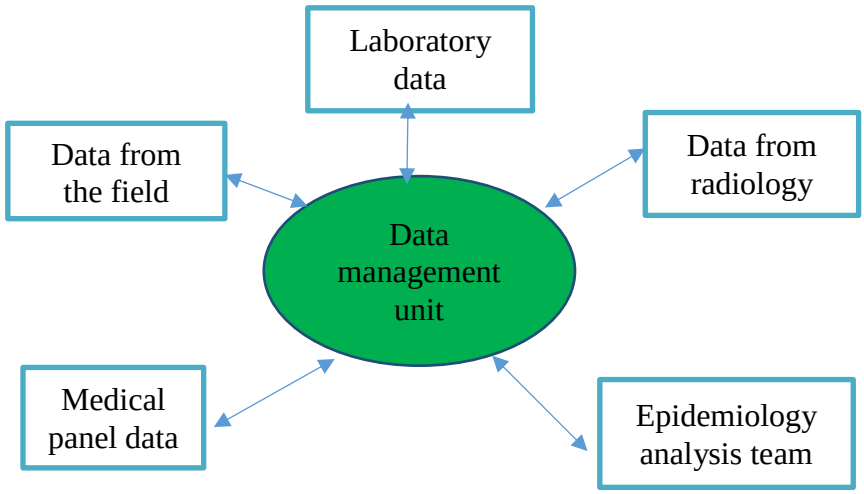


Figure 5: Data flow into the central data management unit

3.8.2 The Electronic Data Capture (EDC) System

The Epi Info 3.5.3 software was used to create a database, capturing data from physical forms, validating it, and analysing it. The database was password protected. Networked directories were used in the data unit to avoid use of flash disks that could carry viruses. These were mostly used to collect data from the of data entrants to the central database by the data manager.

3.8.3 Data Validation Process

Data were validated once they were entered into the system by use of monitoring programs to detect inconsistencies. Data were also double entered and compared solving differences using hard copies. There were eight data entrants divided into four groups each of two members. Each group received data to enter from the data manager, and compared it to ensure all differences and unmatched records were solved based on hard copies. Survey data manager monitored the entire data management process.

3.8.4 Verification of EDC Setup and Implementation

The system was developed and all the eight data entrants trained on how to use the system and thereafter a pilot study was done to ensure that the system was running well. After the pilot, some adjustments were done and users retrained.

3.8.5 Database Closure

After data cleaning was completed the data was locked, and no further editing permitted. All questionnaires, films and other data equipment were then archived. Electronic data files were prepared in Epi info and Stata software.

3.9 Quality assurance, monitoring and supervision, technical assistance

A dedicated quality control officer ensured that all study procedures were conducted according to the protocol, and that all participants' consent forms were available. The quality officer performed 100% source document verification (SDV) on outcome variables, namely cough presence and duration, field CXR reading, sputum collection, and HIV testing data. In addition, he checked 100% variables on 10% of all data. Findings from this last check were used for retraining of the teams where necessary. At the field level, a data checker checked all variables/entries. The field team leader again cross checked the entries, and an electronic quality checking system was in built into the database.

All key teams produced weekly reports, which were reviewed in the weekly survey implementation team (SIT) meetings. A separate weekly management meeting was held to address administrative issues. These meetings were attended by the PI, Co-PI, survey coordinator and the survey administrator.

Monthly reports were produced and submitted to all stakeholders. External monitoring was conducted by the TWG, as well as experts from the WHO, the CDC, and other international organizations on a periodic basis and during a formal mid-term review.

4. RESULTS

4.1 Census – Survey–eligible population

The census team listed 86,108 individuals in 17,535 households (HHs) in the 70 (40 rural and 30 urban) clusters, with an average of 4.9 (SD=3.1) inhabitants per HH. Of the survey population: 53,606 (62.3%) individuals were from rural settings; 45,102 (52.4%) were women; and 36,801 (42.7%) were children aged less than 15 years.

Table 1: Survey population by eligible and ineligible by sex, age group, and residence

			Number (%) ineligible				*Number (%) eligible*		TOTAL
			<15yrs		Non-residents (≥15 yrs.)				
			N	%	N	%	N	%	N
Sex		Male	18,383	44.8	2,536	6.2	20,087	49.0	41,006
		Female	18,418	40.8	1,478	3.3	25,206	55.9	45,102
Age group (years)	*Male*	0–4	6,598	100.0					6,598
		5–14	11,785	100.0					11,785
		15–24			874	10.8	7,262	89.2	8,136
		25–34			797	14.1	4,927	85.9	5,724
		35–44			518	12.6	3,608	87.4	4,126
		45–54			231	9.9	2,114	90.1	2,345
		55–64			79	7.1	1,028	92.9	1,107
		≥65			37	3.1	1,148	96.9	1,185
	Female	0–4	6,577	100.0					6,577
		5–14	11,841	100.0					11,841
		15–24			848	8.4	9,233	91.6	10,081
		25–34			348	4.9	6,687	95.1	7,035
		35–44			154	3.8	3,947	96.2	4,101
		45–54			67	2.6	2,515	97.4	2,582
		55–64			25	1.8	1,328	98.2	1,353
		≥65			36	2.3	1,496	97.7	1,532

Residence		Rural	24,756	46.2	2,018	3.8	26,832	50.0	53,606
		Urban	12,045	37.1	1,997	6.1	18,460	56.8	32,502
TOTAL			**36,801**	**42.7**	**4,014**	**4.7**	**45,293**	**52.6**	**86,108**

Overall, 45,293/86,108 individuals (52.6%) were eligible to attend the survey. Eligibility in this study was based on an age of 15 years or older and residency in sampled HHs for at least 14 days. The proportion of those who were eligible was higher among women (55.9%) than men (49.0%); and among urban (56.8%) than rural (51.1%) residents. Figure 6 displays the eligible individuals by sex and age group. It shows that generally the proportion of the eligible population was lower among men than women; the lowest proportion of eligible men was observed in the group aged 25-34 years; for women, the proportion of eligible progressively increased with age up to the group aged 55- 64 years.

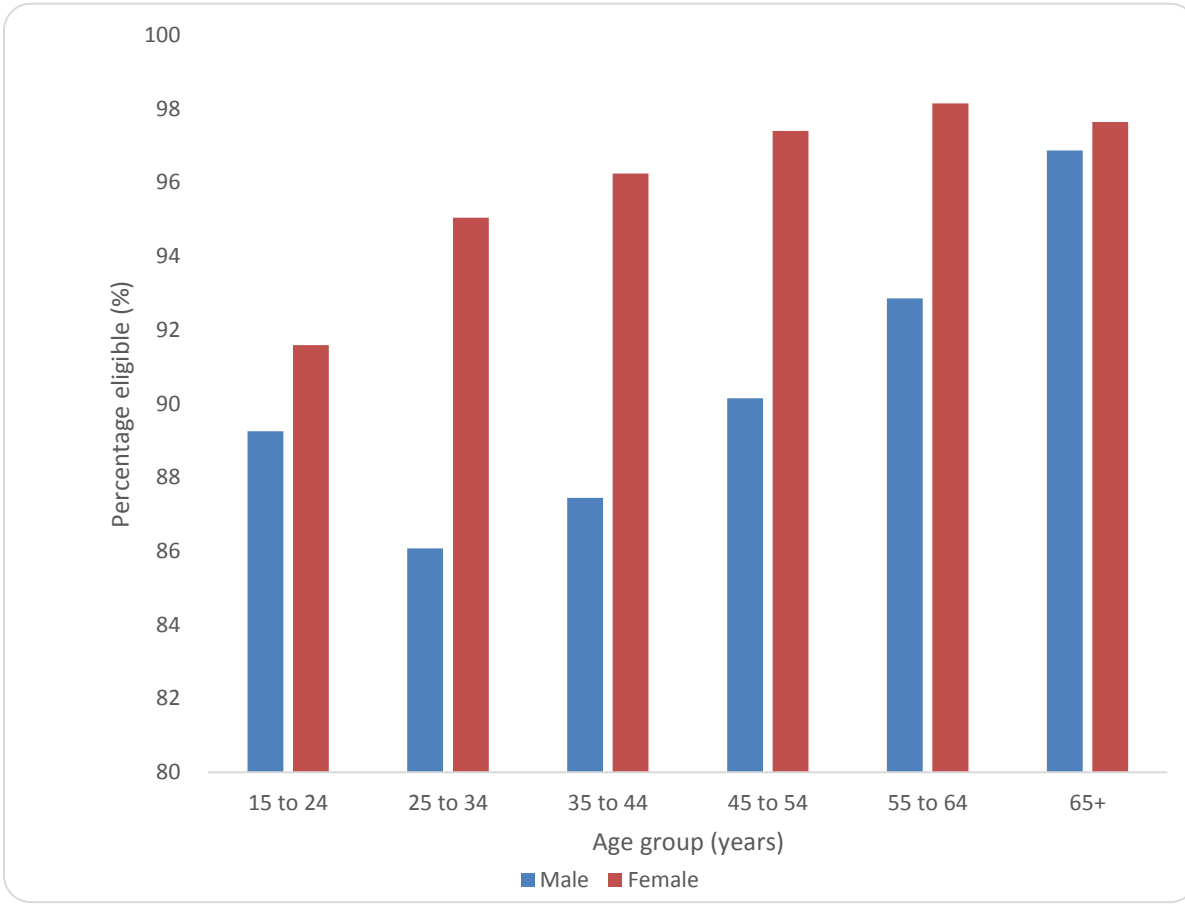


Figure 6: Proportion of eligible individuals among enumerated adults by age group and gender

Figure 7 (a-c) displays the national population pyramid and that of household members enumerated. The age and sex distribution of country and survey populations are similar with broad based population pyramids characteristic of young populations. Despite the similarity, the survey population had a lower male-to-female ratio (90.9:100) than the 2014 national population census (95.4:100), and children aged less than 15 years constituted 42.7% of the survey, compared to 48.7% of the 2014 national population census. The age and sex distribution of "eligible" and "participant" populations were similar. The differences are probably due to the fact the survey included a small sample of the entire population, which has introduced a bias in the selection.

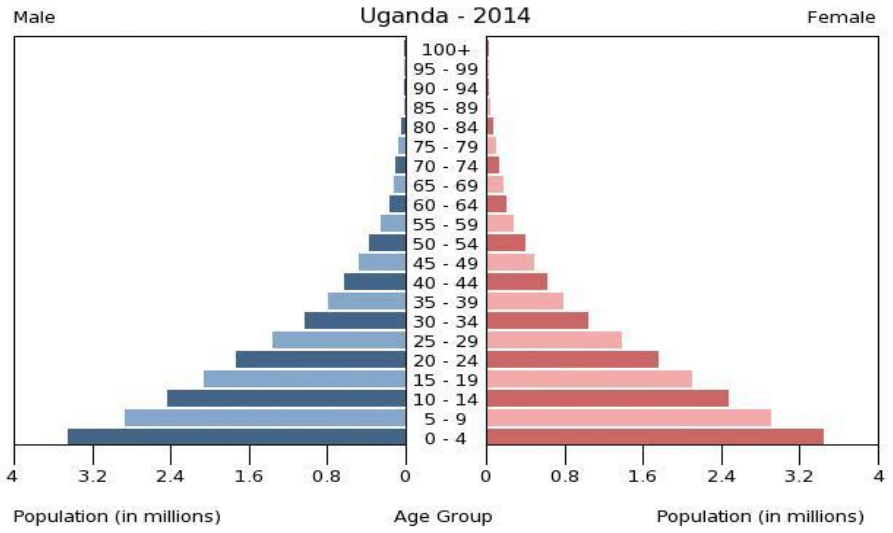


Figure 7a: National Population Pyramid

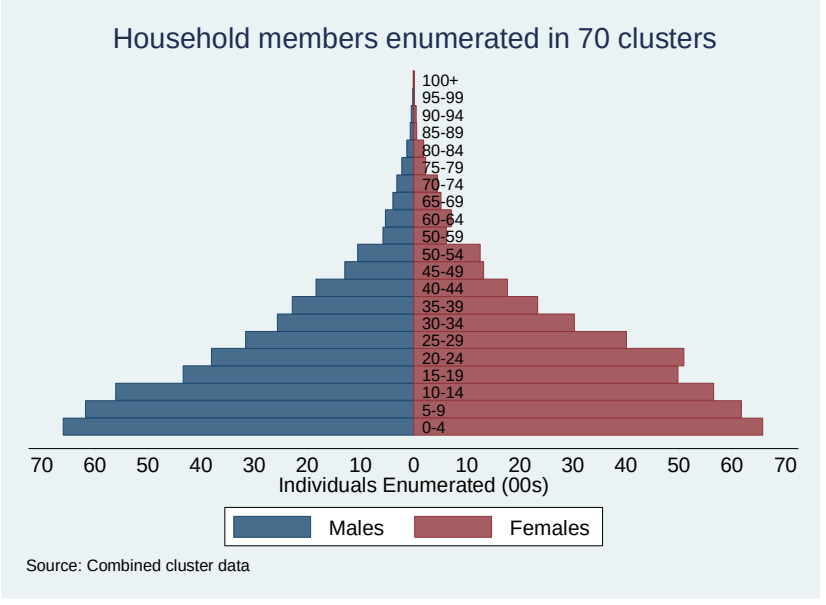


Figure 7b: Survey Population Pyramid

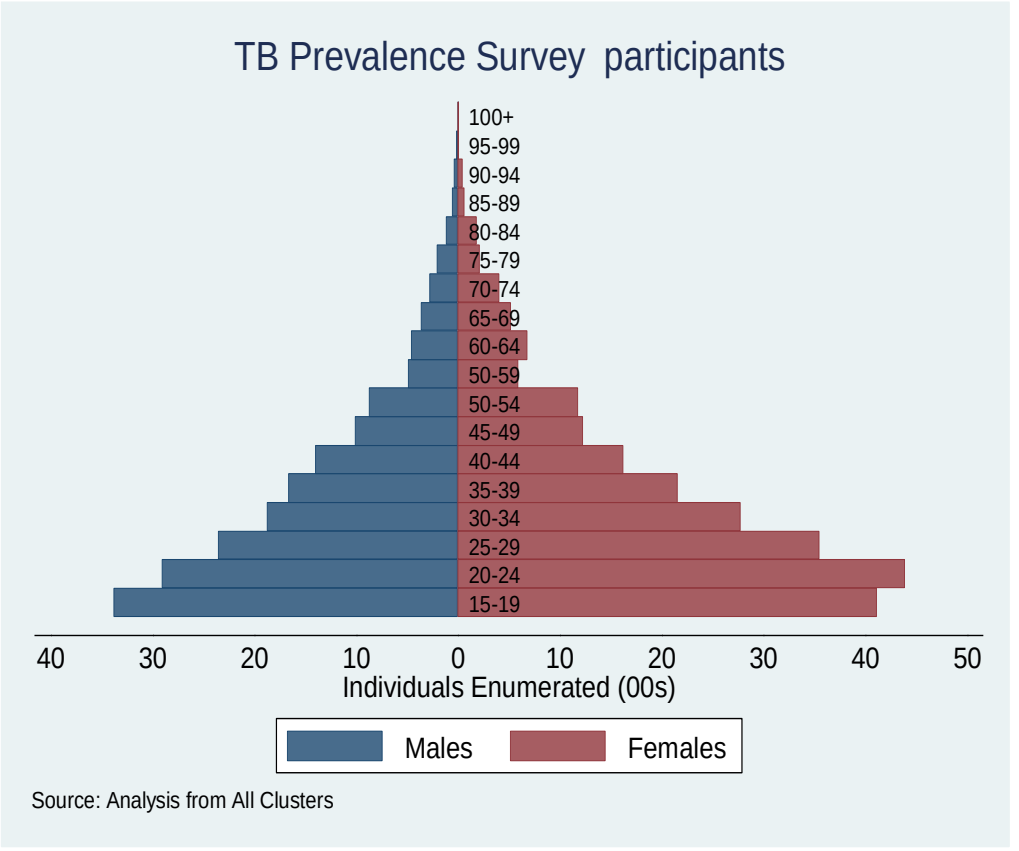


Figure 7c: Population pyramid of survey participants

4.2 Participants

4.2.1 Survey participation

Of the 45,293 eligible individuals, 41,154 (90.9%) were screened by symptoms and/or CXR (Table 2). The observed participation rate (90.9%) was higher than anticipated at planning stage (85%). However, in 12 clusters (Annex 2) the participation rate was less than 85%. This is due targeting big cluster size at the beginning of the survey which the survey team could not complete in the one week allocated to each cluster. The observed participation rate was higher among women than men (93.9% vs. 87. 0%). Furthermore, participation among men was observed to decrease with age to its lowest in those aged 35-44 years, and to increase thereafter, while among women, it increased with age up to its highest 95.7% (2408/2515) among the group aged 45-55 years. Urban participation rate was higher than rural participation (93.9% vs. 88.8%). The higher urban participation rate in this survey can be attributed to intense mobilisation in urban clusters and the fact that urban clusters were covered at the end of the survey when the teams were more experienced with survey

mobilisation and procedures. Table 2 shows eligible individuals stratified into those who participated and those who did not participate by sex, age group and residency status. Figure 8 displays participation rates by sex and age group.

Table 2: Breakdown of eligible individuals into non-participants and participants; overall and by sex, age group and residence

			Non-participants		Participants (interview and/or chest X-ray)		TOTAL (eligible)
			Number	%	N	%	N
Sex		Male	2,602	13.0	17,485	87.0	20,087
		Female	1,537	6.1	23,669	93.9	25,206
Age group in years	Male	15–24	979	13.5	6,283	86.5	7,262
		25–34	702	14.2	4,225	85.8	4,927
		35–44	533	14.8	3,075	85.2	3,608
		45–54	235	11.1	1,879	88.9	2,114
		55–64	85	8.3	943	91.7	1,028
		65+	68	5.9	1,080	94.1	1,148
	Female	15 -24	741	8.0	8,492	92.0	9,233
		25 – 34	369	5.5	6,318	94.5	6,687
		35 – 44	191	4.8	3,756	95.2	3,947
		45 – 54	107	4.3	2,408	95.7	2,515
		55 – 64	58	4.4	1,270	95.6	1,328
		65+	71	4.7	1,425	95.3	1,496
Residence		Rural	3,017	11.2	23,816	88.8	26,833
		Urban	1,122	6.1	17,338	93.9	18,460
Total			**4,139**	**9.1**	**41,154**	**90.9**	**45,293**

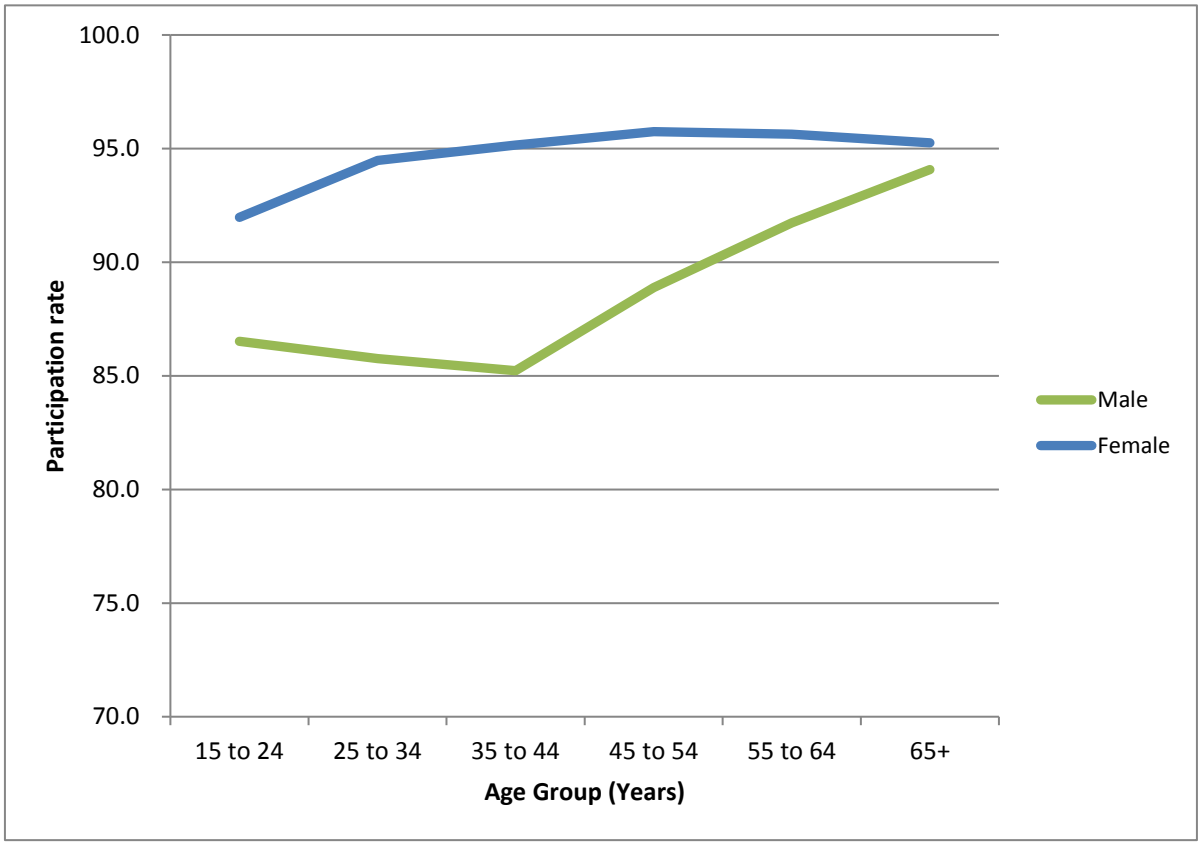


Figure 8: Participation rates by sex and age group

4.2.2 Characteristics of survey participants

Figure 6 displays the population pyramid of the participants by age and sex. Table 3 displays the religious, educational, marital and occupation characteristics of only those who consented and participated in the survey[26]. Most of them [34,272 (83.3%)] were Christians followed by Muslims [6,749 (16.4%)]; nearly half (48.3%) had attained primary level education; (42%) were farmers and only 0.4% were health workers; two thirds (59.2%) were married while 29.5% were single. These findings are consistent with what was observed in the national census.[27]

Table 3: Characteristics of survey participants

[26]Though the census units were required to note the religion; education, marital and occupation status of each HH occupant as they compiled HH registry we decided to use information obtained during individual interviews as this was deemed to be more accurate than that obtained at HHs

[27] http://www.ubos.org/2016/03/24/census-2014-final-results/

	Characteristics	Males		Females		Total	%
		Number	%	Number	%		
Religion	Christian	14,566	83.3	19,706	83.3	34,272	83.3
	Muslim	2,855	16.3	3,894	16.5	6,749	16.4
	Traditionalist	5	0.03	2	0.01	7	0.02
	None	9	0.05	2	0.01	11	0.03
	Other	50	0.03	65	0.3	115	0.3
Education Level	None	1,633	9.3	5,372	22.7	7,005	17.0
	Primary	8,805	50.4	11,061	46.7	19,866	48.3
	Senior 1 -4	4,618	26.4	5,329	22.5	9,947	24.2
	Senior 5 – 6	977	5.6	690	3.0	1,667	4.1
	Tertiary	1,451	8.3	1,215	5.1	2,666	6.5
	Don't Know	1	0.01	1	0.00	2	0
	Unknown	0	0	1	0.00	1	0
Marital Status	Single	6,519	37.3	5,607	23.7	12,126	29.5
	Married	10,141	58	14,201	60.0	24,342	59.2
	Separated	508	2.9	1,482	6.3	1,990	4.8
	Divorced	90	0.5	251	1.1	341	0.8
	Widowed	227	1.3	2,125	9.0	2,352	5.7
	Don't know	0	0	3	0.01	3	0.01
Occupation	Business	1,993	11.4	3,101	13.1	5,094	12.4
	Civil Servant	1,104	6.3	679	2.9	1,783	4.3
	Health worker	58	0.3	110	0.5	168	0.4
	Student	3,376	19.3	3,109	13.1	6,485	15.8
	Unemployed	543	3.1	1,511	6.4	2,054	5.0
	Farmer	6,991	40.0	10,274	43.4	17,265	42.0
	Housewife/husband	31	0.2	3,237	13.7	3,268	8.0
	Skilled Laborer	2,502	14.3	1,049	4.4	3,551	8.6
	Other	887	5.1	599	2.5	1,486	3.6
TOTAL		**17,485**	**100**	**23,669**	**100**	**41,154**	**100**

4.3 Screening

In this survey, a participant was defined as screening positive and hence eligible to provide sputum if s/he was positive for any of the following: cough for at least two weeks; a CXR with field reading result "abnormal lung fields"; or both; or had not taken a CXR. Table 4 and Figure 9 displays participants eligible for sputum collection by sex, age group and residency. It shows that 5,142 (12.5%) out of 41,154 participants were eligible for sputum collection. More men (14.7%) than women (10.8%); and more rural (14.0%) than urban (10.5%) residents were eligible for sputum collection. The proportion eligible increased with age from 6.1%, among the group aged 15 – 24 years to 38.5% among the group aged 65+ years. A total of 552 participants were eligible by both symptom and CXR; 2,141 by cough alone; 2,298 by CXR alone, while 151 were eligible because they had not taken a CXR (CXR exempt).

Table 4: Individuals eligible for sputum collection by sex, age group and residence

		Number of participants	Eligible by any criteria		Eligible symptoms only		Eligible by CXR only		Eligible by CXR exemption		Eligible by both Symptoms and CXR	
			N	%	N	%	N	%	N	%	N	%
Sex	Male	17,485	2,576	14.7	919	5.3	1,262	7.2	80	0.5	315	1.8
	Female	23,669	2,566	10.8	1,222	5.2	1,036	4.4	46	0.2	237	1.0
Age group in years	15–24	14,779	906	6.1	554	3.7	263	1.8	38	0.3	43	0.3
	25–34	10,546	969	9.2	473	4.5	365	3.5	22	0.2	93	0.9
	35–44	6,832	950	13.9	404	5.9	434	6.4	13	0.2	90	1.3
	45–54	4,280	820	19.2	295	6.9	428	10.0	8	0.2	84	2.0
	55–64	2,218	535	24.1	170	7.7	295	13.3	24	1.1	62	2.8
	65+	2,499	962	38.5	245	9.8	513	20.5	46	1.8	180	7.2
Residence	Rural	23,816	3,326	14.0	1,397	5.9	1,459	6.1	74	0.3	396	1.7
	Urban	17,338	1,816	10.5	744	4.3	839	4.8	77	0.4	156	0.9
TOTAL		41,154	5,142	12.5	2141	5.2	2298	5.6	151	0.4	552	**1.3**

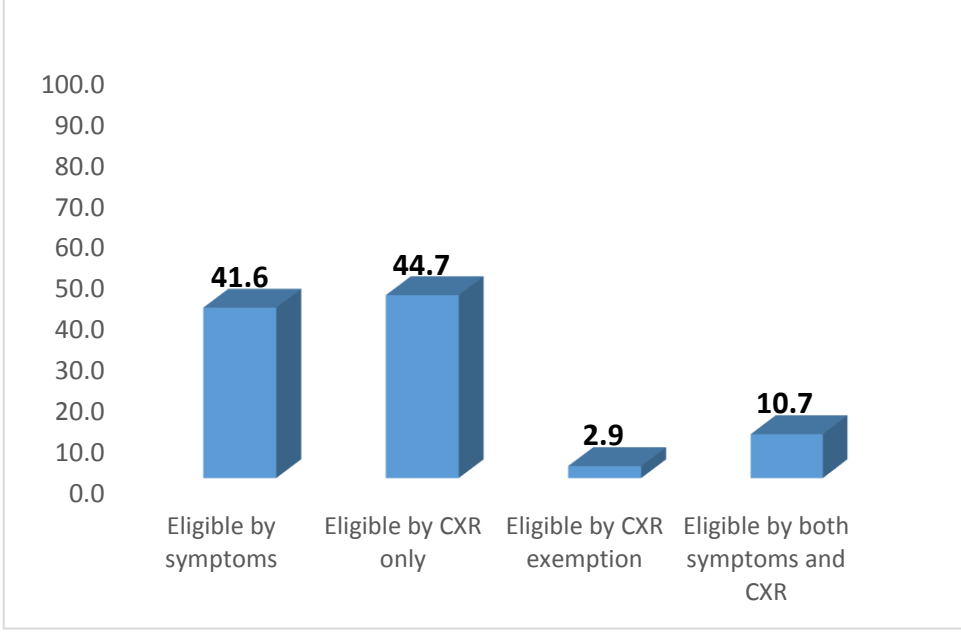


Figure 9: proportion of eligibility by screening criteria

4.3.1 Prevalence of TB symptoms

Table 5 displays reported symptoms by sex, age group and residence. The prevalence of symptoms in descending order were: chest pain (29.6%), cough any duration (21.6%), cough with sputum (11.7%), fever (8.7%), weight loss (6.7%), night sweats (4.2%) and blood-stained sputum (0.6%). The prevalence of cough of two weeks or more was 6.6%.

Table 5: Reported TB symptoms by sex, age group, cluster, and residence

		Participants	Cough (any duration)		Cough for 2+ weeks		Cough with Sputum		Blood-stained sputum		Chest pain		Weight loss		Fever		Night sweats	
			n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Sex	Male	17,485	3,733	21.3	1,240	7.1	2,084	11.9	116	0.7	4,559	26.1	1,081	6.2	1279	7.3	700	4
	Female	23,669	5,173	21.9	1,474	6.2	2,735	11.6	147	0.6	7,583	32	1,675	7.1	2314	9.8	1025	4.3
Age group (years)	15–24	14,775	2,988	20.2	604	4.1	1,459	9.9	70	0.5	3,359	22.7	758	5.1	1123	7.6	363	2.5
	25–34	10,543	2,153	20.4	560	5.3	1,132	10.7	67	0.6	3,139	29.8	786	7.5	903	8.6	405	3.8
	35–44	6,831	1,459	21.4	496	7.3	803	11.8	40	0.6	2,204	32.3	478	7	612	9	342	5
	45–54	4,287	993	23.2	382	8.9	596	13.9	32	0.7	1,536	35.8	329	7.7	413	9.6	301	7
	55–64	2,213	541	24.4	237	10.7	335	15.1	17	0.8	869	39.3	170	7.7	232	10.5	151	6.8
	65+	2,505	772	30.8	435	17.4	494	19.7	37	1.5	1,035	41.3	235	9.4	310	12.4	163	6.5
Residence	Rural	23,816	5,327	22.4	1,803	7.6	3,016	12.7	178	0.7	7,838	32.9	1,769	7.4	2450	10.3	1229	5.2
	Urban	17,338	3,579	20.6	911	5.3	1,803	10.4	85	0.5	4,304	24.8	987	5.7	1143	6.6	496	2.9
TOTAL		41,154	8,906	21.6	2,714	6.6	4,819	11.7	263	0.6	12142	29.5	2,756	6.7	3,593	8.7	1,725	4.2

[3]

4.3.2 Prevalence of radiological abnormalities suggestive of PTB

Per the study protocol, all abnormal CXRs would be re-read centrally by two central radiologists and results arrived at by consensus; where there was discrepancy a third reader would act as a tie breaker. Normal CXRs were read by one central radiologist only. The prevalence of radiological abnormalities suggestive of PTB among the 4,098 participants with interpretable x-rays 0.7% (303 participants), healed/inactive TB 0.7% (270), and other abnormalities consistent with TB 0.7% (300) (see Table 6).

Of the CXRs that the field readers read as normal, central readers identified abnormalities in lung fields in 272 CXRs (including 19 suggestive of active TB, 11 healed TB and 54 with other abnormalities consistent with TB). Of the CXRs that the field readers read as "abnormal, other abnormality", central readers identified abnormalities in lung fields in eight, including one with healed TB and four with other abnormalities suggestive of TB (see Table 8). Seventeen of the CXR films were of poor quality, while 38 were missing.

Table 6: Results of field and central reading of chest X-rays

	Chest X-ray, field reader						
	Normal		*Abnormal lung field*		*Abnormal Others*		**TOTAL**
Chest X-ray, central reader	N	%	N	%	N	%	N
Normal	37,197	96.7	1,110	2.9	142	0.4	38,449
Active TB disease suggestive	19	6.3	284	93.7	0	0.0	303
Inactive/healed TB	11	4.1	258	95.6	1	0.4	270
Other abnormality consistent with TB	54	18.0	242	80.7	4	1.3	300
Other abnormality not with cconsistent with TB	188	21.8	673	77.9	3	0.3	864
Extra pulmonary abnormalities	258	33.9	276	36.2	228	29.9	762
Poor X-ray	10	58.8	7	41.2	0	0	17
Missing	38	100	0	0	0	0	38
TOTAL	37,775	92.1	2,850	7.0	378	0.9	41,003

4.3.3 Current TB and past TB treatment among survey participants

Tables 7a and 7b show participants on current and history of TB treatment by sex, age group and residence. Of the participants interviewed, 61 (representing 0.2% of participants) reported to be on current TB treatment. Of these who reported being on current TB treatment, 55.7% (34/61) were male and 44.32% (27/61) were from a rural area.

812 participants, of whom 52.7% were men, reported a recent history of TB treatment. The group aged 45–54 years had the most number 178 (22.7%) of cases while those aged 55–64 had the least, at 82 (10.1%) cases.

The most recent treatment episode occurred 1–2 years ago in 22.2% of the 464 respondents, 3–5 years ago in 20.3% of respondents, and ≥6 years ago in more than half (53.7%). Most (727 [89.5%]) of those with history of TB medication were treated by public health facilities, while 43 (5.3%) were treated by NGO facilities, 36 (4.4%) by private facilities, 2 (0.3%) by drug shops/pharmacies, and 4 (0.5%) by traditional healers. The proportion of those reporting history of TB treatment was higher among men than women (2.3% versus 1.6 %).

Table 7a: Current TB treatment survey participants

				Gender				Residence			
		All	%	Male	%	Female	%	Rural	%	Urban	%
Status of TB treatment	Not on treatment	41093	99.9	17451	99.8	23642	99.9	23775	99.8	17318	99.9
	On treatment	61	0.2	34	0.2	27	0.1	41	0.2	20	0.1
	TOTAL	41154	100	17485	100	23669	100	23816	100	17338	100
Age Group	15-24	16	26.2	6	17.7	10	37	9	22	7	35
	25-34	14	23	8	23.5	6	22.2	9	22	5	25
	35-44	12	19.7	8	23.5	4	14.8	8	19.5	4	20
	45-54	12	19.7	9	26.5	3	11.1	10	24.4	2	10
	55-64	3	4.9	1	2.9	2	7.4	2	4.9	1	5
	65+	4	6.6	2	5.9	2	7.4	3	7.3	1	5
	TOTAL	61	100	34	100	27	100	41	100	20	100

Table 7b. History of past TB treatment of survey participants

				Gender				Residence			
		All	%	Male	%	Female	%	Rural	%	Urban	%
History of TB	No	40342	98	17053	97.5	23289	98.4	23388	98.2	16954	97.8
	Yes	812	2	432	2.5	380	1.6	428	1.8	384	2.2
	TOTAL	41154	100	17485	100	23669	100	23816	100	17338	100
Place of Past TB Treatment	Public	727	89.5	396	91.7	331	87.1	377	88.1	350	91.2
	NGO	43	5.3	18	4.2	25	6.6	23	5.4	20	5.2
	Private	36	4.4	15	3.5	21	5.5	23	5.4	13	3.4
	Pharmacy/drug shop	2	0.3	0	0	2	0.5	1	0.2	1	0.3
	Traditional healer	4	0.5	3	0.7	1	0.3	4	0.9	0	0
	TOTAL	812	100	432	100	380	100	428	100	384	100
Years since past TB treatment	0-2	174	21.4	105	24.3	69	18.2	103	24.1	71	18.5
	3-5	159	19.6	81	18.8	78	20.5	73	17.1	86	22.4
	6+	479	59	246	56.9	233	61.3	252	58.9	227	59.1
	TOTAL	812	100	432	100	380	100	428	100	384	100

4.3.3 Tobacco smoking

This study asked questions on current and past tobacco smoking. Table 8 displays current tobacco smoking by sex, age group and residency. 3,020 participants reported to smoke at the time of the survey, giving a current tobacco smoking prevalence of 7.3%. Observed current tobacco smoking prevalence was nearly seven times higher among men than women (14.1% versus 2.3%); and was slightly higher among urban than rural residents (7.7% versus 7.1%). The current tobacco smoking was observed to increase with age, from 2.3% in those aged 15–24 years to peak at 13.1% among those 55–64 years.

Table 8: Prevalence of tobacco smoking in the survey population by sex, age group and residence

		Number of Participants	Smoking at the time of the survey	
			Number	%
Sex	Male	17,485	2467	14.1
	Female	23,669	553	2.3
Age group in yrs.	15–24	14,775	334	2.3
	25–34	10,543	797	7.6
	35–44	6,831	794	11.6
	45–54	4,287	516	12.0
	55–64	2,213	290	13.1
	65+	2,505	289	11.5
Residence	Rural	23,816	1,682	7.1
	Urban	17,338	1,338	7.7
TOTAL		**41,154**	**3,020**	**7.3**

4.4 Laboratory examinations

[4]

4.4.1 Sputum collection

The participants eligible for sputum collection were requested to provide two (spot and morning) samples. Table 9 below displays sputum collection by sex, age group and residence. Of the 5,142 participants, eligible for sputum collection, 4,754 (93.2%) provided a spot sample; 4,533 (88.1%) provided a morning sample, and 4,486 (87.2%) provided both. While 4,841 (94.1%) provided at least one sample[28]; slightly more women than men provided at least one sample (94.6% versus 93.7%); and more urban than rural residents

[28] This number differs from those who provided either spot or morning sample as some of the participants who did not provide spot samples returned and gave only a morning sample

(95.7% versus 93.3%) did so. Generally, compliance across the sexes tended to increase with age, at least up to the group aged 45–54 years.

Table 9: Sputum collection among those eligible for sputum collection by sex, age group and residence

		Number of participants eligible	Participants who provided samples					
			Spot sample only		Morning sample only		Both samples	
			N	%	N	%	N	%
Gender	Male	2,576	2,387	92.6	2,240	87.0	2,213	85.9
	Female	2,567	2,408	93.8	2,293	89.3	2,273	88.6
Age group in years	15-24	906	801	88.4	747	82.5	737	81.4
	25-34	970	893	92.1	821	84.6	815	84.0
	35-44	950	899	94.6	848	89.3	841	88.5
	45-54	820	787	96.0	760	92.7	753	91.8
	55-64	535	507	94.8	489	91.4	481	90.0
	65+	962	907	94.3	868	90.2	859	89.3
Residence	Rural	3,327	3,069	92.3	2,879	86.5	2,845	89.3
	Urban	1,816	1,725	93.2	1,654	91.1	2,273	90.4
TOTAL		**5,142**	**4,754**	**93.2**	**4,533**	**88.1**	**4,486**	**87.2**

4.4.2 Smear microscopy

All sputum specimens for this study were transported to and processed at the NTRL. Tables 10a, 10b, and 11 display direct smear microscopy results. Spot samples yielded 57 smear-positive slides; morning samples yielded 69 smear-positive slides, while the combined result for spot and morning samples was 91 smear-positive slides. A total of 44 participants who had negative spot sample had positive smear microscopy on the morning samples, including nine with 1+, eight with 2+ and three with 3+. This finding further shows the superiority of the morning sample over the spot sample in smear-positive results yield and bacillary load. We also found that 2 participants with negative morning sample had a 3+ spot which may reflect differences in sputum quality between the two samples.

By eligibility criteria and using combined results as a reference: 85.7% (78/91) of smear-positive slides were from participants with CXR field reading “abnormal lung fields”, while 11.0% (10/91) were from those with “normal CXR”. Regarding those who suffered from a cough for at least two weeks, smear-positive results were observed among 58.2% (53/91) of participants with cough at least two weeks, 21 (23.1%) had no cough and six (6.7%) had cough of less than one week. Only 44% (40/91) with a smear-positive result were among those eligible by both criteria (abnormal lung field and cough for at least two weeks). Use of

CXR on its own would have missed 14.3% (11/91) of those smear-positive results, while cough for at least two weeks alone would have missed 41.8% (38/91). It must also be noted that 8% and 12% of spot and morning specimens were not available/collected.

Table 10a-1. Smear examination results by sample type and by eligibility criteria: Spot Sputum

Spot Sputum						
Eligibility	**Requested**	**Examined**	**Positive**	**%age**	**Negative**	**N/A**
Symptoms alone	2127	2013	9	0.4	2004	114
Chest X-ray alone	2291	2186	17	0.7	2169	105
Both symptoms and X-ray	550	534	30	5.5	504	16
No X-ray with symptoms	60	47	1	1.7	46	13
No X-ray and no symptoms	16	13	0	0.0	13	3
Not eligible	1	1	0	0.0	1	0
TOTAL	**5045**	**4794**	**57**	**1.1**	**4737**	**251**

Table 10a-2. Smear examination results by sample type and by eligibility criteria: Morning Sputum

Morning Sputum					
Eligibility	**Examined**	**Positive**	**%age**	**Negative**	**N/A**
Symptoms alone	1885	3	0.1	1882	242
Chest X-ray alone	2083	33	1.4	2050	208
Both symptoms and X-ray	512	32	5.8	480	38
No X-ray with symptoms	39	0	0.0	39	21
No X-ray and no symptoms	13	0	0.0	13	3
Not eligible	1	0	0.0	1	0
TOTAL	**4533**	**68**	**1.3**	**4465**	**512**

Table 10a-3. Smear examination results by sample type and by eligibility criteria: Combined Results

Eligibility	Combined Results								
	Examined	2Ps	%age	1P1N	%age	1P1N/A	2N	1N Only	2N/A
Symptoms alone	2029	0	0.0	12	0.6	0	1857	172	98
Chest X-ray alone	2211	12	0.5	25	1.1	1	2021	177	80
Both symptoms and X-ray	537	22	4.0	17	3.1	1	470	44	13
No X-ray with symptoms	50	0	0.0	1	1.7	0	35	15	10
No X-ray and no symptoms	13	0	0.0	0	0.0	0	13	0	3
Not eligible	1	0	0.0	0	0.0	0	1	0	0
TOTAL	**4841**	**34**	**0.7**	**55**	**1.1**	**2**	**4397**	**408**	**204**

Table 10b. Smear examination results by sample type and by sex and age group

	Spot Sputum					Morning Sputum						Combined Results								
	Requested	Examined	Positive	%age	Negative	Requested	Examined	Positive	%age	Negative	Requested	Examined	2Ps	%age	1P1N	%age	1P1N/A	2N	1N Only	2N/A
Sex and Age																				
Male	**2517**	**2386**	**38**	**1.5**	**2348**	**131**	**2240**	**51**	**2.0**	**2189**	**277**	**2413**	**26**	**1.0**	**35**	**1.4**	**2**	**2,152**	**233**	**104**
15-24	385	360	10	2.6	350	25	333	12	3.1	321	52	364	8	2.1	5	1.3	1	316	39	21
25-34	482	453	10	2.1	443	29	409	14	2.9	395	73	456	7	1.5	9	1.9	1	390	58	26
35-44	517	494	10	1.9	484	23	462	13	2.5	449	55	500	4	0.8	15	2.9	0	437	59	17
45-54	426	409	4	0.9	405	17	398	7	1.6	391	28	414	4	0.9	3	0.7	0	386	24	12
55-64	262	251	3	1.1	248	11	235	4	1.5	231	27	254	3	1.1	1	0.4	0	228	23	8
65+	445	419	1	0.2	418	26	403	1	0.2	402	42	425	0	0.0	2	0.4	0	395	30	20
Female	**2528**	**2408**	**19**	**0.8**	**2389**	**120**	**2293**	**17**	**0.7**	**2,276**	**235**	**2,428**	**8**	**0.3**	**20**	**0.8**	**0**	**2,245**	**175**	**100**
15-24	480	441	5	1.0	436	39	414	4	0.8	410	66	447	1	0.2	7	1.5	0	400	46	33
25-34	460	440	5	1.1	435	20	412	1	0.2	411	48	443	0	0.0	6	1.3	0	403	40	17
35-44	419	405	4	1.0	401	14	386	5	1.2	381	33	406	4	1.0	1	0.2	0	380	22	13
45-54	386	378	1	0.3	377	8	362	2	0.5	360	24	380	1	0.3	1	0.3	0	358	21	6
55-64	270	256	2	0.7	254	14	254	2	0.7	252	16	261	0	0.0	4	1.5	0	245	16	9
65+	513	488	2	0.4	486	25	465	3	0.6	462	48	491	2	0.4	1	0.2	0	459	30	22

Setting	**5045[x]**	**4794**	**57**	**1.1**	**4737**	**251**	**4533**	**68**	**1.3**	**4,465**	**512**	**4841**	**34**	**0.7**	**55**	**1.1**	**2**	**4,397**	**408**	**204**
Rural	3274	3069	32	1.0	3037	205	2879	39	1.2	2,840	395	3103	19	0.6	33	1.0	0	2793	291	171
Urban	*1771*	*1725*	*25*	*1.4*	*1700*	*46*	*1654*	*29*	*1.6*	*1,625*	*117*	*1738*	*15*	*0.8*	*22*	*1.2*	*0*	*1604*	*117*	*33*

One person who was not eligible but provided sputum was include in this table. 2Ps=both samples positives, 1P1N= one sample positive and the other negative, 1P 1N/A=one sample positive and the other is not available, 2N=both samples negative, 1N only=only one sample available and negative and 2N/A=both samples not available

Table 11: Sputum smear results by sample type and smear grading among individuals eligible for sputum examination

		Morning smear						
		Negative	Scanty	1+	2+	3+	N/A	Total
	Negative	4,396	14	9	8	3	306	4,736
Spot	Scanty	18	4	4	1	1	0	28
	1+	0	0	3	1	2	1	7
	2+	1	0	1	2	4	1	9
	3+	2	2	0	3	6	0	13
	N/A	47	0	0	0	0	0	251
		4,464	20	17	15	16	308	5,044

4.4.3 Culture

This survey used the Löwenstein-Jensen culture method and cultured both spot and morning specimens. Tables 12a and 12b displays the spot and morning culture results tabulated by screening method (a) and by gender, age group and residence (b). Out of 5,142 individuals who were eligible for sputum testing, requests were made for only 5,045 (98.1%). Although 98 were eligible, sputum samples were not collected. Overall combined spot and morning sample MTB culture positive yield was 160 (3.2%).

Considering culture yield between spot and morning sample and by sputum collection eligibility, it can be seen in table 12a that morning samples yielded more MTB culture positive results 124 (2.5%) vs. 116 (2.3%). By eligibility criteria and using combined results as a reference: 88.8% (142/160) of the MTB culture positives were from participants with CXR field reading "abnormal lung fields" (80 had only abnormal CXR without symptoms and two had both abnormal CXRs and symptoms). Symptom screening alone would have picked only 80 of the 160 (50.0%) participants with MTB positive cultures (18 with symptoms only and normal CXRs and 62 with symptoms and abnormal CXRs). The yield from participants with symptoms only (cough of two weeks or longer) was 18 (0.8%). Symptom only had 0 yield in spot samples. The yield from participants with abnormal CXR only was 80 (3.5%). When participants had a cough of two weeks or longer and an abnormal CXR the yield was 62 cases (11.3%).

By gender the MTB culture positive rate was 4.7% in males compared to 1.6% in females (see Table 12b). Samples from urban participants yielded more MTB-culture-positive results than rural ones (5% vs. 2%). 26 MOTT culture positive results were reported (0.5%). One person had both MTB and MOTT.

Table 12a: Culture Examination results

Eligibility	Spot Sputum								Morning Sputum							Combined Results					
	Requested	Not examined	Examined	MTB (+)	%age	MOTT	Negative	Contaminated	Not examined	Examined	MTB (+)	%age	MOTT	Negative	Contaminated	MTB (+)	%age	MOTT	%age	Negative	N/A
Symptoms alone	2,127	114	2,013	0	0	6	1,882	117	242	1,885	12	0.6	9	1,677	187	18	0.8	15	0.7	1970	124
Chest X-ray alone	2,291	105	2,186	8	0.3	4	1,976	147	208	2,083	60	2.6	6	1,816	201	80	3.5	9	0.4	2078	124
Both symptoms and X-ray	550	16	534	59	10.7	0	451	34	38	512	52	9.5	2	386	72	62	11.3	2	0.4	463	23
No X-ray with symptoms	60	13	47	49	81.7	0	47	0	21	39	0	0	0	36	3	0	0	0	0	49	11
No X-ray and no symptoms	16	3	13	0	0	0	12	1	3	13	0	0	0	11	2	0	0	0	0	13	3
Not eligible	1	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0
TOTAL	**5,045**	**251**	**4,794**	**116**	**2.3**	**10**	**4,369**	**299**	**512**	**4,533**	**124**	**2.5**	**17**	**3,927**	**465**	**160**	**3.2**	**26**	**0.5**	**4574**	**285**

Table 12b: Culture Examination results by sex, age group and residence

	Spot Sputum								Morning Sputum							Combined Results					
Group	Requested	Not examined	Examined	MTB (+)	%age	MOTT	Negative	Contaminated	Not examined	Examined	MTB (+)	%age	MOTT	Negative	Contaminated	MTB (+)	%age	MOTT	%age	Negative	N/A
Male	2,517	131	2,386	89	3.5	5	2,141	151	277	2,240	94	3.7	8	1,934	204	119	4.7	12	0.5	2244	142
15-24	385	25	360	14	3.6	2	326	18	52	333	18	4.7	2	286	27	21	5.5	4	1	333	27
25-34	482	29	453	26	5.4	2	397	28	73	409	26	5.4	0	357	26	33	6.8	2	0.4	418	29
35-44	517	23	494	24	4.6	0	446	24	55	462	20	3.9	2	395	45	30	5.8	1	0.2	464	22
45-54	426	17	409	16	3.8	0	360	33	28	398	15	3.5	2	343	38	18	4.2	2	0.5	382	24
55-64	262	11	251	6	2.3	1	228	16	27	235	11	4.2	2	200	22	11	4.2	3	1.1	235	13
65+	445	26	419	3	0.7	0	384	32	42	403	4	0.9	0	353	46	6	1.3	0	0	412	27
Female	2528	120	2408	27	1.1	5	2228	148	235	2293	30	1.2	9	1993	261	41	1.6	14	0.6	2,330	143
15-24	480	39	441	4	0.8	0	420	17	66	414	9	1.9	2	362	41	9	1.9	2	0.4	434	35
25-34	460	20	440	6	1.3	0	409	25	48	412	6	1.3	3	372	31	9	2	3	0.7	425	23
35-44	419	14	405	7	1.7	2	376	20	33	386	6	1.4	2	329	49	8	1.9	4	1	387	20
45-54	386	8	378	3	0.8	0	349	26	24	362	4	1	0	314	44	5	1.3	0	0	368	13
55-64	270	14	256	1	0.4	2	232	21	16	254	1	0.4	0	215	38	1	0.4	2	0.7	248	19
65+	513	25	488	6	1.2	1	442	39	48	465	4	0.8	2	401	58	9	1.8	3	0.6	468	33
Setting	5045	251	4794	116	2.3	10	4369	299	512	4533	124	2.5	17	3,927	465	160	3	26	0.5	4574	285
Rural	3274	205	3069	55	1.7	3	2821	190	395	2879	62	1.9	10	2,490	317	79	2	12	0.4	2961	222
Urban	1771	46	1725	61	3.4	7	1548	109	117	1654	62	3.5	7	1437	148	81	5	14	0.8	1613	63

MTB= Mycobacterium tuberculosis, MOTT= Mycobacterium other than tuberculosis, %age=percentage, N/A=not available

4.4.4 Relationship between smear and culture results

Table 13a-c compares culture and smear microscopy results. A total of 116 MTB+ cultures were reported from spot samples, with 79 of these (68.1%) being from smear-negative samples. Of the morning samples, 124 showed MTB+ cultures, and 73 (58.9%) were from negative smears.

Table 13a. A comparison of culture examination on morning and spot specimens

	Spot		Morning		Combined	
Culture results	n	%	n	%	n	%
Specimen requested	5,044	100.0	5044	100.0	5044	100
Culture results						
MTB	116	2.3	124	2.5	160	3.2
MOTT	10	0.2	17	0.3	26	0.5
Contaminated	299	5.9	465	9.2	57	1.1
Negative	4,368	86.6	3,926	77.8	4,276	84.8
N/A	251	5.0	512	10.2	525	10.4

Table 13b. Comparison of microscopy and culture results on spot specimens

		Culture results					
		Negative	**MTB**	**MOTT**	**Contaminated**	**N/A**	**Total**
Microscopy results	**Negative**	4,352	79	10	295	0	4,736
	Scanty	15	12	0	1	0	28
	1+	0	7	0	0	0	7
	2+	1	8	0	0	0	9
	3+	0	10	0	3	0	13
	N/A	0	0	0	0	251	251
	Total	4,368	116	10	299	251	5,044

Table 13c. Comparison of microscopy and culture results on morning specimens

		Morning culture results					
		Negative	**MTB**	**MOTT**	**Contaminated**	**N/A**	**Total**
Microscopy results	**Negative**	3913	73	17	461	0	4464
	Scanty	9	10	0	1	0	20
	1+	4	13	0	0	0	17
	2+	0	14	0	1	0	15
	3+	0	14	0	2	0	16
	N/A	0	0	0	0	512	512
	Total	3926	124	17	465	512	5044

Table 13d: Comparison of culture results for spot and morning specimens

		Morning Culture Results					
		Contaminated	**Negative**	**MTB**	**MOTT**	**N/A**	**Total**
Spot	Contaminated	57	214	7	0	21	299
	Negative	395	3,646	37	16	274	4,368
	MTB	9	14	80	1	12	116
	MOTT	1	8	0	0	1	10
	N/A	3	44	0	0	204	251
	Total	465	3,926	124	17	308	5,044

4.4.5 Xpert MTB/RIF

Per the protocol, all smear-positive samples (plus the second sample from the same participant) and smear-negative samples from participants whose culture was not conclusive (i.e. participants with both cultures contaminated) were to be run on Xpert MTB/RIF test on sediment to: confirm that smear-positive are indeed due to *Mycobacterium tuberculosis* (MTB); identify MTB in contaminated specimens; and to enhance speedy identification of rifampicin resistance. A total of 241 Xpert tests were conducted on the spot samples; 1 was rifampicin resistance (MTB RR) and 66 were rifampicin susceptible (MTB RS) (67/241, 25.3%).

For the morning specimens, a total of 307 were tested, and 76 were MTB RS (24.8%). Table 14 below shows Xpert MTB/RIF test results by ZN result, culture result and contamination status of spot and morning samples. A total of 321 participants who were both smear and culture negative but whose CXR were suggestive of active TB were also tested with Xpert. Of these 321, six were Xpert-positive and rifampicin-sensitive. (These patients are not included in the calculation of the prevalence of TB in this survey.)

Table 14: Xpert MTB/RIF results by smear, culture result & contamination status

		Xpert MTB/RIF results									
		Spot specimens					Morning specimens				
		MTB		Negative	N/A	Total	MTB		Negative	N/A	Total
		RR	RS				RR	RS			
Smear	Negative	1	23	160	4552	4736	0	20	219	4225	4464
	Scanty	0	15	13	0	28	0	9	11	0	20
	1+	0	7	0	0	7	0	16	1	0	17
	2+	0	8	1	0	9	0	15	0	0	15
	3+	0	13	0	0	13	0	16	0	0	16
	N/A	0	0	0	349	349	0	0	0	610	610
	Total	1	66	174	4901	5142	0	76	231	4835	5142
Culture	Contaminated	0	4	79	216	299	0	6	64	395	465
	Negative	0	8	95	4265	4368	0	11	165	3750	3926
	MTB	1	54	0	61	116	0	59	2	63	124
	MOTT	0	0	0	10	10	0	0	0	17	17
	N/A	0	0	0	349	349	0	0	0	610	610
	Total	1	66	174	4901	5142	0	76	231	4835	5142

RR= Rifampicin Resistance In: RS= Rifampicin Sensitive: NTB= MTB Not Detected

4.4.6 HIV testing

The study stipulated that participants eligible for sputum collection would undergo HIV counselling and testing (with the possibility to opt out); and those found HIV-positive would be referred to routine health system for management following the National Program guidelines.

Among 5142 participants eligible for sputum collection, 4,386 (85.3%) were tested for HIV. Acceptance was observed to be slightly higher among men than women (85.7% vs. 84.9%) and higher among urban than rural (87.3% vs. 84.2) residents. HIV test acceptance increased with age and peaked at 89.7% in those aged 35-44 years. Table 15 displays acceptance of HIV test and HIV status of participants eligible for sputum collection by sex, age group and residence. Overall, HIV prevalence among the participants eligible for sputum collection was 9.6% (as opposed to 7.3% in 2011 AIDS Indicator Survey)[29]; slightly higher among men than women (9.7% vs. 9.5%); and almost twice as high among urban than rural residents (13.2% vs. 7.6%). All those found to be HIV-positive were referred to the District Health System (DHS).

A total of 756 participants did not take an HIV test: 559 (73.9%) declined, 89 (11.8%) did not show up to have the test done, and 108 (14.3%) gave other reasons.

[29]Uganda, A.I.D.S., 2011. Indicator Survey. Ministry of *Health Kampala, Uganda and Calverton, MD: ICF International & US CDC*.

Table 15: HIV status of participants eligible for sputum collection by sex, age group and residence

		Eligible for sputum	Tested for HIV		HIV positive	
			n	%	n	%
Sex	Male	2,576	2,207	85.7	214	9.7
	Female	2,567	2,179	84.9	208	9.5
Age group in years	15–24	906	759	83.8	28	3.7
	25–34	969	840	86.7	116	13.8
	35–44	950	852	89.7	135	15.8
	45–54	820	716	87.3	88	12.3
	55–64	535	465	86.9	38	8.2
	65+	962	754	78.4	17	2.3
Residence	Rural	3,326	2,800	84.2	213	7.6
	Urban	1,816	1,586	87.3	209	13.2
TOTAL		5,142	4,386	85.3	422	9.6

4.5.0 Prevalent TB cases

A total of 216 participants had at least one positive laboratory result (see Table 17). The medical panel individually reviewed all 216. Of the 216, 160 (66 definitive smear-positive and 94 definitive S- bacteriologically confirmed) were confirmed as prevalent TB cases by the medical panel, while 56 were classified as not survey cases.

Table 16: Distribution of participants with any one positive lab tests eligibility, gender, age, residence

Characteristic		S+C+ Case		S-C+ Case		No survey		Total	
		n=66	%	n=94	%	n=56	%	n=216	%
Eligibility	Symptoms alone	0	0.0	16	17.0	29	51.8	45	20.8
	Chest X-ray alone	30	45.5	51	54.3	19	33.9	100	46.3
	Both symptoms and X-ray	36	54.5	27	28.7	7	12.5	70	32.4
	No X-ray with symptoms	0	0.0	0	0.0	1	1.8	1	0.5
	No X-ray and no symptoms	0	0.0	0	0.0	0	0.0	0	0.0
	Not eligible	0	0.0	0	0.0	0	0.0	0	0.0
Sex	Male	51	77.3	69	73.4	28	50.0	148	68.5
	Female	15	22.7	25	26.6	28	50.0	68	31.5
Age of TB cases	15-24	16	24.2	13	13.8	14	25.0	43	19.9
	25-34	18	27.3	24	25.5	10	17.9	52	24.1
	35-44	18	27.3	21	22.3	12	21.4	51	23.6
	45-54	7	10.6	17	18.1	5	8.9	29	13.4
	55-64	5	7.6	7	7.4	8	14.3	20	9.3
	65+	2	3.0	12	12.8	7	12.5	21	9.7
Residence	Rural	36	54.5	44	46.8	31	55.4	111	51.4
	Urban	30	45.5	50	53.2	25	44.6	105	48.6

4.5.1 Distribution of prevalent cases by sex, age group, residence, and cluster

Table 17 shows the distribution of prevalent cases by sex, age group and residence (N=160). Out of 160 cases, 120 (75%) were males and 40 (25%) females. The age band with the highest number of cases was 25-34, followed by the 35-44 band. Distribution of cases by residence status shows equal number (80 cases in rural and 80 in urban settings).

Table 17: Distribution of prevalent cases by sex, age group, residence, and cluster

		Participants (n)	S+C+ (n)	S-C+(n)	Prevalent cases (n)	Crude Prevalence/100,000
Sex	Male	17,485	51	69	120	686
	Female	23,669	15	25	40	169
Age groups in years	15-24	14,779	16	13	29	196
	25-34	10,546	18	24	42	398
	35-44	6,832	18	21	39	571
	45-54	4,280	7	17	24	561
	55-64	2,218	5	7	12	541
	65+	2,499	2	12	14	560
Residence	Rural	23,816	36	44	80	336
	Urban	17,338	30	50	80	461

4.5.2 Confirmed survey cases by the different screening criteria

Table 18 displays the confirmed survey cases yield of the different screening criteria (cough only, CXR only or both, neither CXR or cough including exempt) of prevalent cases. The highest proportion of prevalent cases, 81 (50.6%) were eligible to provide sputum by CXR only, followed by 63 (39.4%) eligible by both symptoms and CXR, while only 16 (10%) were eligible by cough only.

Table 18. Confirmed survey cases yield of the different screening criteria

Eligibility		S+B+ Case	S-B+ Case	Bacteriologically confirmed	
	TOTAL	66	94	160	100%
Symptoms alone		0	16	16	10.0
Chest X-ray alone		30	51	81	50.6
Both symptoms and X-ray		36	27	63	39.4
No X-ray with symptoms		0	0	0	0.0

No X-ray and no symptoms		0	0	0	0.0

4.5.3 Prevalence of respiratory symptoms and TB treatment experiences of prevalent cases

Almost one-third of prevalent cases did not report cough at all (see Table 19). Out of those that did, 79 (73.1%) reported a cough for two weeks or more. Among other symptoms reported, 24.4% reported weight loss, 18.1% reported fever and 13.1% reported night sweats. Seventy-nine (49.4%) of the 160 prevalent B+ cases in this study had reported cough for at least two weeks.

Only 16 (10.0%) of the 160 prevalent TB cases were on TB treatment at the time of the survey. By treatment history, 10 (6.2%) out of 160 cases had a history of having been treated for TB while 15 (9.4%) were currently on treatment at the time of the survey. Of the prevalent cases, 135 (84.4%) were new cases found by the survey.

Table 19. Prevalence of respiratory symptoms and TB treatment experiences of prevalent cases (N=160)

Characteristic	Yes	No	%
Cough	52	108	32.5
Productive cough	83	77	51.9
Blood in sputum	6	154	3.8
Weight loss	39	121	24.4
Fever	29	131	18.1
Night sweats	21	139	13.1
On TB treatment	16	144	10
Previous TB treatment	10	150	6.2

4.5.4 CXR findings of prevalent cases

Table 20 presents field and central CXR results of the prevalent cases. Of the 160 cases, 148 (92.5%) were classified centrally by radiologists as active TB. In the field, the CXR reading had noted abnormalities in the lung field in 144 of the 160 cases (90.0%).

Table 20. CXR (field and central reading) among prevalent cases

	Central CXR		
Field reading	**Normal**	**Active TB**	**Total**
Normal	10 (62.5%)	6 (37.5%)	16
Abnormal lung fields	2 (1.4%)	142 (98.6%)	144
Total	12	148	160

4.5.5 Laboratory results of prevalent cases

Of the 160 cases, 66 were smear-positive (41.3%). Table 21 shows that 92 prevalent cases had negative morning smears while 117 had negative spot smears. Strong positive smears that grading 1+ and higher was reported in 47 of the 160 cases (29.4%) when morning samples were examined, compared to 28 of the spot samples (17.5%).

For the 160 TB cases, 87 had no Xpert MTB/RIF results (because Xpert MTB/RIF was done for only those with smear-positive results and those with double contaminated culture), eight had one Xpert result, and 65 had both Xpert MTB/RIF (see Table 17). A total of 68 Xpert MTB/RIF were conducted on the Spot samples where 64/68 MTB was detected while for the morning samples, Xpert was conducted on 70 and MTB was detected on 68 of them.

Of the 160 cases, 115 (71.9%) had positive spot samples, while 122 (76.3%) had positive morning samples (Table 19). Seventy-three cases had Xpert MTB/RIF done (66 because they were smear-positive and 7 because they had contaminated cultures). Of these 73, 72 had both positive Xpert MTB/RIF and culture (98.6%) and only one (1.4%) had negative Xpert MTB/RIF and positive culture (see Table 19).

Table 21. Smear grading among prevalent cases

Spot (first) smear result		**Morning (second) smear result**						
		Negative	**Scanty**	**1+**	**2+**	**3+**	**Missing /Undefined**	**Total**
	Negative	85	4	8	8	3	9	117
	Scanty	5	4	4	1	1	0	15
	1+	0	0	3	1	2	1	7
	2+	0	0	1	2	4	1	8
	3+	2	2	0	3	6	0	13

	Total	92	10	16	15	16	11	160

Table 22. Xpert MTB/RIF results (including rifampicin-resistance pattern) of prevalent cases

Xpert MTB/RIF (Spot)	Xpert MTB/RIF (morning)			
	Not done (smear negative)	MTB Detected – Rifampicin Sensitive	MTB Not detected	Total
Not done (smear negative)	87	5	0	92
MTB Detected– Rifampicin Resistance	0	1	0	1
MTB Detected– Rifampicin Sensitive	3	59	1	63
MTB Not Detected	0	3	1	4
Total	90	68	2	160

Table 23. Culture results of prevalent cases

		Culture (morning) results					
		Contaminated	**Negative**	**MTB**	**MOTT**	**N/A**	**Total**
Culture (spot) results	**Negative**	0	3	34	0	0	37
	MTB	9	14	80	1	11	115
	Total	10	17	121	1	11	160

Table 24: Comparison of Xpert MTB/RIF and Culture results of prevalent TB cases

Xpert results		**Final categories**		
		S+B+	**S-B+**	**Total**
	Xpert-not done	0	87	87
	Xpert Negative	1	0	1
	Xpert Positive	65	7*	72
	Total	**66**	**94**	**160**

**7 cases had Xpert tests done despite negative smear microscopy, 1 had both morning and spot samples contaminated, and 6 were not done according to protocol*

4.5.6 HIV Status of the prevalent cases

Out of 160 prevalent B+ PTB cases, 145 (90.1%) took an HIV test (see Table 25). The HIV test acceptance rate in this study is comparable to the 91.0% reported among the 2014 NTLP TB cohort[30]. Just like with those eligible for sputum collection, the observed HIV test acceptance rate was higher among men than women (92.5% vs. 85.0%), and more among rural than urban residents (91.3% vs. 90.0%).

Of the 145 who took the test, 39 (26.9%) were found to be HIV-positive. The proportion of HIV-positive of 26.9% observed in this study is less than that observed in the routine surveillance data (48%).[31]

HIV among B+ cases in this study was more prevalent among women than men (29.4% vs. 26.1%); and among urban than rural residents (33.5% vs. 22.2%). The proportion HIV-positive was highest 33.4% among the group aged 45-54 years followed by those aged 35 – 44 years (27.8%).

Table 25: HIV status of prevalent B+ cases by sex, age group and residence

		Number	Number Tested	%	Number Positive	%	Number Negative	%
Gender	Male	120	111	92.5	29	26.1	82	73.9
	Female	40	34	85	10	29.4	24	70.6
Age group in years	15-24	29	28	96.6	2	7.1	26	92.9
	25-34	42	41	97.6	19	46.3	22	53.7
	35-44	39	36	92.3	10	27.8	26	72.2
	45-54	24	18	75	6	33.3	12	66.7
	55-64	12	11	91.7	2	18.2	9	81.8
	65+	14	11	78.6	0	0	11	100.0
Residence	Rural	80	72	90	16	22.2	56	77.8
	Urban	80	73	91.3	23	31.5	50	68.5
TOTAL		160	145	90.6	39	26.9	106	73.1

[30] WHO, Global TB Report, 2015.
[31] WHO, Global TB Report, 2014,

4.6 TB prevalence

4.6.1 TB prevalence in the survey population

In this survey, a total of 160 prevalent TB cases were confirmed. Three models were employed to estimate the prevalence of TB in the survey: robust standard errors without multiple imputation, robust standard errors with multiple imputation and robust standard errors with multiple imputation & inverse probability weighting. The latter model was used to estimate the final TB prevalence and are presented in the Table 26.

Of the 41,154, there were 5,142 screened positives who were eligible for sputum examination. Of those 5,142, 303 participants did not provide sputum specimens and 312 had at least one smear AND one culture result missing (which is considered missing according to Lime Book definitions), so a total of 615 participants inherited the missing status when combining smear and culture results to get to bacteriologically confirmed outcome. Therefore, for computing the TB prevalence, a denominator of 40,539 was used instead of 41,154, as the total 40,539 are the "measurable" in terms of the outcome of bacteriological confirmation.

Different outcomes (e.g. smear-positive, culture-positive, bacteriologically-confirmed) could have different measurable populations. The participant population tables add up to 41,154 but the number of "missing" will depend on the variable being described.

Table 26. Prevalence of smear-positive and bacteriologically confirmed TB by gender, age, and residence

		Smear-positive					Bacteriologically confirmed				
		Number of cases	***Denominator***	***Best point estimate***	***Lower limit***	***Upper limit***	***Number of cases***	***Denominator***	***Best point estimate***	***Lower limit***	***Upper limit***
TOTAL		66	40,539	174	111	238	160	40,539	401	292	509
Sex	Male	51	17,146	314	216	413	120	17,146	734	554	914
	Female	15	23,393	70	25	114	40	23,393	178	109	248
Age	15-24	16	14,618	124	50	198	29	14,618	228	117	338
	25-34	18	10,402	191	98	284	42	10,402	442	291	592
	35-44	18	6,730	294	162	425	39	6,730	624	379	869
	45-54	7	4217	164	25	303	24	4,217	565	280	850
	55-64	5	2,171	254	26	481	12	2,171	636	277	995
	65+	2	2,401	85	2	205	14	2,401	570	261	879
Residence	Rural	30	17,175	169	91	248	80	17,175	370	237	504
	Urban	36	23,364	191	113	270	80	23,364	504	355	652

It can be seen from the Table 26 that the prevalence of S+ TB was 174 per 100,000 population, 95% CI (111-160) and that of B+ TB was 401 per 100,000 population, 95% CI (292-509). The prevalence was higher among males than females: prevalence of S+ TB:314 vs.70 and prevalence of B+ TB:734 vs. 178.

The most affected age group for S+ TB was that of 35-44 years (294/100,000 population) while for B+ TB it was 55-64 years (636/100,000 population); this number is close to 624/100,000 seen among the 35-44-year age group re-affirming that the 35-44 age group was the most affected.

When considering the urban and rural settings, it can be seen in table 32 that the prevalence of S+ TB was 169/100,000 population in rural areas vs. 191/100,000 population for urban areas. For B+ TB, prevalence was 370/100,000 in rural areas vs. 504/100,000 population in urban areas.

4.6.2 Prevalence of HIV related TB in the survey population

When triangulating the HIV status of TB prevalent cases and calculating the TB prevalence in correlation with HIV, using the same denominator used for prevalence (40,539), we observe that the crude (unadjusted) prevalence of HIV+TB was 96.2/100,000; the prevalence of HIV-TB was 261/100,000; and the prevalence of HIV unknown TB was 37/100,000.

4.6.3 Prevalence to notification ratio for smear-positive and all cases found in the survey

Table 27a & b show the S+ prevalence to S+ notification ratio and B+ prevalence to B+ notification ratios. For smear-positive TB, the national P: N ratio is 1.3 but increases to 1. for males. By age group the P: N is highest for the 15-24-year age group in which it is followed by the 55-64-year age group which has a P: N ratio of 1.5.

Considering all bacteriologically confirmed cases (B+), the P: N ratios are 3.4 for national, higher for males than females (4.6 vs.2.3). By age group the highest P: N ratio is for the >65 years age group (2.7) followed closed by the 15-24 age group (2.6).

Table 27a: S+ Prevalence to S+ notification ratios

		S+ Prevalence ‡per 100,000	S+ Notification** per 100,000	P:N ratio
	TOTAL	174	138	**1.3**
Gender	Male	314	195	**1.6**
	Female	70	94	**0.8**
Age groups (years)	15-24	124	62	**2.0**
	25-34	191	178	**1.1**
	35-44	294	224	**1.3**
	45-54	164	203	**0.8**
	55-64	254	169	**1.5**
	65+	85	221	**0.4**

Table 27b: B+ Prevalence to B+ notification ratios

		B+ Prevalence ‡per 100,000	B+ Notification** per 100,000	P:N ratio
	TOTAL	401	119	3.4
Gender	Male	734	161	4.6
	Female	178	79	2.3
Age groups (years)	15-24	228	87	2.6
	25-34	442	289	1.5
	35-44	624	378	1.7
	45-54	565	352	1.6
	55-64	636	278	2.3
	65+	570	213	2.7

4.6.4 TB Prevalence in general population (all ages and all forms of TB)

The survey included only participants 15 years and older and measured only bacteriologically confirmed pulmonary TB, while TB occurs in people of all ages. There is also bacteriologically negative TB and extra pulmonary TB. For this reason, survey data was used to extrapolate the prevalence to the entire population and for all forms of TB (see Annex 22 for details).

Overall the prevalence of pulmonary B+ TB among adults from survey (rate/100,000) is 401 (95% CI: 292 – 509). This prevalence was adjusted for the proportion in the population 0.49 (UNDP data) and NTLP data showing prevalence of TB in children of 0.09, SD=0.007. to account for extra pulmonary TB the proportion of extrapulmonary over period 2009–2014 (NTP data) of 0.12, SD=0.009 was used. After these adjustments the TB prevalence of all forms, all ages are estimated to be 253 (95% CI: 191 – 315). This approximates to **87,000 TB cases (95% CI: 65,000 – 110,000)**.

The results of this survey have also been used to re-estimate the TB incidence. Prior to the survey, incidence for 2014 was estimated at 161 (95% 141-183) cases per 100,000 population per year[32]. Post-survey, the estimated incidence for 2015 was 202 (120-304) per 100,000 population per year[33].

4.7 Healthcare-seeking behavior of participants with chronic cough and among prevalent cases

4.7.1: Participants with chronic cough

Table 24 portrays healthcare-seeking behaviour of participants with cough at least two weeks, divided by sex and place of residence. A total of 2714 participants had cough of at least two weeks' duration. Of these 1059 (39.0%) did not seek any form treatment for the cough, males 46. % and females 33.0. There was no difference between rural and urban participants (39.0% vs. 39.1%).

[32] WHO, Global TB Report, 2015.
[33] WHO, Global TB Report, 2016.

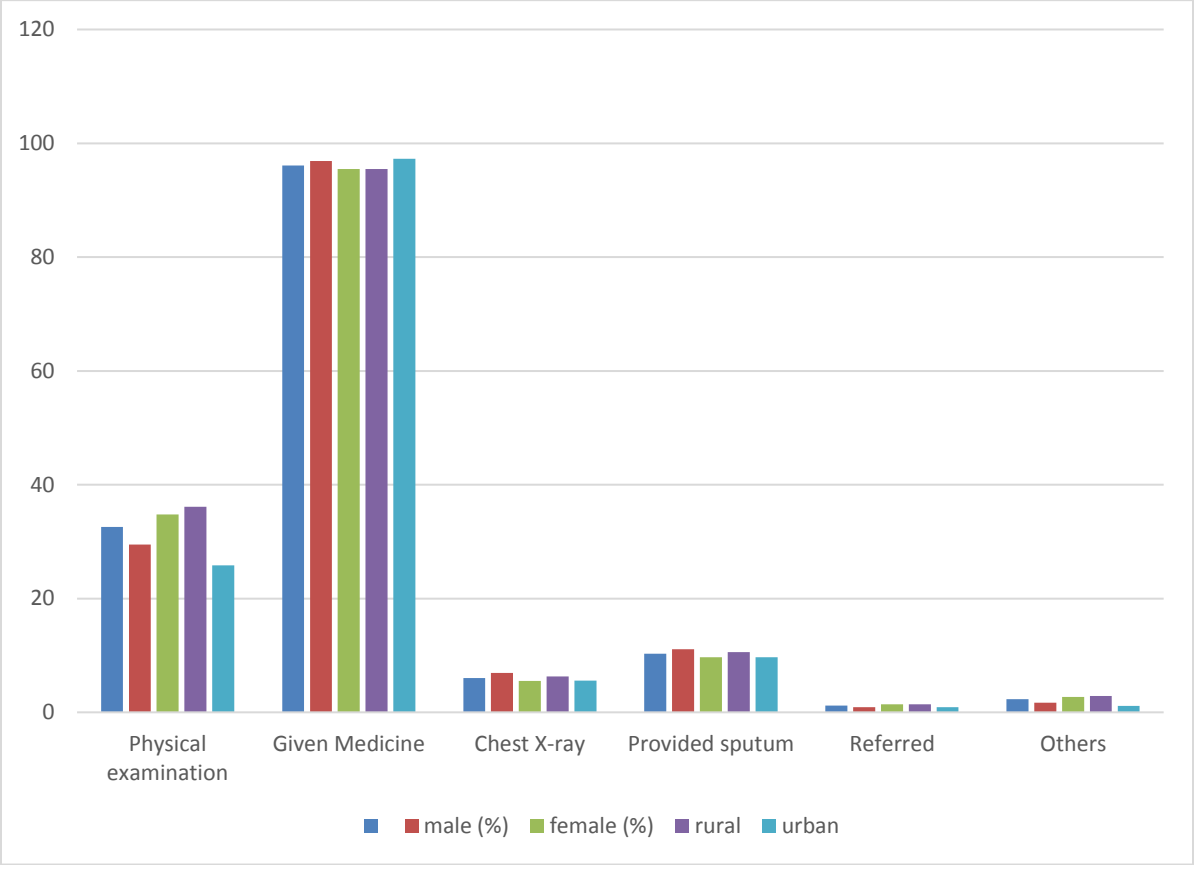
Table 28: Healthcare-seeking behaviour of participants with cough of at least two weeks by sex, and residence

				Gender				Residence			
		All	%	Male	%	Female	%	Rural	%	Urban	%
	No treatment sought	1059	39.0	572	46.1	487	33.0	703	39.0	356	39.1
	Sought treatment	1655	61.0	668	53.9	987	67.0	1,100	61.0	555	60.9
	Total	2714	100.0	1,240	100.0	1,474	100.0	1,803	100.0	911	100.0
Source of Treatment	Public	1038	62.7	385	57.6	653	66.2	745	67.7	293	52.8
	NGO	17	1.0	5	0.8	12	1.2	7	0.6	10	1.8
	Private	146	8.8	65	9.7	81	8.2	84	7.6	62	11.2
	Pharmacy/drug shop	421	25.4	198	29.6	223	22.6	239	21.7	182	32.8
	Traditional healer	11	0.7	6	0.9	5	0.5	8	0.7	3	0.5
	Other	22	1.3	9	1.4	13	1.3	17	1.6	5	0.9
	Total	1655	100.0	668	100.0	987	100.0	1100	100.0	555	100.0
Type of care received	Physical examination	540	32.6	197	29.5	343	34.8	397	36.1	143	25.8
	Given Medicine	1,590	96.1	647	96.9	943	95.5	1,050	95.5	540	97.3
	Chest X-ray	100	6.0	46	6.9	54	5.5	69	6.3	31	5.6
	Provided sputum	170	10.3	74	11.1	96	9.7	116	10.6	54	9.7
	Referred	20	1.2	6	0.9	14	1.4	15	1.4	5	0.9
	Others	38	2.3	11	1.7	27	2.7	32	2.9	6	1.1

4.7.2 Care received by participants with cough of two weeks or more who sought care

Figure 10 and Table 24 show the type of care received. Nearly all (96.1%; 1,591/1,656) of those who sought care received medicine and 32.6% (540/1656) had a physical examination, but less than one-fifth were investigated by either sputum (10.3%; 170/1656) and/or CXR (6%; 100/1656) examination. Yet investigations especially sputum examination could have enhanced early detection of PTB. 1.2% of those who sought care were referred while 2.3% (38/1656) received other types of care.

Figure 10: Type of care received by participants with 2 weeks' cough who sought care by gender and residence.



4.7.3 Reasons for not seeking care

Out of the 2,714 screened individuals who had cough for at least two weeks, 1,059 (39%) had not sought care. Reasons for not seeking care included: ignoring illness in 333 (31.1%) cases and not recognizing illness in 127 (12%) cases. Other reasons included: self-treatment in 328 (31%) cases; hindered by cost in 169 (16%) cases, long distances in 57 (5.4%) cases, long waiting time in 14 (1.3%) cases; and other reasons in 31 (2.9%) cases.

Table 29: Reasons for not seeking care

			Gender				Residence			
	All	**%**	**Male**	**%**	**Female**	**%**	**Rural**	**%**	**Urban**	**%**
Self-treatment	328	31.0	160	28.0	168	34.5	197	28.0	131	36.8
Unrecognized illness	127	12.0	69	12.1	58	11.9	86	12.2	41	11.5
Ignored	333	31.4	196	34.3	137	28.1	215	30.6	118	33.2
Cost	169	16.0	95	16.6	74	15.2	127	18.1	42	11.8
Distance	57	5.4	26	4.6	31	6.4	47	6.7	10	2.8
Long waiting	14	1.3	9	1.6	5	1.0	9	1.3	5	1.4
Others	31	2.9	17	3.0	14	2.9	22	3.1	9	2.5
Total	**1,059**	**100.0**	**572**	**100.0**	**487**	**100.0**	**703**	**100.0**	**356**	**100.0**

4.7.4. Healthcare-seeking of prevalent TB cases

Fifty of the 160 prevalent TB cases (63.2%) had sought care for their cough: 18 (35%) from public health facility, 5 (10%) from drug shops/pharmacy, 2 (4%) from private and 1(1%) from NGO facilities.

Table 30: Healthcare-seeking behaviour of prevalent TB cases by sex and residence

		Gender						Residence			
		All	%	Male	%	Female	%	Rural	%	Urban	%
	No treatment	29	18.1	24	20.0	5	12.5	16	20.0	13	16.3
	Sought treatment	50	31.3	33	27.5	17	42.5	30	37.5	20	25.0
	N/A	81	50.6	63	52.5	18	45.0	34	42.5	47	58.8
	Total	160	100.0	120	100.0	40	100.0	80	100.0	80	100.0
Source of Treatment	Public	35	70.0	26	78.8	9	52.9	24	80.0	11	55.0
	NGO	1	2.0	1	3.0	0	0.0	0	0.0	1	5.0
	Private	4	8.0	1	3.0	3	17.6	0	0.0	4	20.0
	Pharmacy/drug shop	10	20.0	5	15.2	5	29.4	6	20.0	4	20.0
	Traditional healer	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Other	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Total	50	100.0	33	100.0	17	100.0	30	100.0	20	100.0
Type of Care	Physical examination	17	34.0	14	42.4	3	17.6	12	40.0	5	25.0
	Given Medicine	50	100.0	33	100.0	17	100.0	30	100.0	20	100.0
	Chest X-ray	5	10.0	3	9.1	5	29.4	2	6.7	3	15.0
	Provided sputum	12	24.0	8	24.2	4	23.5	5	16.7	7	35.0
	Referred	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Others	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

5. PROGRAM IMPLICATIONS

This survey is the first national population-based TB prevalence survey in Uganda. The survey provides unique information on the true burden of TB, and provides a baseline against which to measure all repeat prevalence surveys. The overall TB prevalence (all forms, all ages) found in this survey was estimated to be 253 per 100,000 (95% CI: 196 – 317). This is higher than the previously estimated 159 per 100,000 (95% CI: 87-252). The observed high prevalence across age groups suggests that TB transmission is still widespread despite implementation of the Stop TB strategy. According to survey results, a total of 87,000 new cases occur every year. Considering that Uganda notified 46,171 TB patients[34] survey results revealed that 40,829 patients (47%) were missed in 2014. These findings call for prompt actions to find and treat TB cases, and halt TB transmission in Uganda.

5.1 Main program implications and suggested approaches

Considering the vast number of cases missed every year (around 41,000), the Ministry of Health and the National Tuberculosis and Leprosy Program should prioritise interventions to increase TB case finding and ensure all identified cases are notified to curtail the spread of the disease in the community. Partners, donors, and stakeholders should actively collaborate with the MOH/NTLP in designing and implementing a robust strategic plan to tackle TB in Uganda. This calls for strengthening the capacity of NTLP for effective coordination and leadership.

A multi-level approach to enhance TB case finding should be put in place, starting with increasing strategic investments for TB control and better utilization of available diagnostics. There is urgent need to make available TB screening and diagnostic services to the different levels, with emphasis on TB hotspots and high-risk population (prisons, health workers, congregate settings, PLHIV, diabetics, slum dwellers and contacts of confirmed and infectious TB patients).

5.2 Addressing barriers to healthcare-seeking behaviour

An important finding of the survey was poor healthcare-seeking behaviour of those reporting chronic cough. About 39% of symptomatic presumptive TB patients and 37% of symptomatic prevalent TB cases did not take any action for their symptoms. The reasons for not seeking care included ignored illness (31.1%), self-treated (31%), hindered by cost (16%), did not recognise illness (12%), long distance (5.4%), long waiting time (1.3%) and others (2.9%). Understanding and addressing patients' barriers to service access is crucial to

[34] WHO, 2015.

maximize the demand for service utilisation. The community should be empowered to seek and demand TB services. The program should adopt an appropriate Behavioural Change Communication (BCC) strategy, social and livelihood support. Additionally, to understand and reduce costs in TB care, the TB program should conduct a patients' cost survey.
The survey revealed that among those who sought care due to chronic cough, a very low proportion was offered TB screening; only 10% and 6%, respectively, were asked to provide a sputum sample and offered X-rays services.

If patients with chronic cough have not been recognized as presumptive TB cases at the health facility level, it may be due to lack of training/skilled healthcare worker/lack of resources as diagnostic facilities/ limited or lack of supportive supervision/others on TB case finding. The gaps should be identified and addressed accordingly; through staff training, supportive supervision, improved M&E and staff motivation.

5.3 Systematic screening for active TB

At the service delivery level, there is need for systematic screening for active TB in high risk populations. This implies the correct identification of presumptive TB cases and timely diagnosis of TB using appropriate tests. The program should develop and implement a TB screening algorithm that is sensitive, specific and cost effective.

5.4 Review of TB screening criteria

In Uganda, the program is largely dependent on identification of presumptive TB through symptom screening, especially using cough of two or more weeks. However, survey data revealed that using symptom screening only, about half of the smear-positive cases (30 out of 66 cases) would have been missed. Addition of chest X-ray to symptom screening allowed the identification of a higher number of bacteriologically confirmed cases compared to the contribution of cough as a symptom alone. Ministry of Health might use the survey results to consider a revision of current diagnostic algorithm (i.e. TB screening criteria, access to CXR, etc.)

5.5 Utilization of diagnostic tools and universal access to DST

Currently the country relies heavily on smear microscopy and this limits the diagnostic capacity for the smear-negative patients. The survey identified 160 prevalent bacteriologically confirmed cases. Only 66 (41.2%) were smear-positive and the rest were identified by culture or Xpert MTB/RIF. Smear microscopy missed approximately 60% of TB patients, thus the government should urgently expand and decentralise access to Xpert MTB/RIF and future innovative cost effective diagnostic tools for all presumptive TB patients. In addition, the government should increase investment to culture and drug susceptibility testing (DST) in line with the End TB Strategy.

5.6 TB/HIV in the survey

HIV co-infection rate of 27% was found among survey patients compared to 45% based on health facility data.[35] The survey results revealed that the prevalence of TB in HIV positives was 96.2/100,000 as compared to 261/100,000 among HIV-negatives. The reasons for this are not clear but we believe it is since TB in HIV progresses faster and is a more severe disease, HIV infected patients may be more likely to seek care than their HIV uninfected counter parts. This can create a high prevalence in healthcare settings and low prevalence in the community.

HIV co-infection is high at both community and health facility level. Although National guidelines for TB/HIV collaborative services (MoH, 2013) exist up to the health facility level, there is urgent need to expand these services to the community. The government should prioritize TB case finding in all healthcare service delivery points especially among HIV negative individuals and involve the community in TB case finding.

5.7 Targeted strategies to enhance TB case finding

5.7.1 Enhance TB case finding among men.

TB among men (15 years and above) was four times higher than in women (prevalence among bacteriologically confirmed 734/100,000 men and 178 women/100,000), and the prevalence was higher among those aged 25 and above. The TB program should design interventions targeting these most at risk populations for TB.

5.7.2 Enhance TB case finding in urban areas

Prior to the survey, Program data showed that up to 19% of cases were notified from Kampala city. This presupposed that TB is far more common in urban areas than rural areas. This is in line with the prevalence survey findings that indicated a higher prevalence of bacteriologically confirmed TB of 504/100,000 in urban areas compared to 370/100,000 in rural areas.
The National TB and Leprosy program should use appropriate strategies to enhance TB case finding in urban areas e.g. the urban TB DOTS model, public private partnerships strategies, etc.

5.7.3 TB hotspots

TB hotspots existed both in rural and urban areas. This case clustering further justifies contact tracing for all smear-positive TB cases to increase case finding.

[35] WHO, 2015.

National TB Program should target TB hotspots with interventions such as active case finding, contact tracing and outreaches among others.

5.7.4 Involvement of private health sector in TB prevention care and treatment

Of those who sought care, 62.7% did so at public health facilities. Besides the public sector, the most common first point of contact for people with cough and TB cases was the pharmacy/drug shop, which highlights the important role pharmacies and drug shops can play in TB case-finding activities, especially through the referral of TB suspects by pharmacy staff to appropriate healthcare providers. In some areas, NGOs and private sector are the only available providers for TB services. The Program should reinforce private-public partnerships, involving the pharmacies/drug shops, private practitioners and traditional healers in TB related activities. TB is a notifiable disease in Uganda by law. Mandatory notification of TB should be revived.

5.7.5 Community involvement

The survey utilised several community engagement strategies including but not limited to; extended working hours and working on weekends, incentives, use of political and technical structures as entry points into the community and use of community resource persons. Participation rate of 91% was recorded even in urban settings, despite the challenges like highly mobile communities, inaccessibility due to fenced/guarded premises. The flexible teams (community health workers/VHTs) were trained and developed skills in community screening for TB.

The National TB program should increase the involvement and participation of the existing community structures in raising awareness, screening and referral for TB prevention, care and treatment.

5.8 Areas for further research

The program needs to develop a clear research agenda and research strategy to guide TB related research in the country. The following are research questions derived directly from the prevalence survey—

- Risk-factor analysis (i.e. correlation between smoking, alcohol dependence and cough and TB)
- Research into the contribution of clinically diagnosed and/or extra pulmonary TB
- An assessment of TB in Children – increase investments in this area
- Research to improve TB screening algorithm
- Burden of TB in special settings e.g. prisons.
- Establish drivers of TB among men

- Establish means for finding the missed young TB patients
- Epidemiological mapping of TB hotspots in Uganda
- Determine drivers of TB in identified TB hotspots.
- Conduct national TB patient cost surveys to establish the economics of TB on patients and the impact of high costs on TB control
- Repeat national population TB prevalence survey after 5 years
- Assessment of the extent of TB under reporting

5.9 Limitations of the survey

The study did not enroll children less than 15 years of age into the study. This was partly due to difficulty in accessing sputum in children and risks associated with exposure of X-rays to children less than 15 years. A special survey for prevalence of TB among children would be very helpful.

Clinically diagnosed (CD) and extra-pulmonary TB (EPTB) were not considered. Results were extrapolated using Program data and fitted into the final results; we risk not including strategies to address CD/EPTB due to lack of evidence base. A special study identifying the EPTB would also be very helpful.

Other operational limitations included significant delays in starting the survey due to funding constraints, bureaucratic procurement procedures. The survey also experienced frequent equipment breakdown notably X-ray machines probably due to the high tropical temperatures.

ANNEXES

Annex 1. Cluster ID, name and location (urban/rural)

Cluster ID	Cluster Name	Location
1	Obokora-Pallisa	RURAL
2	Butiru Tow-Manafwa	RURAL
3	Kitooro Central-Wakiso	URBAN
4	Paacwa-Kagadi	RURAL
5	Bumanya-Kaliro	RURAL
6	Kasubi ward-Gulu	URBAN
7	Central Ward-Zombo	RURAL
8	Kazo Angola Cetral Kampala	URBAN
9	Luzige A-Kampala	URBAN
10	Nyakitabire-Kabale	URBAN
11	Kibira-Sironko	RURAL
12	Bukwiri-Kyankwanzi	RURAL
13	Bwigula-Iganga	RURAL
14	Ojinga-Yumbe	RURAL
15	Buyaga-Bulambuli	RURAL
16	MajiMuzuri-Jinja	URBAN
17	Anyara-Kaberamaido	RURAL
18	Kapir-Ngora	RURAL
19	Estern ward-Dokolo	RURAL
20	Kabaare Li-Isingiro	RURAL
21	Yoana Marai-Kampala	URBAN
22	Muruhura-Kanungu	RURAL
23	Ndorero-Rukungiri	RURAL
24	Ssaza Central-Masaka	RURAL
25	Anyalima-Otuke	RURAL
26	Oli C-Arua	URBAN
27	Abangaiamai-Alebtong	RURAL
28	Kichinjaji-soroti	URBAN
29	Ireda shamba-Lira	URBAN
30	Rushaka-Hoima	URBAN
31	Kiziranfumbi-Hoima	URBAN

32	Ntezi II-Kabarole	URBAN
33	Kahimba-Kyegegwa	RURAL
34	Nyarwesha-Sheema	RURAL
35	NyoriCheku-Koboko	RURAL
36	Kirokole-Kampala	URBAN
37	Magudi central-Nebbi	URBAN
38	Makukuulu-Bukomansimbi	RURAL
39	Lalal-Agago	RURAL
40	Kidugala-Nakasongola	RURAL
41	Kiring-Kapchorwa	RURAL
42	Nkandwa-Mubende	RURAL
43	Kira-Wakiso	URBAN
44	Lwanda-luuka	RURAL
45	Mugalasi-Kampala	URBAN
46	Kirinya Main-Wakiso	URBAN
47	Bijaaba-Lwengo	RURAL
48	Aojakitoi-Amuria	RURAL
49	Muhofa Zone-Jinja	URBAN
50	Kabulamuliro Ssekiwunga-Wakiso	URBAN
51	Boroboro-Kitgum	RURAL
52	Katooma B-Sembabule	RURAL
53	Nsikye-Mbarara	URBAN
54	Kibuku-Kamapala	URBAN
55	Mawotto-Mukono	URBAN
56	Katale-Nakaseke	RURAL
57	Kashwa-Kiruhura	RURAL
58	Mariach C-Busia	URBAN
59	Musaale-Luwero	RURAL
60	Kangulumira-Kayunga	RURAL
61	Nauto-Mbale	URBAN
62	Nyamitangaro-Ntungamu	URBAN
63	Central-Kampala	URBAN
64	Kanyange-Kasese	RURAL
65	Ondorokwa-Arua	URBAN
66	Kyankuuta-Kyenjojo	RURAL
67	Katanga ward-Nakapiripirit	RURAL

68	Kironde-Kampala	URBAN
69	Serinya-Mityana	RURAL
70	Kibale-Kisoro	URBAN

Annex 2: Survey population by eligible and ineligible

			Number (%) ineligible				Number (%) eligible		TOTAL
			<15yrs		Visitors ≥15 yrs.				
			n	%	n	%	n	%	N
Sex		Male	18,383	44.8	2,536	6.2	20,087	49.0	41,006
		Female	18,418	40.8	1,478	3.3	25,206	55.9	45,102
Age group in years	Males	0–4	6,598	100.0					6,598
		5–14	11,785	100.0					11,785
		15–24			874	10.8	7,262	89.2	8,136
		25–34			797	14.1	4,927	85.9	5,724
		35–44			518	12.6	3,608	87.4	4,126
		45–54			231	9.9	2,114	90.1	2,345
		55–64			79	7.1	1,028	92.9	1,107
		65+			37	3.1	1,148	96.9	1,185
	Females	0–4	6,577	100.0					6,577
		5–14	11,841	100.0					11,841
		15–24			848	8.4	9,233	91.6	10,081
		25–34			348	4.9	6,687	95.1	7,035
		35–44			154	3.8	3,947	96.2	4,101
		45–54			67	2.6	2,515	97.4	2,582
		55–64			25	1.8	1,328	98.2	1,353
		65+			36	2.3	1,496	97.7	1,532
Residence		Rural	24,756	46.2	2,018	3.8	26,832	50.1	53,606
		Urban	12,045	37.1	1,997	6.1	18,460	56.8	32,502
Cluster		1	699	51.5	27	2.0	632	46.5	1,358
		2	577	44.7	45	3.5	669	51.8	1,291
		3	301	31.2	54	5.6	610	63.2	965
		4	563	43.0	117	8.9	628	48.0	1,308
		5	751	51.7	50	3.4	651	44.8	1,452
		6	483	41.4	46	3.9	637	54.6	1,166
		7	453	38.9	79	6.8	634	54.4	1,166
		8	356	33.5	117	11.0	589	55.5	1,062
		9	106	13.5	119	15.2	558	71.3	783
		10	462	40.1	63	5.5	627	54.4	1,152
		11	741	51.5	20	1.4	677	47.1	1,438
		12	920	51.9	5	0.3	848	47.8	1,773
		13	668	48.2	38	2.7	680	49.1	1,386
		14	609	49.2	39	3.2	590	47.7	1,238
		15	556	43.2	79	6.1	652	50.7	1,287

16	248	26.7	26	2.8	655	70.5	929
17	635	48.0	32	2.4	655	49.5	1,322
18	564	45.3	77	6.2	603	48.5	1,244
19	531	43.6	59	4.8	629	51.6	1,219
20	454	40.1	72	6.4	606	53.5	1,132
21	205	24.1	34	4.0	611	71.9	850
22	455	39.4	64	5.5	635	55.0	1,154
23	341	32.2	91	8.6	628	59.2	1,060
24	529	37.1	212	14.9	684	48.0	1,425
25	698	51.6	31	2.3	626	46.2	1,354
26	581	44.5	108	8.3	618	47.3	1,307
27	647	48.7	44	3.3	638	48.0	1,329
28	437	37.7	73	6.3	650	56.0	1,160
29	421	34.4	183	15.0	620	50.7	1,224
30	623	50.1	15	1.2	605	48.7	1,243
31	564	46.7	16	1.3	628	52.0	1,208
32	506	45.3	15	1.3	595	53.3	1,116
33	635	49.6	31	2.4	614	48.0	1,280
34	461	38.4	133	11.1	606	50.5	1,200
35	699	51.9	18	1.3	631	46.8	1,348
36	333	32.0	70	6.7	638	61.3	1,041
37	564	48.5	37	3.2	562	48.3	1,163
38	762	51.2	49	3.3	678	45.5	1,489
39	746	51.1	41	2.8	672	46.1	1,459
40	777	52.2	55	3.7	657	44.1	1,489
41	732	51.8	11	0.8	671	47.5	1,414
42	730	48.5	1	0.1	774	51.4	1,505
43	313	30.4	101	9.8	615	59.8	1,029
44	832	50.8	0	0.0	806	49.2	1,638
45	339	32.7	100	9.6	599	57.7	1,038
46	279	28.2	98	9.9	613	61.9	990
47	725	50.3	9	0.6	706	49.0	1,440
48	756	52.8	47	3.3	628	43.9	1,431
49	458	40.1	17	1.5	667	58.4	1,142
50	315	31.4	85	8.5	603	60.1	1,003
51	646	48.9	70	5.3	604	45.8	1,320
52	761	48.3	1	0.1	815	51.7	1,577
53	317	31.6	43	4.3	642	64.1	1,002
54	177	19.7	114	12.7	607	67.6	898
55	433	42.2	48	4.7	544	53.1	1,025
56	607	42.3	8	0.6	819	57.1	1,434
57	511	38.9	0	0.0	804	61.1	1,315

		58	539	45.7	23	2.0	617	52.3	1,179
		59	620	44.9	95	6.9	665	48.2	1,380
		60	666	46.4	100	7.0	669	46.6	1,435
		61	390	34.2	88	7.7	661	58.0	1,139
		62	533	45.9	41	3.5	588	50.6	1,162
		63	252	27.0	61	6.5	622	66.5	935
		64	399	36.4	46	4.2	650	59.4	1,095
		65	579	42.9	134	9.9	637	47.2	1,350
		66	269	30.4	29	3.3	587	66.3	885
		67	469	41.0	86	7.5	589	51.5	1,144
		68	323	32.4	48	4.8	627	62.8	998
		69	562	40.4	7	0.5	823	59.1	1,392
		70	608	48.9	20	1.6	615	49.5	1,243
TOTAL			**36, 801**	**42.7**	**4,014**	**4.7**	**45,293**	**52.6**	**86,108**

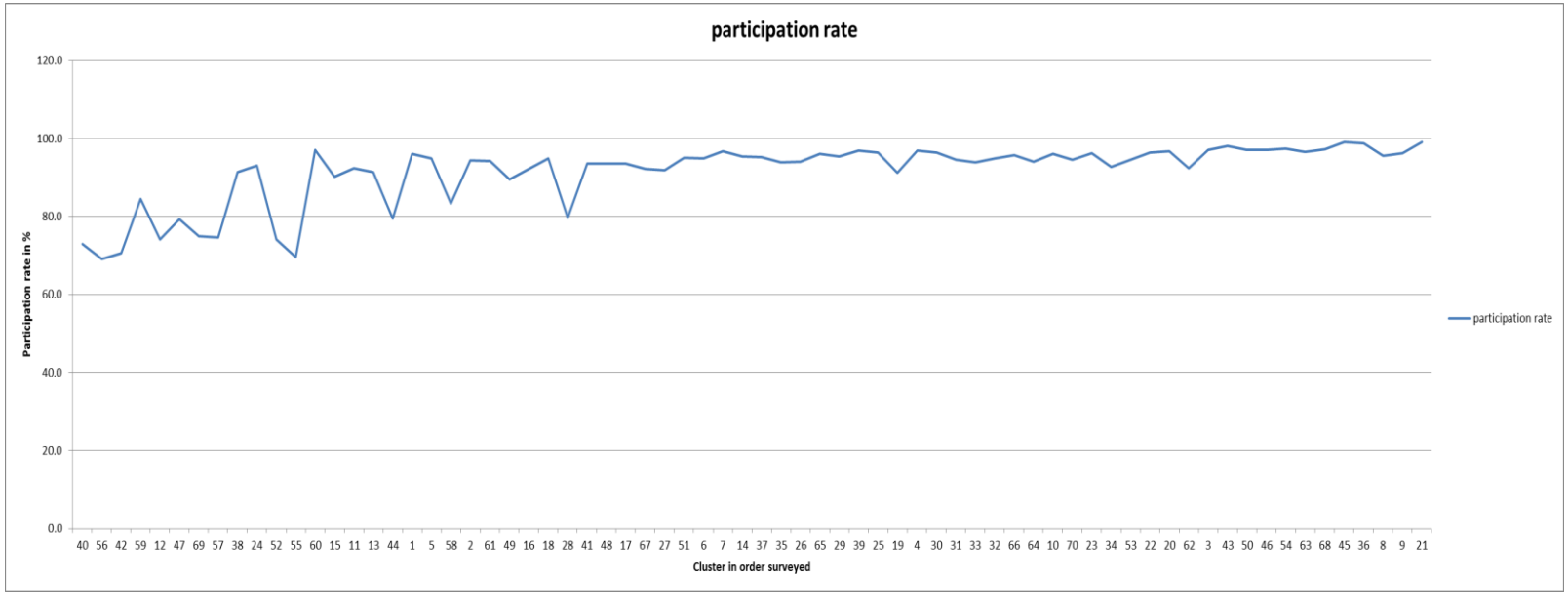
Annex 3: Breakdown of eligible individuals into non-participants and participants: overall and by sex, age group, residence and cluster

			Non-participants		Participants (interview and/or chest X-ray)		TOTAL (eligible)
			Number	%	n	%	n
Sex		Male	2,602	13.0	17,485	87.0	20,087
		Female	1,537	6.1	23,669	93.9	25,206
Age in years	**Male**	15–24	979	13.5	6,283	86.5	7,262
		25–34	702	14.2	4,225	85.8	4,927
		35–44	533	14.8	3,075	85.2	3,608
		45–54	235	11.1	1,879	88.9	2,114
		55–64	85	8.3	943	91.7	1,028
		65+	68	5.9	1,080	94.1	1,148
Age in years	**Female**	15 -24	741	8.0	8,492	92.0	9,233
		25 – 34	369	5.5	6,318	94.5	6,687
		35 – 44	191	4.8	3,756	95.2	3,947
		45 – 54	107	4.3	2,408	95.7	2,515
		55 – 64	58	4.4	1,270	95.6	1,328
		65+	71	4.7	1,425	95.3	1,496
Residence		Rural	3,017	11.2	23,816	88.8	26,833
		Urban	1,122	6.1	17,338	93.9	18,460
Cluster		1	25	4.0	607	96.0	632
		2	38	5.7	631	94.3	669
		3	18	3.0	592	97.0	610
		4	19	3.0	609	97.0	628
		5	33	5.1	618	94.9	651
		6	33	5.2	604	94.8	637
		7	21	3.3	613	96.7	634
		8	26	4.4	563	95.6	589
		9	21	3.8	536	96.1	558
		10	25	4.0	602	96.0	627
		11	51	7.5	626	92.5	677
		12	219	25.8	628	74.1	848
		13	59	8.7	621	91.3	680
		14	27	4.6	563	95.4	590
		15	64	9.8	588	90.2	652
		16	51	7.8	604	92.2	655
		17	42	6.4	613	93.6	655

	18	31	5.1	572	94.9	603
	19	55	8.7	574	91.3	629
	20	20	3.3	586	96.7	606
	21	6	1.0	604	98.9	611
	22	23	3.6	612	96.4	635
	23	24	3.8	603	96.0	628
	24	48	7.0	636	93.0	684
	25	22	3.5	603	96.5	626
	26	37	6.0	581	94.0	618
	27	52	8.2	586	91.8	638
	28	132	20.3	518	79.7	650
	29	28	4.5	592	95.5	620
	30	22	3.6	583	96.4	605
	31	34	5.4	593	94.4	628
	32	30	5.0	565	95.0	595
	33	37	6.0	577	94.0	614
	34	44	7.3	562	92.7	606
	35	39	6.2	592	93.8	631
	36	8	1.3	630	98.7	638
	37	27	4.8	535	95.2	562
	38	59	8.7	619	91.3	678
	39	21	3.1	651	96.9	672
	40	178	27.1	478	72.8	657
	41	43	6.4	628	93.6	671
	42	228	29.5	546	70.5	774
	43	12	2.0	603	98.0	615
	44	166	20.6	640	79.4	806
	45	5	0.8	594	99.2	599
	46	18	2.9	595	97.1	613
	47	146	20.7	560	79.3	706
	48	40	6.4	588	93.6	628
	49	70	10.5	597	89.5	667
	50	18	3.0	585	97.0	603
	51	30	5.0	574	95.0	604
	52	211	25.9	604	74.1	815
	53	35	5.5	607	94.5	642
	54	16	2.6	591	97.4	607
	55	165	30.3	379	69.7	544
	56	253	30.9	566	69.1	819
	57	204	25.4	600	74.6	804
	58	103	16.7	514	83.3	617

	59	104	15.6	562	84.1	665
	60	20	3.0	649	97.0	669
	61	38	5.7	623	94.3	661
	62	45	7.7	543	92.3	588
	63	21	3.4	601	96.6	622
	64	39	6.0	610	93.8	650
	65	25	3.9	612	96.1	637
	66	25	4.3	562	95.7	587
	67	46	7.8	543	92.2	589
	68	17	2.7	610	97.3	627
	69	206	25.0	616	74.8	823
	70	33	5.4	582	94.6	615
TOTAL		**4,139**	**9.1**	**41,154**	**90.9**	**45,293**

Annex 4: Participation rate by cluster in chronological order



Annex 5: Coverage by chest X-ray and symptom screening among those eligible by sex, age group, cluster and residence

		Number eligible	Screened by Cough (Symptom)		Screened by Chest X-ray	
			n	%	n	%
Sex	Male	20,087	17,485	87.0	17,405	86.6
	Female	25,206	23,669	93.9	23,598	93.6
Age group in years	15–24	14,755	14,775	85.4	14,728	85.0
	25–34	10,453	10,453	87.2	10,508	86.7
	35–44	6,831	6,831	86.9	6,808	86.5
	45–54	4,287	4,287	90.3	4,273	90.1
	55–64	2,213	2,213	92.6	2,206	92.4
	65+	2,505	2,505	94.2	2,480	93.5
Residence	Rural	26,833	23,816	88.8	23,742	88.5
	Urban	18,460	17,338	93.9	17,261	93.5
Cluster	1	632	607	96.0	607	96.0
	2	669	631	94.3	631	94.3
	3	610	592	97.0	589	96.6
	4	628	609	97.0	608	96.8
	5	651	618	94.9	614	94.3
	6	637	604	94.8	604	94.8
	7	634	613	96.7	609	96.1
	8	589	563	95.6	562	95.4
	9	558	536	96.1	535	95.9
	10	627	602	96.0	592	94.4
	11	677	626	92.5	624	92.2
	12	848	628	74.1	627	73.9
	13	680	621	91.3	621	91.3
	14	590	563	95.4	563	95.4
	15	652	588	90.2	586	89.9
	16	655	604	92.2	604	92.2
	17	655	613	93.6	613	93.6
	18	603	572	94.9	572	94.9
	19	629	574	91.3	573	91.1
	20	606	586	96.7	583	96.2
	21	611	604	98.9	603	98.7
	22	635	612	96.4	612	96.4

	Number eligible	Screened by Cough (Symptom)		Screened by Chest X-ray	
		n	%	n	%
23	628	603	96.0	603	96.0
24	684	636	93.0	633	92.5
25	626	603	96.5	603	96.5
26	618	581	94.0	580	93.9
27	638	586	91.8	586	91.8
28	650	518	79.7	502	77.2
29	620	592	95.5	592	95.5
30	605	583	96.4	581	96.0
31	628	593	94.4	589	93.8
32	595	565	95.0	564	94.8
33	614	577	94.0	577	94.0
34	606	562	92.7	562	92.7
35	631	592	93.8	592	93.8
36	638	630	98.7	630	98.7
37	562	535	95.2	534	95.0
38	678	619	91.3	607	89.5
39	672	651	96.9	651	96.9
40	657	478	72.8	477	72.6
41	671	628	93.6	625	93.1
42	774	546	70.5	543	70.2
43	615	603	98.0	603	98.0
44	806	640	79.4	640	79.4
45	599	594	99.2	593	99.0
46	613	595	97.1	595	97.1
47	706	560	79.3	560	79.3
48	628	588	93.6	585	93.2
49	667	597	89.5	596	89.4
50	603	585	97.0	583	96.7
51	604	574	95.0	572	94.7
52	815	604	74.1	604	74.1
53	642	607	94.5	601	93.6
54	607	591	97.4	590	97.2
55	544	379	69.7	377	69.3
56	819	566	69.1	566	69.1
57	804	600	74.6	596	74.1
58	617	514	83.3	509	82.5

		Number eligible	Screened by Cough (Symptom)		Screened by Chest X-ray	
			n	%	n	%
	59	665	562	84.1	549	82.2
	60	669	649	97.0	642	96.0
	61	661	623	94.3	622	94.1
	62	588	543	92.3	543	92.3
	63	622	601	96.6	601	96.6
	64	650	610	93.8	610	93.8
	65	637	612	96.1	597	93.7
	66	587	562	95.7	561	95.6
	67	589	543	92.2	543	92.2
	68	627	610	97.3	610	97.3
	69	823	616	74.8	611	74.2
	70	615	582	94.6	580	94.3
TOTAL		**45,293**	**41,154**	**90.6**	**41,003**	**90.5**

Annex 6: Coverage by chest X-ray and symptom screening among participants by sex, age group, residence and cluster

		# participants	Number (%) screened by Cough (Symptom)		Number (%) screened by Chest X-ray	
			n	%	n	%
Sex	Male	17,485	17,485	100.0	17,405	99.5
	Female	23,669	23,669	100.0	23,598	99.7
Age group in years	15–24	14,775	14,778	100.0	14,728	99.7
	25–34	10,453	10,546	100.0	10,508	99.6
	35–44	6,831	6,831	100.0	6,808	99.6
	45–54	4,287	4,287	100.0	4,273	99.7
	55–64	2,213	2,213	100.0	2,206	99.6
	65+	2,505	2,505	100.0	2,480	99.0
Residence	Rural	23,816	23,816	100.0	23,742	99.7
	Urban	17,338	17,338	100.0	17,261	99.6
Cluster	1	607	607	100	607	100.0
	2	631	631	100	631	100.0
	3	592	592	100	589	99.5
	4	609	609	100	608	99.8
	5	618	618	100	614	99.4
	6	604	604	100	604	100.0
	7	613	613	100	609	99.3
	8	563	563	100	562	99.8
	9	536	536	100	535	99.8
	10	602	602	100	592	98.3
	11	626	626	100	624	99.7
	12	628	628	100	627	99.8
	13	621	621	100	621	100.0
	14	563	563	100	563	100.0
	15	588	588	100	586	99.7
	16	604	604	100	604	100.0
	17	613	613	100	613	100.0
	18	572	572	100	572	100.0
	19	574	574	100	573	99.8
	20	586	586	100	583	99.5
	21	604	604	100	603	99.8
	22	612	612	100	612	100.0
	23	603	603	100	603	100.0
	24	636	636	100	633	99.5
	25	603	603	100	603	100.0
	26	581	581	100	580	99.8
	27	586	586 B+ Prevalence	100	586	100.0

	# participants	Number (%) screened by Cough (Symptom)		Number (%) screened by Chest X-ray	
		n	%	n	%
28	518	518	100	502	96.9
29	592	592	100	592	100.0
30	583	583	100	581	99.7
31	593	593	100	589	99.3
32	565	565	100	564	99.8
33	577	577	100	577	100.0
34	562	562	100	562	100.0
35	592	592	100	592	100.0
36	630	630	100	630	100.0
37	535	535	100	534	99.8
38	619	619	100	607	98.1
39	651	651	100	651	100.0
40	478	478	100	477	99.8
41	628	628	100	625	99.5
42	546	546	100	543	99.5
43	603	603	100	603	100.0
44	640	640	100	640	100.0
45	594	594	100	593	99.8
46	595	595	100	595	100.0
47	560	560	100	560	100.0
48	588	588	100	585	99.5
49	597	597	100	596	99.8
50	585	585	100	583	99.7
51	574	574	100	572	99.7
52	604	604	100	604	100.0
53	607	607	100	601	99.0
54	591	591	100	590	99.8
55	379	379	100	377	99.5
56	566	566	100	566	100.0
57	600	600	100	596	99.3
58	514	514	100	509	99.0
59	562	562	100	549	97.7
60	649	649	100	642	98.9
61	623	623	100	622	99.8
62	543	543	100	543	100.0
63	601	601	100	601	100.0
64	610	610	100	610	100.0
65	612	612	100	597	97.5

		# participants	Number (%) screened by Cough (Symptom)		Number (%) screened by Chest X-ray	
			n	%	n	%
	66	562	562	100	561	99.8
	67	543	543	100	543	100.0
	68	610	610	100	610	100.0
	69	616	616	100	611	99.2
	70	582	582	100	580	99.7
TOTAL		**41,154**	**41,154**	**100**	**41,003**	99.6

Annex 7: Current TB symptoms by sex, age group, residence and cluster

		Participants	Cough		Sputum		Blood stained		Chest pain		Weight loss		Fever		Night sweats	
			n	%	n	%	n	%	n	%	n	%	n	%	n	%
TOTAL		24,004	5,604	23.3	3,123	13.0	198	0.8	7,787	32.4	1949	8.1	2,712	11.3	1,324	5.5
Sex	Male	17485	3733	21.3	2084	11.9	116	0.7	4559	26.1	1081	6.2	1279	7.3	700	4.0
	Female	23669	5173	21.9	2735	11.6	147	0.6	7583	32.0	1675	7.1	2314	9.8	1025	4.3
Age group in yrs.	15–24	14775	2988	20.2	1459	9.9	70	0.5	3359	22.7	758	5.1	1123	7.6	363	2.5
	25–34	10543	2153	20.4	1132	10.7	67	0.6	3139	29.8	786	7.5	903	8.6	405	3.8
	35–44	6831	1459	21.4	803	11.8	40	0.6	2204	32.3	478	7.0	612	9.0	342	5.0
	45–54	4287	993	23.2	596	13.9	32	0.7	1536	35.8	329	7.7	413	9.6	301	7.0
	55–64	2213	541	24.4	335	15.1	17	0.8	869	39.3	170	7.7	232	10.5	151	6.8
	65+	2505	772	30.8	494	19.7	37	1.5	1035	41.3	235	9.4	310	12.4	163	6.5
Residence	Rural	23816	5327	22.4	3016	12.7	178	0.7	7838	32.9	1769	7.4	2450	10.3	1229	5.2
	Urban	17338	3579	20.6	1803	10.4	85	0.5	4304	24.8	987	5.7	1143	6.6	496	2.9
Cluster	1	607	26.5	26.5	26.5	14.3	1	0.2	212	34.9	91	15.0	168	27.7	55	9.1
	2	631	26.0	26.0	26.0	17.9	1	0.2	246	39.0	32	5.1	144	22.8	53	8.4
	3	592	16.0	16.0	16.0	7.6	1	0.2	83	14.0	36	6.1	36	6.1	14	2.4
	4	609	15.1	15.1	15.1	5.9	0	0.0	116	19.0	19	3.1	3	0.5	2	0.3
	5	618	25.2	25.2	25.2	12.5	1	0.2	198	32.0	12	1.9	12	1.9	9	1.5
	6	604	22.5	22.5	22.5	8.8	1	0.2	238	39.4	46	7.6	67	11.1	30	5.0
	7	613	17.9	17.9	17.9	8.8	1	0.2	235	38.3	65	10.6	68	11.1	14	2.3
	8	563	27.9	27.9	27.9	10.5	1	0.2	134	23.8	11	2.0	3	0.5	0	0.0
	9	536	33.8	33.8	33.8	14.9	5	0.9	225	42.0	17	3.2	5	0.9	4	0.7
	10	602	15.1	15.1	15.1	9.5	1	0.2	121	20.1	11	1.8	47	7.8	10	1.7
	11	626	27.5	27.5	27.5	14.5	5	0.8	218	34.8	37	5.9	142	22.7	63	10.1
	12	628	23.6	23.6	23.6	16.6	1	0.2	152	24.2	71	11.3	71	11.3	51	8.1
	13	621	17.9	17.9	17.9	7.7	5	0.8	155	25.0	18	2.9	179	28.8	46	7.4

	Participants	Cough		Sputum		Blood stained		Chest pain		Weight loss		Fever		Night sweats	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%
14	563	21.7	21.7	21.7	12.1	8	1.4	236	41.9	101	17.9	64	11.4	25	4.4
15	588	28.9	28.9	28.9	14.5	3	0.5	203	34.5	24	4.1	6	1.0	7	1.2
16	604	17.5	17.5	17.5	7.6	6	1.0	145	24.0	69	11.4	54	8.9	30	5.0
17	613	17.9	17.9	17.9	10.1	13	2.1	222	36.2	64	10.4	78	12.7	17	2.8
18	572	32.3	32.3	32.3	9.3	3	0.5	269	47.0	11	1.9	0	0.0	17	3.0
19	574	24.4	24.4	24.4	12.9	8	1.4	303	52.8	14	2.4	2	0.3	4	0.7
20	586	14.8	14.8	14.8	7.7	1	0.2	128	21.8	19	3.2	48	8.2	20	3.4
21	604	27.2	27.2	27.2	14.1	4	0.7	125	20.7	52	8.6	54	8.9	23	3.8
22	612	19.0	19.0	19.0	9.8	0	0.0	171	27.9	37	6.0	60	9.8	27	4.4
23	603	13.9	13.9	13.9	7.5	2	0.3	129	21.4	56	9.3	34	5.6	37	6.1
24	636	19.2	19.2	19.2	12.9	1	0.2	119	18.7	74	11.6	48	7.5	35	5.5
25	603	19.6	19.6	19.6	11.6	11	1.8	290	48.1	49	8.1	52	8.6	13	2.2
26	581	17.7	17.7	17.7	7.1	3	0.5	184	31.7	61	10.5	79	13.6	27	4.6
27	586	36.7	36.7	36.7	17.6	6	1.0	297	50.7	7	1.2	2	0.3	4	0.7
28	518	16.8	16.8	16.8	7.1	1	0.2	103	19.9	9	1.7	0	0.0	21	4.1
29	592	23.3	23.3	23.3	11.8	4	0.7	246	41.6	57	9.6	71	12.0	15	2.5
30	583	15.4	15.4	15.4	8.7	3	0.5	180	30.9	36	6.2	65	11.1	43	7.4
31	593	15.7	15.7	15.7	10.3	1	0.2	141	23.8	37	6.2	42	7.1	14	2.4
32	565	8.1	8.1	8.1	3.7	2	0.4	80	14.2	13	2.3	24	4.2	23	4.1
33	577	14.6	14.6	14.6	8.0	0	0.0	105	18.2	51	8.8	26	4.5	18	3.1
34	562	18.3	18.3	18.3	11.4	0	0.0	153	27.2	10	1.8	3	0.5	7	1.2
35	592	30.9	30.9	30.9	16.7	18	3.0	328	55.4	17	2.9	6	1.0	10	1.7
36	630	18.1	18.1	18.1	9.4	1	0.2	93	14.8	21	3.3	31	4.9	9	1.4
37	535	30.7	30.7	30.7	20.7	4	0.7	212	39.6	59	11.0	41	7.7	30	5.6
38	619	22.8	22.8	22.8	14.1	0	0.0	115	18.6	61	9.9	56	9.0	36	5.8

	Participants	Cough		Sputum		Blood stained		Chest pain		Weight loss		Fever		Night sweats	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%
39	651	21.0	21.0	21.0	11.2	3	0.5	261	40.1	58	8.9	36	5.5	13	2.0
40	478	28.2	28.2	28.2	18.4	5	1.0	172	36.0	22	4.6	84	17.6	33	6.9
41	628	27.7	27.7	27.7	15.1	19	3.0	245	39.0	90	14.3	244	38.9	86	13.7
42	546	23.4	23.4	23.4	13.9	2	0.4	155	28.4	65	11.9	38	7.0	68	12.5
43	603	19.7	19.7	19.7	7.5	0	0.0	133	22.1	13	2.2	35	5.8	12	2.0
44	640	28.1	28.1	28.1	15.5	3	0.5	207	32.3	80	12.5	193	30.2	62	9.7
45	594	20.4	20.4	20.4	8.6	3	0.5	112	18.9	26	4.4	51	8.6	24	4.0
46	595	22.2	22.2	22.2	6.6	1	0.2	132	22.2	27	4.5	2	0.3	4	0.7
47	560	19.1	19.1	19.1	14.8	5	0.9	143	25.5	79	14.1	64	11.4	86	15.4
48	588	15.1	15.1	15.1	10.0	7	1.2	234	39.8	61	10.4	94	16.0	20	3.4
49	597	19.6	19.6	19.6	10.1	5	0.8	142	23.8	84	14.1	135	22.6	31	5.2
50	585	20.9	20.9	20.9	10.4	1	0.2	130	22.2	20	3.4	2	0.3	4	0.7
51	574	20.7	20.7	20.7	13.1	4	0.7	227	39.5	8	1.4	3	0.5	5	0.9
52	604	20.4	20.4	20.4	15.6	5	0.8	149	24.7	76	12.6	74	12.3	67	11.1
53	607	15.8	15.8	15.8	7.4	0	0.0	101	16.6	14	2.3	1	0.2	1	0.2
54	591	25.5	25.5	25.5	13.4	0	0.0	156	26.4	14	2.4	3	0.5	2	0.3
55	379	21.4	21.4	21.4	13.2	1	0.3	53	14.0	55	14.5	31	8.2	24	6.3
56	566	20.1	20.1	20.1	13.3	2	0.4	75	13.3	42	7.4	34	6.0	33	5.8
57	600	23.3	23.3	23.3	11.5	7	1.2	197	32.8	31	5.2	12	2.0	13	2.2
58	514	30.0	30.0	30.0	17.5	5	1.0	164	31.9	16	3.1	4	0.8	6	1.2
59	562	26.5	26.5	26.5	14.1	2	0.4	118	21.0	16	2.8	33	5.9	21	3.7
60	649	19.9	19.9	19.9	10.6	6	0.9	194	29.9	40	6.2	5	0.8	8	1.2
61	623	26.2	26.2	26.2	12.2	6	1.0	221	35.5	20	3.2	92	14.8	26	4.2
62	543	15.7	15.7	15.7	11.4	3	0.6	149	27.4	35	6.4	28	5.2	10	1.8
63	601	22.1	22.1	22.1	14.1	4	0.7	109	18.1	44	7.3	53	8.8	16	2.7

		Participants	Cough		Sputum		Blood stained		Chest pain		Weight loss		Fever		Night sweats	
			n	%	n	%	n	%	n	%	n	%	n	%	n	%
	64	610	15.4	15.4	15.4	8.4	2	0.3	157	25.7	19	3.1	78	12.8	17	2.8
	65	612	16.5	16.5	16.5	8.2	11	1.8	167	27.3	6	1.0	6	1.0	5	0.8
	66	562	18.3	18.3	18.3	10.7	1	0.2	217	38.6	20	3.6	2	0.4	10	1.8
	67	543	31.9	31.9	31.9	22.3	8	1.5	330	60.8	80	14.7	151	27.8	82	15.1
	68	610	26.2	26.2	26.2	14.8	4	0.7	110	18.0	59	9.7	42	6.9	26	4.3
	69	616	22.6	22.6	22.6	15.7	8	1.3	157	25.5	42	6.8	33	5.4	35	5.7
	70	582	13.6	13.6	13.6	7.6	3	0.5	115	19.8	19	3.3	39	6.7	12	2.1
TOTAL		41154	8906	21.6	4819	11.7	263	0.6	12142	29.5	2756	6.7	3593	8.7	1725	4.2

Annex 8: Distribution and duration of cough by sex, age group, residence and cluster

		Participants Interviewed N	Number (%) with cough (any duration)		Number (%) with cough at least 2 wks.	
			n	%	n	%
Sex	Male	17,485	3,733	21.3	1,240	7.1
	Female	23,669	5,173	21.9	1,474	6.2
Age in years	15-24	14,775	2,989	20.2	599	4.1
	25-34	10,543	2,153	20.4	570	5.4
	35-44	6,831	1,464	21.4	494	7.2
	45-54	4,287	985	23.0	381	8.9
	55-64	2,213	547	24.7	233	10.5
	65+	2,505	768	30.7	437	17.5
Residence	Rural	23,816	5,327	22.4	1,803	7.6
	Urban	17,338	3,579	20.6	911	5.3
Cluster	1	607	161	26.5	24	4.0
	2	631	164	26.0	56	8.9
	3	592	95	16.0	27	4.6
	4	609	92	15.1	24	3.9
	5	618	156	25.2	47	7.6
	6	604	136	22.5	53	8.8
	7	613	110	17.9	39	6.4
	8	563	157	27.9	12	2.1
	9	536	181	33.8	22	4.1
	10	602	91	15.1	35	5.8
	11	626	172	27.5	65	10.4
	12	628	148	23.6	56	8.9
	13	621	111	17.9	23	3.7
	14	563	122	21.7	22	3.9
	15	588	170	28.9	71	12.1
	16	604	106	17.5	16	2.6
	17	613	110	17.9	29	4.7
	18	572	185	32.3	43	7.5
	19	574	140	24.4	34	5.9
	20	586	87	14.8	26	4.4
	21	604	164	27.2	24	4.0
	22	612	116	19.0	20	3.3
	23	603	84	13.9	16	2.7

24	636	122	19.2	66	10.4
25	603	118	19.6	30	5.0
26	581	103	17.7	38	6.5
27	586	215	36.7	73	12.5
28	518	87	16.8	31	6.0
29	592	138	23.3	59	10.0
30	583	90	15.4	26	4.5
31	593	93	15.7	22	3.7
32	565	46	8.1	12	2.1
33	577	84	14.6	12	2.1
34	562	103	18.3	29	5.2
35	592	183	30.9	63	10.6
36	630	114	18.1	26	4.1
37	535	164	30.7	33	6.2
38	619	141	22.8	61	9.9
39	651	137	21.0	32	4.9
40	478	135	28.2	72	15.1
41	628	174	27.7	76	12.1
42	546	128	23.4	55	10.1
43	603	119	19.7	27	4.5
44	640	180	28.1	35	5.5
45	594	121	20.4	34	5.7
46	595	132	22.2	22	3.7
47	560	107	19.1	38	6.8
48	588	89	15.1	40	6.8
49	597	117	19.6	25	4.2
50	585	122	20.9	21	3.6
51	574	119	20.7	56	9.8
52	604	123	20.4	46	7.6
53	607	96	15.8	14	2.3
54	591	151	25.5	17	2.9
55	379	81	21.4	15	4.0
56	566	114	20.1	48	8.5
57	600	140	23.3	63	10.5
58	514	154	30.0	64	12.5
59	562	149	26.5	68	12.1
60	649	129	19.9	71	10.9
61	623	163	26.2	68	10.9

	62	543	85	15.7	40	7.4
	63	601	133	22.1	36	6.0
	64	610	94	15.4	15	2.5
	65	612	101	16.5	28	4.6
	66	562	103	18.3	27	4.8
	67	543	173	31.9	41	7.6
	68	610	160	26.2	36	5.9
	69	616	139	22.6	91	14.8
	70	582	79	13.6	28	4.8
TOTAL		41,154	8,906	21.6	2,714	6.6

Annex 9: Results of field chest X-ray reading by sex, age group, residence and cluster

		Field CXR Reading						TOTAL (of those with anX-ray)
		Normal		*Abnormal Lung field*		*Other Abnormalities*		
		N	%	N	%	N	%	N
Sex	Male	15, 701	90.2	1,577	9.1	127	0.7	18,405
	Female	22,074	93.5	1,273	5.4	251	1.1	23,598
Age group in years	15–24	14,384	97.7	304	2.1	40	0.3	14,728
	25–34	9,987	95	453	4.3	68	0.7	10,508
	35–44	6,217	91.3	530	7.8	61	0.9	6,808
	45–54	3,710	86.8	509	11.9	54	1.3	4,275
	55–64	1,781	80.7	365	16.6	60	2.7	2,206
	65+	1,696	68.4	689	27.9	95	3.8	2, 480
Residence	Rural	21,656	91.2	1,855	7.8	231	1	23,742
	Urban	16,119	93.4	995	5.8	147	0.8	17,261
Cluster	1	563	92.8	36	5.9	8	1.3	607
	2	558	88.4	66	10.5	7	1.1	631
	3	534	90.7	49	8.3	6	1.0	589
	4	577	94.9	25	4.1	6	1.0	608
	5	597	97.2	15	2.4	2	0.3	614
	6	542	89.7	52	8.6	10	1.7	604
	7	520	85.4	78	12.8	11	1.8	609
	8	542	96.4	19	3.4	1	0.2	562
	9	506	94.6	25	4.7	4	0.7	535
	10	545	92.1	39	6.6	8	1.4	592
	11	551	88.3	62	9.9	11	1.8	624
	12	501	79.9	117	18.7	9	1.4	627
	13	549	88.4	63	10.1	9	1.4	621
	14	530	94.1	27	4.8	7	1.2	563
	15	565	96.4	21	3.6	0	0.0	586
	16	560	92.7	39	6.5	5	0.8	604
	17	577	94.1	32	5.2	4	0.7	613
	18	553	96.7	18	3.1	1	0.2	572
	19	521	90.9	47	8.2	5	0.9	573
	20	556	95.4	21	3.6	6	1.0	583
	21	581	96.4	19	3.2	3	0.5	603
	22	590	96.4	20	3.3	2	0.3	612
	23	564	93.5	36	6.0	3	0.5	603
	24	582	91.9	43	6.8	8	1.3	633
	25	569	94.4	31	5.1	3	0.5	603
	26	526	90.7	40	6.9	14	2.4	580
	27	564	96.2	21	3.6	1	0.2	586
	28	487	97.0	10	2.0	5	1.0	502

		Field CXR Reading						TOTAL (of those with anX-ray)
		Normal		*Abnormal Lung field*		*Other Abnormalities*		
	29	543	91.7	45	7.6	4	0.7	592
	30	537	92.4	40	6.9	4	0.7	581
	31	542	92.0	40	6.8	7	1.2	589
	32	535	94.9	28	5.0	1	0.2	564
	33	544	94.3	27	4.7	6	1.0	577
	34	530	94.3	24	4.3	8	1.4	562
	35	548	92.6	39	6.6	5	0.8	592
	36	594	94.3	31	4.9	5	0.8	630
	37	503	94.2	26	4.9	5	0.9	534
	38	480	79.1	122	20.1	5	0.8	607
	39	609	93.5	38	5.8	4	0.6	651
	40	350	73.4	118	24.7	9	1.9	477
	41	547	87.4	71	11.3	8	1.3	626
	42	521	95.9	21	3.9	1	0.2	543
	43	555	92.0	40	6.6	8	1.3	603
	44	572	89.4	63	9.8	5	0.8	640
	45	539	90.9	55	9.3	4	0.7	593
	46	576	96.8	18	3.0	1	0.2	595
	47	524	93.6	26	4.6	10	1.8	560
	48	519	88.7	51	8.7	15	2.6	585
	49	561	94.1	29	4.9	6	1.0	596
	50	548	94.0	33	5.7	2	0.3	583
	51	551	96.3	18	3.1	3	0.5	572
	52	521	86.3	70	11.6	7	1.2	604
	53	574	95.5	25	4.2	2	0.3	601
	54	545	92.4	42	7.1	3	0.5	590
	55	336	89.1	36	9.5	5	1.3	377
	56	520	91.9	36	6.4	10	1.8	566
	57	573	96.1	20	3.4	3	0.5	596
	58	477	93.7	25	4.9	7	1.4	509
	59	394	71.8	140	25.5	15	2.7	549
	60	617	96.1	12	1.9	3	0.5	642
	61	565	90.8	48	7.7	9	1.4	622
	62	512	94.3	24	4.4	7	1.3	543
	63	573	95.3	25	4.2	3	0.5	601
	64	585	95.9	22	3.6	3	0.5	610
	66	512	91.3	46	8.2	3	0.5	561
	67	478	88.0	61	11.2	4	0.7	543
	68	569	93.3	39	6.4	2	0.3	610
	69	568	93.0	42	6.9	1	0.2	611
	70	538	92.8	37	6.4	5	0.9	580
TOTAL		**37,775**	**92.1**	**2,850**	**7.0**	**378**	**0.9**	**41,003**

Annex 10: Individuals eligible for sputum collection by sex, age group, residence and cluster

		Number participants	Number (%) eligible for sputum collection	
			n	%
Sex	Male	17,485	2,576	14.7
	Female	23,669	2,567	10.8
Age group in years	15–24	14,728	906	6.1
	25–34	10,508	970	9.2
	35–44	6,808	950	8.1
	45–54	4,273	820	19.1
	55–64	2,206	535	24.2
	65+	2,480	962	38.4
Residence	Rural	23,816	3,327	14.0
	Urban	17,338	1,816	10.5
Cluster	1	607	56	9.2
	2	631	111	9.2
	3	592	72	12.1
	4	609	45	7.4
	5	618	57	9.2
	6	604	98	16.2
	7	613	109	17.8
	8	563	29	5.2
	9	536	42	7.8
	10	602	75	12.5
	11	626	107	17.1
	12	628	150	23.9
	13	621	80	12.9
	14	563	43	7.6
	15	588	84	13.7
	16	604	51	8.4
	17	613	56	9.1
	18	572	58	10.1
	19	574	72	12.9
	20	586	47	8.0
	21	604	43	7.1
	22	612	37	6.1
	23	603	49	8.1
	24	636	96	15.1
	25	603	55	9.1
	26	581	70	12.1

		Number participants	Number (%) eligible for sputum collection	
			n	%
	27	586	85	14.5
	28	518	56	10.8
	29	592	92	15.5
	30	583	63	10.8
	31	593	63	10.6
	32	565	40	7.1
	33	577	36	6.2
	34	562	52	9.3
	35	592	99	16.7
	36	630	54	8.6
	37	628	123	19.6
	38	619	172	27.8
	39	651	60	9.2
	40	478	162	33.9
	41	628	123	19.6
	42	546	73	13.7
	43	603	64	10.6
	44	640	89	13.9
	45	594	82	13.8
	46	595	39	8.7
	47	560	59	10.5
	48	588	85	14.5
	49	597	52	8.7
	50	585	51	9.3
	51	574	72	12.5
	52	604	104	17.2
	53	607	43	13.7
	54	591	55	9.3
	55	379	49	12.9
	56	566	75	13.3
	57	600	82	13.7
	58	514	85	16.5
	59	562	185	32.5
	60	649	92	14.2
	61	623	99	15.9
	62	543	57	10.5
	63	601	55	9.2
	64	610	33	5.4
	65	612	57	9.3

		Number participants	Number (%) eligible for sputum collection	
			n	%
	66	562	67	11.9
	67	543	55	16.4
	68	610	66	10.8
	69	616	119	19.3
	70	582	57	9.8
TOTAL		**41,154**	**5,143**	**12.5**

Annex 11: Sputum collection among eligible for sputum collection by spot, morning and both as well as by sex, age group, residence and cluster

		# participants eligible	Participants (No. & %) who provided samples					
			Spot sample		Morning sample		Both samples	
			Number	%	Number	%	Number	%
Gender	Male	2,576	2,387	92.6	2,240	87	2,213	85.9
	Female	2,567	2,408	93.8	2,293	89.3	2,273	88.6
Age group in years	15-24	906	801	88.4	747	82.5	737	81.4
	25-34	970	893	92.1	821	84.6	815	84
	35-44	950	899	94.6	848	89.3	841	88.5
	45-54	820	787	96	760	92.7	753	91.8
	55-64	535	507	94.8	489	91.4	481	90
	65+	962	907	94.3	868	90.2	859	89.3
Residence	Rural	3,327	3,069	92.3	2,879	86.5	2,845	89.3
	Urban	1,816	1,725	93.2	1,654	91.1	2,273	90.4
Cluster	1	56	55	98.2	53	94.6	52	92.9
	2	111	105	94.6	107	96.4	104	93.7
	3	72	71	98.6	71	98.6	70	97.2
	4	45	42	93.3	40	88.9	39	86.7
	5	57	47	82.5	44	77.2	44	77.2
	6	98	98	100	96	98	96	98
	7	109	105	96.3	100	91.7	99	96.8
	8	29	29	100	29	100	29	100
	9	42	42	100	40	95.2	40	95.2
	10	75	71	94.7	70	93.3	67	89.3
	11	107	100	93.5	94	87.9	94	87.9
	12	150	135	90	129	86	128	85.3
	13	80	80	100	78	97.5	78	97.5
	14	43	43	100	42	97.7	42	97.7
	15	84	71	84.5	57	67.9	57	67.9
	16	51	50	98	50	98	50	98
	17	56	53	94.6	53	94.6	53	94.6
	18	58	52	89.7	46	79.3	45	77.6
	19	72	68	94.4	70	97.2	68	72
	20	47	46	97.9	46	97.9	46	97.8
	21	43	38	88.4	35	81.4	33	76.7
	22	37	37	100	37	100	37	100
	23	49	48	98	47	95.6	47	95.9
	24	96	87	90.6	84	87.5	82	85.4
	25	55	53	96.4	53	96.4	52	94.6
	26	70	70	100	69	99.6	69	98.6
	27	85	83	97.7	84	98.8	82	96.5
	28	56	36	65	33	58.9	32	57.1
	29	92	90	97.8	82	89.1	82	89.1
	30	63	61	96.8	57	90.5	57	90.5

	# participants eligible	Participants (No. & %) who provided samples					
		Spot sample		Morning sample		Both samples	
		Number	%	Number	%	Number	%
31	63	61	96.8	62	98.4	61	96.8
32	40	39	97.5	38	96.4	38	95
33	36	36	100	35	97.2	35	97.2
34	52	52	100	51	98.1	51	98.1
35	99	94	95	90	90.9	90	90.9
36	54	54	100	54	100	54	100
37	57	54	96.5	56	98.3	55	96.5
38	172	159	92.4	156	90.7	154	89.5
39	60	60	100	60	100	60	100
40	162	153	94.4	126	77.8	123	79.9
41	123	122	99.2	121	98.4	120	97.9
42	75	72	94.7	67	89.3	67	89.3
43	64	63	98.4	62	96.8	62	96.9
44	89	87	97.8	81	91	80	89.9
45	82	82	100	82	100	82	100
46	39	38	97.4	36	92.3	36	92.3
47	59	58	98.3	56	94.9	56	94.9
48	85	84	98.8	84	98.8	84	98.8
49	52	50	96.2	47	90.4	47	90.4
50	51	50	98	47	92.2	47	92.2
51	72	59	81.9	58	80.6	58	80.6
52	104	91	87.5	84	94.9	83	79.8
53	43	36	83.7	31	72	31	72.1
54	55	52	94.6	52	94.6	52	94.6
55	49	47	95.9	43	87.8	43	87.8
56	75	71	94.7	66	88	65	86.7
57	82	64	78.1	45	54.9	43	52.4
58	85	74	87.1	63	74.1	62	72.9
59	185	162	87.6	136	73.5	133	71.9
60	92	62	67.4	47	51.1	44	47.8
61	99	94	95	92	92.9	89	89.9
62	57	57	100	57	100	57	100
63	55	54	98.2	47	85.5	47	85.5
64	33	32	97	32	97	32	97
65	57	41	71.5	35	61.4	35	61.4
66	67	65	97	61	91	61	91.4
67	89	87	97.8	84	94.4	83	93.3
68	66	65	98.5	63	95.5	63	95.5
69	119	90	75.6	75	63	74	62.2
70	57	57	100	55	96.5	55	96.5
TOTAL	**5,143**	**4,754**	**93.2**	**4,533**	**88.1**	**4,486**	**87.2**

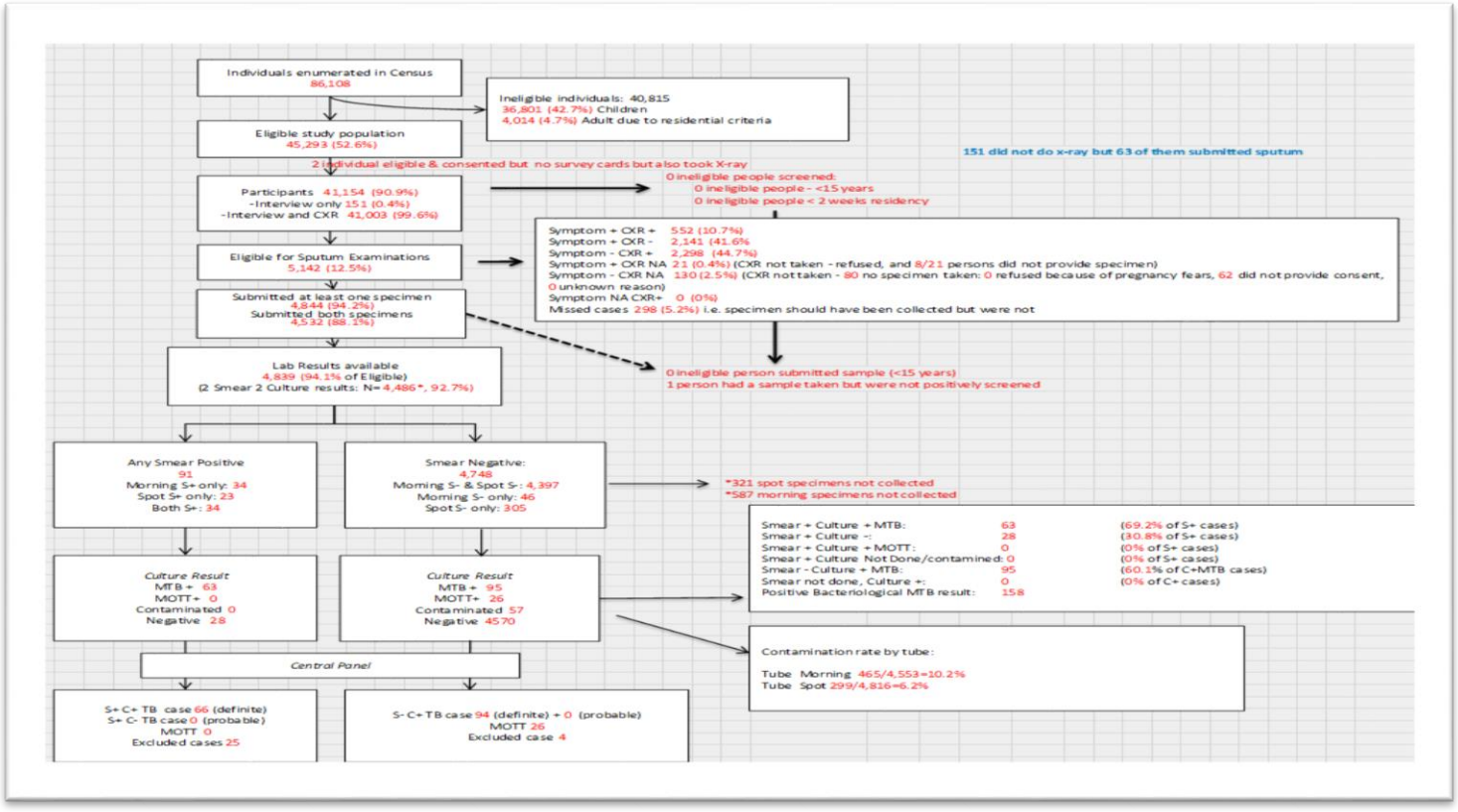
Annex 12: Breakdown of combined smear and culture (bacteriological) results (irrespective of identification status) for all individuals who were eligible for sputum examination; overall and by sex, age and cluster

		S+C+		S+C-		S-C+		S-C-		N/A		Total
		n	%	n	%	n	%	n	%	n	%	N
Sex	Male	48	1.9	15	0.6	83	3.2	2,049	79.5	381	14.8	2,576
	Female	15	0.6	13	0.5	40	1.6	2,179	84.9	320	12.5	2,567
Age group	15-24yrs	15	1.7	7	0.8	21	2.3	694	76.6	169	18.7	906
	25-34yrs	18	1.9	5	0.5	29	3.0	764	78.8	154	15.9	970
	35-44yrs	17	1.8	7	0.7	26	2.7	786	82.7	114	12.0	950
	45-54yrs	6	0.7	3	0.4	19	2.3	710	86.6	82	10.0	820
	55-64yrs	5	0.9	3	0.6	12	2.2	450	84.1	65	12.1	535
	65+yrs	2	0.2	3	0.3	16	1.7	824	85.7	117	12.2	962
Residence	RURAL	33	1.0	19	0.6	58	1.7	2,709	81.4	508	15.3	3,327
	URBAN	30	1.7	9	0.5	65	3.6	1,519	83.6	193	10.6	1,816
Clusters	1	0	0.0	0	0.0	2	3.6	48	85.7	6	10.7	56
	2	0	0.0	0	0.0	0	0.0	103	92.8	8	7.2	111
	3	0	0.0	0	0.0	1	1.4	68	94.4	3	4.2	72
	4	2	4.4	1	2.2	2	4.4	35	77.8	5	11.1	45
	5	1	1.8	1	1.8	0	0.0	41	71.9	14	24.6	57
	6	0	0.0	0	0.0	4	4.1	90	91.8	4	4.1	98
	7	3	2.8	1	0.9	3	2.8	92	84.4	10	9.2	109
	8	1	3.4	0	0.0	3	10.3	25	86.2	0	0.0	29
	9	1	2.4	0	0.0	3	7.1	36	85.7	2	4.8	42
	10	1	1.3	0	0.0	4	5.3	62	82.7	8	10.7	75
	11	0	0.0	0	0.0	0	0.0	92	86.0	15	14.0	107
	12	1	0.7	2	1.3	0	0.0	125	83.3	22	14.7	150
	13	0	0.0	0	0.0	1	1.3	72	90.0	7	8.8	80
	14	0	0.0	0	0.0	2	4.7	38	88.4	3	7.0	43
	15	0	0.0	0	0.0	4	4.8	54	64.3	26	31.0	84
	16	3	5.9	1	2.0	1	2.0	43	84.3	3	5.9	51
	17	1	1.8	0	0.0	0	0.0	49	87.5	6	10.7	56
	18	0	0.0	0	0.0	0	0.0	45	77.6	13	22.4	58
	19	2	2.8	0	0.0	2	2.8	64	88.9	4	5.6	72
	20	0	0.0	0	0.0	0	0.0	46	97.9	1	2.1	47
	21	1	2.3	0	0.0	0	0.0	32	74.4	10	23.3	43

22	0	0.0	0	0.0	0	0.0	37	100.0	0	0.0	37
23	0	0.0	0	0.0	3	6.1	44	89.8	2	4.1	49
24	2	2.1	0	0.0	4	4.2	76	79.2	14	14.6	96
25	0	0.0	0	0.0	1	1.8	51	92.7	3	5.5	55
26	0	0.0	0	0.0	1	1.4	67	95.7	2	2.9	70
27	1	1.2	0	0.0	3	3.5	78	91.8	3	3.5	85
28	0	0.0	0	0.0	0	0.0	32	57.1	24	42.9	56
29	1	1.1	0	0.0	1	1.1	78	84.8	12	13.0	92
30	1	1.6	0	0.0	2	3.2	54	85.7	6	9.5	63
31	0	0.0	1	1.6	1	1.6	59	93.7	2	3.2	63
32	1	2.5	0	0.0	5	12.5	33	82.5	1	2.5	40
33	0	0.0	0	0.0	2	5.6	33	91.7	1	2.8	36
34	1	1.9	0	0.0	0	0.0	50	96.2	1	1.9	52
35	1	1.0	0	0.0	0	0.0	89	89.9	9	9.1	99
36	0	0.0	0	0.0	2	3.7	52	96.3	0	0.0	54
37	0	0.0	1	1.8	0	0.0	52	91.2	4	7.0	57
38	1	0.6	0	0.0	2	1.2	151	87.8	18	10.5	172
39	2	3.3	1	1.7	3	5.0	54	90.0	0	0.0	60
40	0	0.0	0	0.0	2	1.2	121	74.7	39	24.1	162
41	0	0.0	9	7.3	1	0.8	109	88.6	4	3.3	123
42	1	1.3	1	1.3	2	2.7	63	84.0	8	10.7	75
43	0	0.0	0	0.0	3	4.7	59	92.2	2	3.1	64
44	1	1.1	0	0.0	1	1.1	77	86.5	10	11.2	89
45	2	2.4	1	1.2	2	2.4	76	92.7	1	1.2	82
46	1	2.6	0	0.0	1	2.6	34	87.2	3	7.7	39
47	0	0.0	0	0.0	0	0.0	56	94.9	3	5.1	59
48	1	1.2	0	0.0	0	0.0	80	94.1	4	4.7	85
49	1	1.9	0	0.0	1	1.9	42	80.8	8	15.4	52
50	2	3.9	0	0.0	1	2.0	44	86.3	4	7.8	51
51	1	1.4	0	0.0	2	2.8	55	76.4	14	19.4	72
52	0	0.0	1	1.0	1	1.0	81	77.9	21	20.2	104
53	1	2.3	0	0.0	1	2.3	29	67.4	12	27.9	43
54	1	1.8	0	0.0	3	5.5	48	87.3	3	5.5	55
55	1	2.0	0	0.0	1	2.0	41	83.7	6	12.2	49
56	1	1.3	0	0.0	0	0.0	63	84.0	11	14.7	75
57	0	0.0	0	0.0	0	0.0	43	52.4	39	47.6	82
58	5	5.9	2	2.4	3	3.5	54	63.5	21	24.7	85
59	0	0.0	0	0.0	1	0.5	132	71.4	52	28.1	185

	60	1	1.1	0	0.0	3	3.3	40	43.5	48	52.2	92
	61	2	2.0	0	0.0	7	7.1	74	74.7	16	16.2	99
	62	0	0.0	1	1.8	2	3.5	54	94.7	0	0.0	57
	63	2	3.6	0	0.0	2	3.6	44	80.0	7	12.7	55
	64	1	3.0	0	0.0	0	0.0	31	93.9	1	3.0	33
	65	0	0.0	0	0.0	0	0.0	34	59.6	23	40.4	57
	66	0	0.0	0	0.0	3	4.5	58	86.6	6	9.0	67
	67	6	6.7	2	2.2	4	4.5	64	71.9	13	14.6	89
	68	1	1.5	0	0.0	8	12.1	54	81.8	3	4.5	66
	69	2	1.7	0	0.0	4	3.4	69	58.0	44	37.0	119
	70	1	1.8	2	3.5	2	3.5	49	86.0	3	5.3	57
TOTAL		**63**	**1.2**	**28**	**0.5**	**123**	**2.4**	**4,228**	**82.2**	**701**	**13.6**	**5,143**

Annex 13 .Figure showing summary of Uganda TB survey 2014-2015



Annex 14. Crude prevalence of S+ TB, overall and by age, sex, residence and cluster

		S+	All Participants	Crude Prevalence/100,000
Sex	Male	51	17,485	292
	Female	15	23,669	63
Age groups in years	15–24	16	14,779	108
	25–34	18	10,546	171
	35–44	18	6,832	263
	45–54	7	4,280	164
	55–64	5	2,218	225
	65+	2	2,499	80
Residence	Rural	36	23,816	151
	Urban	30	17,338	173
Cluster	1	0	607	0
	2	0	631	0
	3	0	592	0
	4	2	609	328
	5	1	618	162
	6	0	604	0
	7	3	613	489
	8	1	563	178
	9	1	536	187
	10	1	602	166
	11	0	626	0
	12	1	628	159
	13	0	621	0
	14	0	563	0
	15	0	588	0
	16	3	604	497
	17	1	613	163
	18	0	572	0
	19	2	574	348
	20	0	586	0
	21	1	604	166
	22	0	612	0

	23	0	603	0
	24	2	636	314
	25	0	603	0
	26	0	581	0
	27	1	586	171
	28	0	518	0
	29	1	592	169
	30	1	583	172
	31	0	593	0
	32	1	565	177
	33	0	577	0
	34	1	562	178
	35	1	592	169
	36	0	630	0
	37	0	535	0
	38	1	619	162
	39	3	651	461
	40	0	478	0
	41	0	628	0
	42	1	546	183
	43	0	603	0
	44	1	640	156
	45	2	594	337
	46	1	595	168
	47	0	560	0
	48	1	588	170
	49	1	597	168
	50	2	585	342
	51	1	574	174
	52	0	604	0
	53	1	607	165
	54	1	591	169
	55	1	379	264
	56	1	566	177
	57	0	600	0

	58	5	514	973
	59	0	562	0
	60	1	649	154
	61	2	623	321
	62	0	543	0
	63	2	601	333
	64	1	610	164
	65	0	612	0
	66	0	562	0
	67	8	543	1,473
	68	1	610	164
	69	2	616	325
	70	1	582	172
Total		**66**	**41,154**	**160**

Annex 15. Crude prevalence of TB (all survey cases), overall and by age, sex, residence and cluster

		Participants (n)	S+C+ (n)	S-C+(n)	Prevalent cases (n)	Crude Prevalence/100,000
Sex	Male	17,485	51	69	120	686
	Female	23,669	15	25	40	169
Age groups in years	15-24	14,779	16	13	29	196
	25-34	10,546	18	24	42	398
	35-44	6,832	18	21	39	571
	45-54	4,280	7	17	24	561
	55-64	2,218	5	7	12	541
	65+	2,499	2	12	14	560
Residence	Rural	23,816	36	44	80	336
	Urban	17,338	30	50	80	461
Cluster	1	607	0	1	1	165
	2	631	0	0	0	0
	3	592	0	1	1	169
	4	609	2	2	4	657
	5	618	1	0	1	162
	6	604	0	2	2	331
	7	613	3	3	6	979
	8	563	1	3	4	710
	9	536	1	2	3	560
	10	602	1	3	4	664
	11	626	0	0	0	0
	12	628	1	0	1	159
	13	621	0	1	1	161
	14	563	0	1	1	178
	15	588	0	4	4	680
	16	604	3	1	4	662
	17	613	1	0	1	163
	18	572	0	0	0	0
	19	574	2	2	4	697
	20	586	0	0	0	0

	21	604	1	0	1	166
	22	612	0	0	0	0
	23	603	0	3	3	498
	24	636	2	3	5	786
	25	603	0	0	0	0
	26	581	0	1	1	172
	27	586	1	3	4	683
	28	518	0	0	0	0
	29	592	1	1	2	338
	30	583	1	2	3	515
	31	593	0	0	0	0
	32	565	1	4	5	885
	33	577	0	1	1	173
	34	562	1	0	1	178
	35	592	1	0	1	169
	36	630	0	1	1	159
	37	535	0	0	0	0
	38	619	1	0	1	162
	39	651	3	2	5	768
	40	478	0	1	1	209
	41	628	0	1	1	159
	42	546	1	2	3	549
	43	603	0	3	3	498
	44	640	1	1	2	313
	45	594	2	0	2	337
	46	595	1	0	1	168
	47	560	0	0	0	0
	48	588	1	0	1	170
	49	597	1	0	1	168
	50	585	2	1	3	513
	51	574	1	2	3	523
	52	604	0	0	0	0
	53	607	1	1	2	329
	54	591	1	3	4	677
	55	379	1	1	2	528

	56	566	1	0	1	177
	57	600	0	0	0	0
	58	514	5	3	8	1,556
	59	562	0	1	1	178
	60	649	1	1	2	308
	61	623	2	5	7	1,124
	62	543	0	2	2	368
	63	601	2	2	4	666
	64	610	1	0	1	164
	65	612	0	0	0	0
	66	562	0	3	3	534
	67	543	8	5	13	2,394
	68	610	1	7	8	1,311
	69	616	2	1	3	487
	70	582	1	1	2	344
TOTAL		**41,154**	**66**	**94**	**160**	**389**

Annex 16: HIV status of participants eligible for sputum collection by sex, age group, residence and cluster

		Eligible for sputum	Tested for HIV		HIV Status (positive)	
			Number	%	Number	%
Sex	Male	2,576	2,207	85.7	214	9.7
	Female	2,567	2,180	84.9	208	9.5
Age group in years	15–24	906	757	83.8	28	3.7
	25–34	970	841	86.7	116	13.7
	35–44	950	852	89.7	135	15.8
	45–54	820	716	87.3	88	12.3
	55–64	535	465	86.9	38	8.2
	65+	962	754	78.4	17	2.3
Residence	Rural	3,327	2,801	84.2	213	7.6
	Urban	1,816	1,586	87.3	209	13.2
Cluster	1	52	52	100.0	2	3.8
	2	57	39	68.4	3	7.7
	3	107	75	70.1	11	14.7
	4	150	132	88.0	1	0.8
	5	80	79	98.8	0	0.0
	6	84	63	75.0	38	60.3
	7	96	90	93.8	13	14.4
	8	172	161	93.6	0	0.0
	9	162	157	96.9	5	3.2
	10	75	71	94.7	11	15.5
	11	89	63	70.8	4	6.3
	12	59	47	79.7	11	23.4
	13	49	34	69.4	2	5.9
	14	75	52	69.3	0	0.0
	15	82	59	72.0	7	11.9
	16	85	64	75.3	6	9.4
	17	185	166	89.7	2	1.2
	18	92	54	58.7	3	5.6
	19	120	91	75.8	0	0.0
	20	111	109	98.2	8	7.3
	21	98	98	100.0	6	6.1
	22	43	32	74.4	8	25.0
	23	51	50	98.0	6	12.0

	Eligible for sputum	Tested for HIV		HIV Status (positive)	
		Number	%	Number	%
24	56	44	78.6	15	34.1
25	58	58	100.0	6	10.3
26	85	72	84.7	6	8.3
27	56	27	48.2	4	14.8
28	92	91	98.9	3	3.3
29	99	94	94.9	14	14.9
30	57	47	82.5	7	14.9
31	123	122	99.2	1	0.8
32	85	82	96.5	11	13.4
33	52	47	90.4	2	4.3
34	72	63	87.5	4	6.3
35	104	67	64.4	1	1.5
36	99	99	100.0	6	6.1
37	89	71	79.8	0	0.0
38	109	108	99.1	10	9.3
39	70	70	100.0	7	10.0
40	36	34	94.4	7	20.6
41	58	41	70.7	4	9.8
42	71	67	94.4	4	6.0
43	61	51	83.6	10	19.6
44	63	61	96.8	2	3.3
45	80	72	90.0	8	11.1
46	29	28	96.6	1	3.6
47	47	44	93.6	3	6.8
48	82	77	93.9	5	6.5
49	47	39	83.0	8	20.5
50	31	25	80.6	6	24.0
51	63	59	93.7	4	6.8
52	67	62	92.5	5	8.1
53	25	21	85.7	4	19.0
54	36	31	84.9	5	16.1
55	34	29	83.8	5	17.2
56	52	41	86.7	11	26.8
57	59	52	89.6	7	13.5
58	64	60	87.6	4	6.7
59	166	143	86.8	23	16.1
60	54	53	78.4	1	1.9

		Eligible for sputum	Tested for HIV		HIV Status (positive)	
			Number	%	Number	%
	61	99	86	84.2	13	15.1
	62	57	55	87.3	2	3.6
	63	49	42	100.0	7	16.7
	64	31	28	68.4	3	10.7
	65	40	39	70.1	1	2.6
	66	42	38	88.0	4	10.5
	67	71	66	98.8	5	7.6
	68	53	43	75.0	10	23.3
	69	90	84	93.8	6	7.1
	70	54	54	93.6	0	0.0
TOTAL		**5,149**	**4,394**	**85.3**	**422**	**9.6**

Annex 17: Healthcare-seeking behaviour of participants with cough at least two weeks by sex, age group, residence and cluster

		Sought care for cough 2 weeks		
		Number with cough	Number sought	% sought care
Sex	Male	1,240	668	53.9
	Female	1,474	987	67.0
Age group in years	15–24	599	334	55.8
	25–34	570	350	61.4
	35–44	494	298	60.3
	45–54	381	258	67.7
	55–64	233	136	58.4
	65+	437	279	63.8
Stratum	Rural	1,803	1,100	61.0
	Urban	911	555	60.9
	1	24	16	66.7
	2	56	36	64.3
	3	27	13	48.1
	4	24	6	25.0
	5	47	29	61.7
	6	53	36	67.9
	7	39	31	79.5
	8	12	7	58.3
	9	22	10	45.5
	10	35	21	60.0
	11	65	34	52.3
	12	56	32	57.1
	13	23	18	78.3
	14	22	16	72.7
	15	71	57	80.3
	16	16	7	43.8
	17	29	13	44.8
	18	43	15	34.9
	19	34	16	47.1
	20	26	16	61.5
	21	24	15	62.5
	22	20	11	55.0

	Sought care for cough 2 weeks		
	Number with cough	Number sought	% sought care
23	16	12	75.0
24	66	48	72.7
25	30	19	63.3
26	38	21	55.3
27	73	25	34.2
28	31	16	51.6
29	59	40	67.8
30	26	16	61.5
31	22	12	54.5
32	12	9	75.0
33	12	12	100.0
34	29	10	34.5
35	63	47	74.6
36	26	12	46.2
37	33	22	66.7
38	61	31	50.8
39	32	28	87.5
40	72	37	51.4
41	76	55	72.4
42	55	28	50.9
43	27	16	59.3
44	35	28	80.0
45	34	23	67.6
46	22	11	50.0
47	38	23	60.5
48	40	22	55.0
49	25	22	88.0
50	21	10	47.6
51	56	39	69.6
52	46	30	65.2
53	14	8	57.1
54	17	9	52.9
55	15	9	60.0
56	48	35	72.9
57		34	54.0

		Sought care for cough 2 weeks		
		Number with cough	Number sought	% sought care
	58	64	34	53.1
	59	68	46	67.6
	60	71	40	56.3
	61	68	45	66.2
	62	40	25	62.5
	63	36	24	66.7
	64	15	11	73.3
	65	28	16	57.1
	66	27	10	37.0
	67	41	32	78.0
	68	36	30	83.3
	69	91	52	57.1
	70	28	16	57.1
TOTAL		**2,714**	**1,655**	**61.0**

Annex 18: Participants currently on TB treatment by sex, age group, residence and cluster

		Number of participants	Number (%) on current TB treatment	
			N	%
Sex	Male	17,485	34	0.2
	Female	23,669	27	0.1
Age group in years	15–24	14,775	16	0.1
	25–34	10,543	14	0.1
	35–44	6,831	12	0.2
	45–54	4,287	12	0.3
	55–64	2,213	3	0.1
	65+	2,505	4	0.2
Residence	Rural	23,816	41	0.2
	Urban	17,338	20	0.1
Cluster	1	607	0	0.0
	2	631	1	0.2
	3	592	3	0.5
	4	609	0	0.0
	5	618	2	0.3
	6	604	0	0.0
	7	613	2	0.3
	8	563	0	0.0
	9	536	0	0.0
	10	602	2	0.3
	11	626	0	0.0
	12	628	2	0.3
	13	621	0	0.0
	14	563	0	0.0
	15	588	0	0.0
	16	604	0	0.0
	17	613	0	0.0
	18	572	0	0.0
	19	574	0	0.0
	20	586	1	0.2
	21	604	0	0.0
	22	612	0	0.0
	23	603	0	0.0

	Number of participants	Number (%) on current TB treatment	
		N	%
24	636	0	0.0
25	603	1	0.2
26	581	0	0.0
27	586	3	0.5
28	518	0	0.0
29	592	2	0.3
30	583	0	0.0
31	593	0	0.0
32	565	1	0.2
33	577	1	0.2
34	562	0	0.0
35	592	1	0.2
36	630	1	0.2
37	535	0	0.0
38	619	1	0.2
39	651	4	0.6
40	478	2	0.4
41	628	1	0.2
42	546	1	0.2
43	603	0	0.0
44	640	1	0.2
45	594	1	0.2
46	595	0	0.0
47	560	0	0.0
48	588	0	0.0
49	597	1	0.2
50	585	1	0.2
51	574	1	0.2
52	604	0	0.0
53	607	0	0.0
54	591	0	0.0
55	379	0	0.0
56	566	0	0.0
57	600	0	0.0
58	514	3	0.6
59	562	0	0.0

		Number of participants	Number (%) on current TB treatment	
			N	%
	60	649	2	0.3
	61	623	1	0.2
	62	543	1	0.2
	63	601	1	0.0
	64	610	0	0.0
	65	612	2	0.3
	66	562	1	0.2
	67	543	11	2.0
	68	610	1	0.2
	69	616	2	0.3
	70	582	0	0.0
TOTAL		41,154	**61**	**0.2**

Annex 19: Participants with history of recent episode of TB Treatment by sex, age group, residence and cluster

		Number participants	Number (%) with history of previous TB treatment	
			n	%
Sex	Male	17,485	432	52.7
	Female	23,669	380	47.3
Age group in years	15–24	14,775	112	13.8
	25–34	10,543	172	21.2
	35–44	6,831	178	21.9
	45–54	4,287	183	22.7
	55–64	2,213	82	10.1
	65+	2,505	85	10.5
Residence	Rural	23,816	428	52.7
	Urban	17,338	384	27.3
Cluster	1	607	8	1.3
	2	631	7	1.1
	3	592	12	2.0
	4	609	10	1.6
	5	618	10	1.6
	6	604	33	5.5
	7	613	22	3.6
	8	563	18	3.2
	9	536	28	5.2
	10	602	8	1.3
	11	626	4	0.6
	12	628	7	1.1
	13	621	6	1.0
	14	563	9	1.6
	15	588	12	2.0
	16	604	5	0.8
	17	613	5	0.8
	18	572	11	1.9
	19	574	2	0.4
	20	586	10	1.7
	21	604	10	1.7

	Number participants	Number (%) with history of previous TB treatment	
		n	%
22	612	10	1.6
23	603	11	1.8
24	636	11	1.7
25	603	25	4.2
26	581	14	2.4
27	586	6	1.0
28	518	12	2.3
29	592	24	4.1
30	583	1	0.2
31	593	5	0.8
32	565	15	2.7
33	577	6	1.0
34	562	4	0.7
35	592	4	0.7
36	630	9	1.4
37	535	12	2.2
38	619	7	1.1
39	651	28	4.3
40	478	11	2.3
41	628	5	0.8
42	546	5	0.9
43	603	9	1.5
44	640	6	0.9
45	594	19	3.2
46	595	9	1.5
47	560	9	1.6
48	588	16	2.7
49	597	12	2.0
50	585	11	1.9
51	574	23	4.0
52	604	13	2.2
53	607	10	1.7
54	591	23	3.9
55	379	5	1.3
56	566	9	1.6

		Number participants	Number (%) with history of previous TB treatment	
			n	%
	57	600	10	1.7
	58	514	20	3.9
	59	562	10	1.8
	60	649	13	2.0
	61	623	15	2.4
	62	543	3	0.6
	63	601	8	1.3
	64	610	10	1.6
	65	612	8	1.3
	66	562	15	2.7
	67	543	28	5.2
	68	610	21	3.4
	69	616	10	1.6
	70	582	5	0.9
TOTAL		**41,154**	**812**	**2.0**

Annex 20: Prevalence of tobacco smoking in the survey population by sex, age group, residence and cluster

		Number of participants	Smoking	
			Number	%
Sex	Male	17,485	2467	14.1
	Female	23,669	553	2.3
Age group in yrs.	15–24	14,775	334	2.3
	25–34	10,543	797	7.6
	35–44	6,831	794	11.6
	45–54	4,287	516	12.0
	55–64	2,213	290	13.1
	65+	2,505	289	11.5
Residence	Rural	23,816	1,682	7.1
	Urban	17,338	1,338	7.7
Cluster	1	607	6	1.0
	2	631	14	2.2
	3	592	27	4.6
	4	609	27	4.4
	5	618	8	1.3
	6	604	39	6.5
	7	613	56	9.1
	8	563	24	4.3
	9	536	99	18.5
	10	602	49	8.1
	11	626	9	1.4
	12	628	83	13.2
	13	621	24	3.9
	14	563	69	12.3
	15	588	9	1.5
	16	604	147	24.3
	17	613	32	5.2
	18	572	23	4.0
	19	574	31	5.4
	20	586	47	8.0

	21	604	29	4.8
	22	612	54	8.8
	23	603	56	9.3
	24	636	20	3.1
	25	603	57	9.5
	26	581	34	5.9
	27	586	37	6.3
	28	518	23	4.4
	29	592	21	3.5
	30	583	58	9.9
	31	593	37	6.2
	32	565	58	10.3
	33	577	37	6.4
	34	562	37	6.6
	35	592	88	14.9
	36	630	25	4.0
	37	535	63	11.8
	38	619	46	7.4
	39	651	50	7.7
	40	478	42	8.8
	41	628	23	3.7
	42	546	38	7.0
	43	603	28	4.6
	44	640	26	4.1
	45	594	36	6.1
	46	595	13	2.2
	47	560	71	12.7
	48	588	37	6.3
	49	597	26	4.4
	50	585	52	8.9
	51	574	43	7.5
	52	604	69	11.4
	53	607	22	3.6
	54	591	81	13.7
	55	379	18	4.7
	56	566	22	3.9

	57	600	98	16.3
	58	514	49	9.5
	59	562	16	2.8
	60	649	40	6.2
	61	623	15	2.4
	62	543	32	5.9
	63	601	56	9.3
	64	610	23	3.8
	65	612	52	8.5
	66	562	34	6.0
	67	543	125	23.0
	68	610	91	14.9
	69	616	55	8.9
	70	582	34	5.8
TOTAL		**41,154**	**3,020**	**7.3**

Annex 21: Comparison of cough prevalence among smokers and non-smokers, overall and by age, sex, residence and cluster

		Smokers			Non-Smokers		
		N	n	%	n	n	%
Sex	Male	2467	780	31.6	15018	2953	19.7
	Female	553	160	28.9	23115	5013	21.7
Age group in yrs.	15–24	334	114	34.1	14440	2874	19.9
	25–34	797	227	28.5	9746	1926	19.8
	35–44	794	251	31.6	6037	1208	20.0
	45–54	516	167	32.4	3771	826	21.9
	55–64	290	82	28.3	1923	459	23.9
	65+	289	99	34.3	2216	673	30.4
Residence	Rural	1682	520	30.9	22134	4807	21.7
	Urban	1338	420	31.4	15999	3159	19.7
Cluster	1	6	1	16.7	601	160	26.6
	2	14	6	42.9	617	158	25.6
	3	27	8	29.6	565	87	15.4
	4	27	4	14.8	582	88	15.1
	5	8	4	50.0	610	152	24.9
	6	39	14	35.9	565	122	21.6
	7	56	18	32.1	557	92	16.5
	8	24	11	45.8	539	146	27.1
	9	99	47	47.5	437	134	30.7
	10	49	11	22.4	553	80	14.5
	11	9	5	55.6	617	167	27.1
	12	83	25	30.1	545	123	22.6
	13	24	10	41.7	597	101	16.9
	14	69	19	27.5	494	103	20.9
	15	9	4	44.4	579	166	28.7
	16	147	34	23.1	457	72	15.8
	17	32	5	15.6	581	105	18.1
	18	23	13	56.5	549	172	31.3
	19	31	16	51.6	543	124	22.8
	20	47	8	17.0	539	79	14.7

21	29	14	48.3	575	150	26.1
22	54	13	24.1	558	103	18.5
23	56	15	26.8	547	69	12.6
24	20	6	30.0	616	116	18.8
25	57	10	17.5	546	108	19.8
26	34	9	26.5	547	94	17.2
27	37	19	51.4	549	196	35.7
28	23	12	52.2	495	75	15.2
29	21	11	52.4	571	127	22.2
30	58	12	20.7	525	78	14.9
31	37	11	29.7	556	82	14.7
32	58	9	15.5	507	37	7.3
33	37	11	29.7	540	73	13.5
34	37	7	18.9	525	96	18.3
35	88	29	33.0	504	154	30.6
36	25	8	32.0	605	106	17.5
37	63	23	36.5	472	141	29.9
38	46	14	30.4	573	127	22.2
39	50	15	30.0	601	122	20.3
40	42	16	38.1	436	119	27.3
41	23	11	47.8	605	163	26.9
42	38	11	28.9	508	117	23.0
43	28	9	32.1	575	110	19.1
44	26	6	23.1	614	174	28.3
45	36	12	33.3	558	109	19.5
46	13	3	23.1	582	129	22.2
47	71	21	29.6	489	86	17.6
48	37	6	16.2	551	83	15.1
49	26	11	42.3	571	106	18.6
50	52	19	36.5	533	103	19.3
51	43	9	20.9	531	110	20.7
52	69	22	31.9	535	101	18.9
53	22	5	22.7	585	91	15.6
54	81	25	30.9	510	126	24.7
55	18	6	33.3	361	75	20.8
56	22	10	45.5	544	104	19.1
57	98	28	28.6	502	112	22.3

	58	49	20	40.8	465	134	28.8
	59	16	6	37.5	546	143	26.2
	60	40	10	25.0	609	119	19.5
	61	15	7	46.7	608	156	25.7
	62	32	12	37.5	511	73	14.3
	63	56	18	32.1	545	115	21.1
	64	23	5	21.7	587	89	15.2
	65	52	8	15.4	560	93	16.6
	66	34	9	26.5	528	94	17.8
	67	125	53	42.4	418	120	28.7
	68	91	26	28.6	518	134	25.9
	69	55	20	36.4	561	119	21.2
	70	34	5	14.7	548	74	13.5
TOTAL		**3020**	**940**	**31.1**	**38133**	**7966**	**20.9**

Annex 22: Statistical analysis

A detailed data analysis plan was made with close involvement of the survey epidemiology team and international experts from the WHO and CDC. All analysis was done in STATA v.12. To start, all data were cleaned through testing for completeness and consistency of the "core" data on source documents including the questionnaires, X-ray reports and laboratory result forms. Descriptive statistics were used to summarize sample and participation characteristics.

Chi square test (X^2) was used for comparison of categorical variables or the 2-sided Fishers test.

Methods for the estimation of survey prevalence

All analyses described below were conducted separately for each of the two binary ("yes" or "no") survey outcomes: smear-positive pulmonary TB and bacteriologically-confirmed pulmonary TB.

Cluster-level analysis

With cluster as the unit of analysis, the survey prevalence estimate is in fact a summary measure of all cluster-level prevalence estimates. The average of the cluster-level prevalence estimates is the point estimate of survey prevalence among all survey participants, and the standard error is calculated by dividing the standard deviation of the cluster-level prevalence estimates by the square root of the number of clusters.

Individual-level analyses

Individual-level analyses of pulmonary TB prevalence were performed using logistic regression, in which the log odds, i.e. $\mathbf{log}(\frac{\boldsymbol{\pi_{ij}}}{\mathbf{1}-\boldsymbol{\pi_{ij}}})$ is modelled, where $\boldsymbol{\pi_{ij}}$ is the probability of individual $\boldsymbol{i}$ in cluster $\boldsymbol{j}$ being a prevalent pulmonary TB case. The simplest model that can be fitted is$\boldsymbol{\alpha} = \mathbf{log}(\frac{\boldsymbol{\pi_{ij}}}{\mathbf{1}-\boldsymbol{\pi_{ij}}})$, in which case the overall prevalence of pulmonary TB is then estimated as: $\mathbf{p} = \frac{\mathbf{exp}(\boldsymbol{\alpha})}{\mathbf{1}+\mathbf{exp}(\boldsymbol{\alpha})}$, where $\mathbf{p}$ is the observed overall proportion of study participants with pulmonary TB. Logistic regression was used because the outcome is binary i.e. for each individual there is a probability that they have pulmonary TB at the time of the cross-sectional survey (in the generalised linear models framework, the logistic link function is the "natural link function"). The most crucial characteristic of such analyses is that they take into account the clustering of individuals: if this is not done, the calculated 95%

confidence interval (CI) for true pulmonary TB prevalence will have less than the nominal 95% coverage, due to underestimation of the standard error of the prevalence estimate. We used the recommended logistic regression for these type of surveys, with robust standard errors calculated from the observed between-cluster variability. We used three recommended models of analysis in total, one of which does not account for missing data and two of which attempt to correct for bias due to missing data.

Model 1: Robust standard errors on complete case dataset

This model does not account for variation in the number of individuals per cluster, or correlation among individuals in the same cluster, when estimating the point prevalence of pulmonary TB (logit command with the robust option in Stata). Equal weight is given to each individual in the sample. However, the model does correct for clustering (by using the observed between-cluster variation) when estimating the 95% confidence interval, and can control for the strata that were part of the survey design. This model exactly corresponds to the classical analysis of surveys (svy commands with Stata) when one does not need to adjust for sampling weights. This is indeed the case in the self-weighting survey design for nationwide TB prevalence surveys. This model is restricted to survey participants (n=41,156).

Model 2: Robust standard errors with multiple imputation for missing values

This model uses multiple missing value imputation for individuals: a) without a field CXR result and/or symptom screening, and b) for individuals with a positive CXR result or TB symptoms but without smear and/or culture results, in order to include all individuals who were eligible for the survey in the analysis (n=45,293). This model (logit command with the robust option in Stata) allows for both the clustering in the survey design and the uncertainty introduced by imputation of missing values when estimating the 95% confidence interval for the prevalence of pulmonary TB.

Model 3: robust standard errors with missing value imputation and inverse probability weighting

Missing value imputation is used for individuals eligible for sputum examination (defined as having a field CXR reading that was abnormal and/or TB symptoms) for whom data from one or more of the central CXR reading, symptom questions, and smear and/or culture results were not available. Survey participants were defined for this analysis as individuals who had a CXR that was technically adequate and also participated in the symptom screening survey. Inverse probability weighting (IPW)

was then used to correct for differentials in the participation of individuals by age, sex, and cluster. Through the combination of imputation of missing data and the use of weights, the analysis (using the logit command with the robust option in Stata) aims to represent the whole of the survey eligible population (n=45,293), but the weights are applied only to individuals who were screened by both CXR and symptoms (n=41,156).

Handling missing data

DESCRIBING MISSING DATA

Missing data in the outcome variables:

- Participants categorized as eligible for sputum examination by symptom (including cough of equal to or more than two weeks) but having no, or only one, bacteriological result of sputum specimen examinations.
- Participants eligible for sputum examination by field CXR reading regardless of types of shadows, but having no, or only one, bacteriological result of sputum examination.
- Participants having abnormal shadow detected by central CXR reading but having no, or only one, bacteriological result of sputum examination.

Missing data in the exposure variables:

- The results of field and/or CXR reading are not available (CXR not taken, quality unreadable).

Imputation models

All imputation models were run in STATA 12 using the mi group of command for the imputation of data and calculation of pooled estimates combining all imputed datasets.

Outcome of smear-positive TB: All variables which are associated with being a smear-positive case and missingness were investigated for inclusion in the imputation model. These are setting rural: urban, age group, sex, field CXR result, central CXR result, cough for more than 2 weeks, weight loss, fever, blood in sputum, chest pain, and having history of TB treatment. The final imputation model included: setting rural: urban, age group, sex, central CXR result, cough for more than 2 weeks, blood in sputum, weight loss, anti-TB treatment history, and currently on anti-TB reading. Multiply imputed 10, 15 and 20 datasets, after 10 and 15 cycles for each saved dataset were generated, each time combining datasets for producing final estimates. The same imputation model was used for imputation of values among eligible individual for the survey participants n=45,293 (Model 2), with a percentage

of missing values of 11%, and among eligible for sputum examination n=5,144, with a percentage of missing values of 12% (Model 3).

Outcome of bacteriologically-confirmed TB: All variables which are associated with being a bacteriologically confirmed case and missingness were investigated for inclusion in the imputation model. These are setting rural: urban, age group, sex, field CXR result, central CXR result, cough for more than 2 weeks, weight loss, fever, blood in sputum, chest pain, and having history of TB treatment. The final imputation model included: setting rural: urban, age group, sex, central CXR result, cough for more than 2 weeks, blood in sputum, weight loss and anti-TB treatment history. Multiply imputed 10, 15 and 20 datasets, after 10 and 15 cycles for each saved dataset were generated, each time combining datasets for producing final estimates. The same imputation model was used for imputation of values among eligible individual for the survey participants n=45,293 (Model 2), with a percentage of missing values of 11%, and among eligible for sputum examination n=5,143, with a percentage of missing values of 12% (Model 3).

Extrapolating nationwide from survey prevalence

The prevalence estimates drawn from the survey population are among adults of 15 and above, for pulmonary TB. Since the interest is in national prevalence estimates for all ages, and all forms of TB some adjustments need to be made in the survey estimate of prevalence for extra-pulmonary TB and TB among children (0-14 years).

STEP 1. Getting to pulmonary TB, all ages

- Percentage of children over total population for 2014 in Uganda using UN population estimates (version 2015). i.e. UNDP:0.49.
- Calculated smear-positive TB case notification rate per 100,000 for children, and its standard deviation from 2014 data only because previous years data show very clear under-reporting. *NTP data: 0.09, SD=0.007 used the RSE from the uncertainty in extra-pulmonary notification data*
- Extrapolated to pulmonary TB all ages as a weighted average of pulmonary TB in children and pulmonary TB in adults. Assuming this is the same as the ratio of pulmonary TB prevalence rate of children to adults.

  $$p_{pulm}=p_{child} * c + p_{adult}*(1-c)$$

  where p_{child} is the prevalence among children ($\mathbf{p_{child} = p_{adult}*ratio_{child/adult}}$), p_{adult} the prevalence among adults drawn from the survey and c the percentage of children in the country i.e. UNDP:0.49.

STEP 2. Getting to TB all forms

- Assumed EP prevalence rate was constant across all ages.

- Calculated the proportion of EP over total TB case notifications, and its standard deviation over the last few years, 2009-2014.
- Inflated the pulmonary TB prevalence all ages estimate, by the same amount for extrapulmonary TB prevalence as extra-pulmonary TB contributes to total TB case notifications.

pfinal = ppulm/(1-prep)

where pr_{ep} is the proportion extra-pulmonary among new all forms TB case notifications; average over 2009–2014 (*NTP data: 0.12, SD=0.009*). Assuming this is the same as the proportion extra-pulmonary among all forms TB prevalence.

Summary

Extrapolating to national prevalence

- Pulmonary TB prevalence, adults from survey (rate/100,000)

401 (95% CI: 292 – 509)

- Pulmonary TB prevalence, children from surveillance (rate/100,000)

36 (95% CI: 25 – 47)

- After step I: pulmonary TB prevalence, all ages (rate/100,000)

223 (95% CI: 168 – 277)

- After step II: TB prevalence all forms, all ages (rate/100,000)

253 (95% CI: 191 – 315)

- TB prevalence all forms, all ages (number)

87,000 (95% CI: 65,000 – 110,000)

Annex 23: Steering committee members

1) Director General MOH (Chair) Dr. Aceng Jane Ruth
2) Director C and C MOH, Dr. Mbonye Anthony
3) Commissioner National Disease Control (NDC), Dr. Opio Alex
4) Institutional representatives of: World Health Organisation Representative, Dr. Alemu Wondi
5) Institutional representatives of the UNION, Dr. Anna Nakanwagi
6) Institutional representatives of CDC, Dr. RoseMary Odeke
7) Institutional representatives of UBOS, James Muwonge
8) Institutional representatives of GLRA, Dr. Kawuma Joseph
9) Dean of School of Public Health, Prof. William Bazeyo
10 Global Fund representative, Dr. Jim Arinaitwe
In attendance
11) The NTLP Program Manager (MoH Principal Investigator), Dr. Frank Mugabe
12) the MakSPH Principal Investigator Dr. Elizeus Rutebemberwa
13) the Co-Principal Investigator Dr. Bruce Kirenga

Annex 24: Technical working group members

1) Dr. Mugabe Frank- Principal Investigator-policy and Program Manager, NTLPDr. Mabumba Eldard –NTLP
2) Dr. Quinto Ebony –NTLP
3) Dr. Marra Claudio – USAID advisor to NTLP
4) Dr. Bagambe Vincent –GFATM Focal coordination office, MoH Uganda
5) Dr. Martin Sendioyona – Quality assurance, MoH Uganda
6) Mr. Raymond Asiimwe–National TB Reference Laboratory
7) Mr. Awongo Peter- National TB Reference Laboratory
8) Dr. Katamba Achilles-CHS, Makerere University
9) Dr. Kaggwa Mugagga-WHO, Uganda
10) Dr. Estella Birabwa-USAID, Uganda
11) Dr. Martin Ruhweza-TRACK TB Project
12) Dr. Rosemary Odeke-CDC, Uganda
13) Dr. Daniel Kadobera-CDC AFENET

Annex 25: Survey Implementation team members

1) Dr. Elizeus Rutebemberwa–TB Prevalence Survey Technical Principal Investigator
2) Dr. Bruce Kirenga–Co-PI (Clinical and Operations) and Pulmonologist, CHS-Makerere University.
3) Dr. Samuel Kasozi–TB Prevalence Survey Coordinator, School of Public Health, Makerere.
4) Dr. Simon Kasasa–Biostatician/Epidemiologist, School of Public Health, Makerere University
5) Mr. George Wilson Kigozi–Quality Control Officer, TB Prevalence survey Project
6) Dr. Worodria William, Senior Consultant Pulmonologist, Department of Medicine Mulago Hospital & Complex, Uganda
7) Dr. Claudio Marra–USAIDadvisor to NTLP
8) Mr. Herbert Ampaire–School of Public Health, Makerere University
9) Dr. Frank Mugabe–Principal Investigator-policy and Program Manager, NTLP
10) Dr. Vincent Bagambe–GFATM-Focal coordination Office, MoH-Uganda
11) Dr. Moses Joloba–Laboratory Consultant and Director, National TB Reference Laboratory
12) Mr. Kenneth Musisi–Lab Manager, National TB Reference Laboratory
13) Dr. Okot Martin Nwang –Senior Consultant Pulmonologist and Head of Medical Panel
14) Dr. Harriet Kisembo–Lead Radiologist and Consultant Radiologist, Mulago Hospital
15) Mr. Rogers Sekibira–Data Manager, TB Prevalence survey Project, School of Public Health, Makerere
16) Dr. Abel Nkolo–National Professional Officer, TB, WHO Uganda
17) Kaggwa Mugagga–NPO WHO, Uganda
18) Ms. Doreen Katusiime–Administrator, TB Prevalence Survey Project, School of Public Health, Makerere
19) Mr. Mathias Tumwebaze–Senior Radiographer–CHS-Makerere University.
20) Dr. Ebony Quinto–M& E, NTLP-MoH.
21) Dr. Daniel Kadobera–CDC AFENET
22) Mr. George William Kasule–Survey lab focal person and staff at National TB Reference Laboratory

Annex 26: Survey field staff members by team

Position	Team A	Team B	Team C
Field Team Leaders	Dr. Ronald Anguzu	Dr. Annet Nagudi	Ms Racheal Tumwebaze
Receptionists	Yasasira Anna	Okiror Peter	Ssegawa Cylus
Interviewers	Jennifer Kataike Felix Ekitui Caroline Atukwase	Barbara Kusiima Sarah Auma Hadija Omar	Arinda Agatha Nyeko Godfrey Taaka Wandera
Radiographers (Degree)	Hilda Kikule Namanda	Stanislas Mutabazi	Pamella Nuwamanya
Radiographers (Diploma)	Kikoole Douglas Aguajibi Victor	Timothy Mugume Rodgers Katamba	David Emong Tremendous Senteza
Biomedical technicians	Richard Kiiza	Babishaba Doloviko Louis	Abubaker Wasajja Katerega
Data checkers	Kyanjo Erimiah	Josiah Kayanga	Simon Peter Bakabulindi
Lab technicians	Eunice Ainomugisha	Goeffrey Oguma	Hillary Ahimbisibwe
HCT counsellors	Buni Boniface	Jackline Nanono	John Jackiel
Survey project drivers			
Fred Mulindwa			
Abel Moses Kavuma			
Bogere Magada			
Biramahire Godwin			
Nsiiro Sulaiman			
Muyinda John			
Mubiru Dickson			
Kalema Paul			

Annex 27: Survey central unit

A. Survey Central coordinating Team Members

1. Dr. Elizeus Rutebemberwa–TB Prevalence Survey Technical Principal Investigator
2. Dr. Bruce Kirenga–Co-PI (Clinical and Operations) and Pulmonologist, CHS-Makerere University.
3. Dr. Samuel Kasozi -TB Prevalence Survey Coordinator, School of Public Health, Makerere.
4. Ms. Doreen Katusiime -Administrator, TB Prevalence survey Project, School of Public Health, Makerere

Other staff at central office

5. Ms. Namubiru Teddy Lucky – Logistics Officer, TB Survey Project.
6. Ms. Susan Babirye and Mr. Nelson Kukundakwe–Communications Officers, TB Survey Project
7. Albert Ningwa – IT Officer, TB Survey Project

B. Data Management unit

1. Mr. Rogers Sekibira–Data Manager, TB Prevalence survey Project
2. Mr. George Wilson Kigozi–Quality Control Officer, TB Prevalence survey Project
3. Ms. Annet N. Katamba–Data entrant, TB Prevalence survey Project
4. Mr. John Bosco Oribakiriho–Data entrant, TB Prevalence survey Project
5. Mr. Andama Edwin Mayoki–Data entrant, TB Prevalence survey Project
6. Ms. Kansiime Sheilla–Data entrant, TB Prevalence survey Project
7. Ms. Phillipa Busingye–Data entrant, TB Prevalence survey Project
8. Mr. Nyombi Herbert–Data entrant, TB Prevalence survey Project
9. Mr. Ssentamu Faruku–Data entrant, TB Prevalence survey Project
10. Ms. Nakyesige Racheal–Data entrant, TB Prevalence survey Project

C. Radiology unit

1. Dr. Harriet Kisembo–Lead Radiologist and Consultant Radiologist, Mulago Hospital
2. Dr. Richard Omara–Consultant Radiologist, Mulago Hospital
3. Dr. Zeridah Muyinda– Consultant Radiologist, Mulago Hospital

D. Central laboratory team

1. Dr. Moses Joloba–Laboratory Consultant and Director, National TB Reference Laboratory
2. Mr. Kenneth Musisi -Lab Manager, National TB Reference Laboratory
3. Mr. George William Kasule -Survey lab focal person and staff at National TB Reference Laboratory
4. Ms. Nakiwala Dorothy –Lab staff -National TB Reference Laboratory
5. Ms. Nabanooba Evelyn –Lab staff -National TB Reference Laboratory
6. Mr. Nsubuga Richard –Lab staff -National TB Reference Laboratory
7. Mr. Wabwire Ivan–Lab staff -National TB Reference Laboratory
8. Mr. Ashaba Justus –Lab Data Manager -National TB Reference Laboratory
9. Mr. Bbaale Ndawula- Lab staff -National TB Reference Laboratory
10. Mr. Didas Tugumisirize- Lab staff -National TB Reference Laboratory
11. Ms. Alikoba Faith Lydia- Lab staff -National TB Reference Laboratory
12. Ms. Lilian Bulage- Lab staff -National TB Reference Laboratory
13. Ms. Nakabira Sarah- Lab staff -National TB Reference Laboratory
14. Ms. Nakalyango Hanifa- Lab staff -National TB Reference Laboratory
15. Mr. Mugisha Derrick Marvin- Lab staff -National TB Reference Laboratory
16. Ms. Jenipher Kyomugisha- Lab staff -National TB Reference Laboratory
17. Mr. Matovu John B- Lab staff -National TB Reference Laboratory
18. Mr. Ekuka Godfrey
19. Mr. Henry Masengere

E. Epidemiology team

1. Dr. Simon Kasasa–Consultant Biostatician/Epidemiologist
2. Dr.Jayne Byakiika–Consultant Epidemiologist
3. Dr. Imoko Joseph–TB Consultant

F. Medical Panel

1. Dr. Okot Martin Nwang–Senior Consultant Pulmonologist and Head of Medical Panel
2. Dr. Worodria William, Senior Consultant Pulmonologist, Department of Medicine Mulago Hospital & Complex, Uganda
3. Dr. Harriet Kisembo–Lead Radiologist and Consultant Radiologist, Mulago Hospital

Annex 28: Prevalence Survey Report Writing Committee

1. Dr. Elizeus Rutebemberwa–TB Prevalence Survey Technical Principal Investigator
2. Dr. Frank Mugabe-Principal Investigator-policy and Program Manager, NTLP
3. Dr. Bruce Kirenga–Co-PI (Clinical and Operations) and Pulmonologist, CHS-Makerere University.
4. Dr. Samuel Kasozi–TB Prevalence Survey Coordinator, School of Public Health, Makerere.
5. Dr. Imoko Joseph–TB Consultant and member Medical Panel

Annex 29: TB Survey Study tools

Tool 01-Household register

Republic of Uganda–Uganda Ministry of Health

National Tuberculosis and Leprosy Program–National Tuberculosis Prevalence Survey

HOUSEHOLD REGISTER

Cluster number: Household Number:

Name of enumerator: _____Date:_____/_____/_____
DD MM YYYY

Sub-County: _____ Parish: _____ Village: _____

Household physical address: _____

Household contact Person: _____Phone number: _____

PIN **(C#/HH#/I #)**	**Surname**	**Name**	**Age** Year(s)	**Sex** 1-M 2-F	**Occupation***	**Permanent (P) or Temporary (T) resident?**	**Meet residential criteria^?** 1-Yes, 2-No	**Eligible?** 1-Yes 2-No	**Attended the survey?** 1-Yes 2-No	**Consent** 1-Yes 2-No	**Serial number** (sticker)	**Remarks** (Reason for Absence, ineligibility)
- – 01												
- – 02												
- – 03												
- – 04												
- – 05												

PIN (C#/HH#/I #)	Surname	Name	Age Year(s)	Sex 1-M 2-F	Occupation*	Permanent (P) or Temporary (T) resident?	Meet residential criteria^? 1-Yes, 2-No	Eligible? 1-Yes 2-No	Attended the survey? 1-Yes 2-No	Consent 1-Yes 2-No	Serial number (sticker)	Remarks (Reason for Absence, ineligibility)
- – 06												
- – 07												
- – 08												
- – 09												
- – 10												
- – 11												
- – 12												
- – 13												
- – 14												
- – 15												

***Occupation classification:**
0 –Child **1 –**Business **2** – Civil servant **3**– Healthcare worker
4– Student **5** – Unemployed **6** – Farmer **7** – House wife/husband
8 – Skilled labor **9** – Other

^ Residential criteria:
Permanent resident must have spent at least one night in the household in the 2 weeks prior to census day. **Temporary visitors** must have arrived in the household at least 2 weeks before census day

Field Data checker: _____Signature: _____Field Team leader: _____ Signature: _____
Data manager: _____ Signature: _____ Date: _____/_____/_____

Tool 02-Survey Household Number

Republic of Uganda

LABEL FOR HOUSEHOLD NUMBER

Survey Household Number

Tool 03-Survey invitation card (Front)

INVITATION CARD FOR THE UGANDA NATIONAL TB PREVALENCE SURVEY

PERSONAL IDENTIFICATION NUMBER | | | | | | | | **(PIN)**

Cluster HH Individual

NAME *(Write in capital letters)*	**5. AGE Year(s)**	**6. SEX**
Surname *First Name*	___ ___	☐Male ☐Female

Please participate in the National TB Prevalence Survey on

_____ day _____month _____ year

_____(morning or afternoon)

at survey site located at _____

KINDLY BRING THIS CARD WITH YOU WHEN YOU COME TO THE SURVEY SITE!

Tool 03-Survey invitation card (Back)

Information about the TB survey

Tuberculosis (TB) is a disease that mainly affects the lungs. It is important to get diagnosed and treated on time. This survey is to assess the burden of pulmonary TB disease in Uganda. It also provides the invaluable information to improve the TB prevention and control program and to provide better services in Uganda. Your participation is very important.

You are invited to the survey site for interview and chest x-ray. You may be requested to provide sputum for further TB testing. If so, you will be informed in case your sputum is positive.

In case of any question, feel free to contact
…….(FTL tel:)

Tool 04-Individual survey questionnaire

Location of the interview:
1 – Survey site
2–Outreached

Republic of Uganda
Uganda Ministry of Health
National Tuberculosis and Leprosy Program
National Tuberculosis Prevalence Survey
INDIVIDUAL QUESTIONNAIRE

Personal identification number (PIN) ☐☐ ☐☐☐ ☐☐
Cluster *HH* *Individual*

Surname and Name _____ Date: _____/_____/_____
(DD,MM,YYY

Section A-F to be filled by the interviewer

A. Identification

1. Sex: *(Circle one)* 1–Male 2–Female

2. Age*(in years)* **as at last birthday: _____ if age unknown, check and estimate age: _____**

☐
Y)

3. Education: *(Circle one)*	**4. Religion:** *(Circle one)*	**5. Marital Status:** *(Circle one)*	**6. Occupation:** *(Circle one)*
1–None	1–Christian	1–Single	1 –Business
2–Primary	2–Muslim	2–Married	2 – Civil servant
3–Senior 1-4	3–Traditional	3–Separated	3– Healthcare worker
4–Senior 5-6	4–None	4–Divorced	4– Student
5–Tertiary education	5–Other: _____	5–Widowed	5 – Unemployed
6–Don't know	6–Don't know	6–Don't know	6 – Farmer
7- Unknown	7–Unknown	7–Unknown	7 – House wife/husband
			8 – Skilled labor
			9 – Other _____

B. Symptoms

7. Do you have any of these symptoms? *(Circle all that apply).***If Yes, for how long*(in days)*?**

Symptom		# of days	
7.1 Cough	1–Yes		2–No
7.2 Sputum	1–Yes		2–No
7.3 Blood stained sputum	1–Yes		2–No
7.4 Chest pain	1–Yes		2–No
7.5 Body weight loss	1–Yes		2–No
7.6 Fever	1–Yes		2–No

C. Behavior regarding cough 14 days or more

8 . Did you seek medical care for your cough?*(Circle one)* 1–Yes 2–No

NOTE: If yes, then go to Q 9 and 10, if no then go to Q 11

9. Where did you first seek care?*(Circle one)*

1 -Public health facility
2–NGO health facility
3 -Private health facility
4 -Pharmacy/Drug shop
5–Traditional healer
6–Other:_____

10. What care did you receive?

(Circle all that apply)

1 -Given medicine
2 -Chest x-ray
3 -Asked to provide sputum
4 -Referred elsewhere for care
5 -Physical exam/Consultation
6–Other: _____

11. What is the main reason for not seeking care? *(Circle one)*

1–Self-treatment
2–Not recognized as illness
3–Ignored
4–Cost
5–Distance
6–Long waiting times
7–Other:_____

D. TB treatment history

Current TB Treatment

12. Are you currently taking any anti-TB drugs?

1–Yes 2 No (Go to 17)

13. If yes, how long? *(In weeks)*_____

14. Where are you getting the treatment?*(Circle one)*

1–Public facility
2–NGO facility
3–Private facility
4–Pharmacy/Drug shop
5–Traditional healer
6–Other (Specify): _____

15. How long did you have symptoms before seeking care for TB?*(In weeks)* _____

16. How long did you have symptoms before starting

Past History of TB Treatment

17. Have you been treated for TB in the past?

1–Yes 2–No (Go to 20)

18. If yes what was the year of your last episode?____

19. Where did you receive the treatment?

(Circle one)

1–Public facility
2–NGO facility
3–Private facility
4–Pharmacy/Drug shop
5–Traditional healer
6–Other (Specify): _____

E. Tobacco use

20. Do you smoke tobacco? *(Circle one)*

1 – Yes*(Go to Q 21 and 22)*
2 – No*(Go to Q 23)*
3 – Unknown*(Go to Q 23)*

21. If yes, how often: *(Circle one)*

1–Daily
2–Less than daily (Not every day)
3–Unknown

22a. Duration of smoking?*(current and past in years)*_____

22b. Number of tobacco pieces/sticks smoked per day_____

23. Have you ever smoked in the past? *(Circle one)*

1 – Yes*(Go to Q 24)*
2 – No*(Go to Section F)*
3 – Unknown*(Go to Section F)*

24. If yes, how often:*(Circle one)*

1–Daily
2–Less than daily (Not every day)
3–Unknown

25a. Duration of smoking in the past*(in years)*_____

25b. Number of tobacco pieces/sticks smoked per day_____

F. Eligibility for sputum based on symptoms screening (to be filled by the interviewer)

26. Is participant eligible for sputum based on symptoms? *(Circle one)*

1 – Yes (if yes to 7.1 and # of days is ≥ 14) **2 – No**

H. Chest X-Ray (to be filled by the CXR reader

27. Chest X-ray done*(Circle one)*

1 – Yes 2 – No, unable 3 – No, declined 4 –No, other: _____

28. Result of field screening of X-ray *(Circle one)*

1 – Normal 2 – Abnormal, lung field 3 – Abnormal, other abnormality

29. Is participant eligible for sputum collection based on CXR? *(Circle one)*

1–Yes (if answer 2, 3, or 4 to Q 27 OR answer 2 to Q 28) **2 – No**

I. Overall sputum collection eligibility section (to be filled by data checker)

30. Eligible for sputum examination, specify reason for eligibility

(Circle one; if 1 AND 4 apply, circle both of them)

1–cough of ≥14 days 2–Abnormal CXR 3 – Both 4 – CXR not taken

31. If eligible, respondent sent for sputum collection*(Circle one)* 1–Yes 2 – No

32. If not sent, specify reason 1-Declined 2- Respondent not available 3

J. Sputum collection section (to be filled by the lab technician)(DD,MM,YYYY)

33. Spot Sputum collected*(Circle one)* 1-Yes 2-No

Date_____/_____/_____

34. If not collected, specify reason 1-No sputum 2-Declined 3-Other

_____

35. Morning Sputum collected*(Circle one)* 1-Yes 2-No

Date_____/_____/_____

36. If not collected, specify reason 1-No sputum 2-Declined 3-Other

_____

K: HIV testing (to be filled by HCT only for those eligible for sputum)

37. HIV test done *(Circle one)* 1- Yes 2-No

38.If No, specify reason*(Circle one)* 1-Declined 2-Did not return 3-Other

_____

L. Final check (to be filled by the FTL)

I have checked the questionnaire and it is complete

Field Team leader's signature: _____

Tool 05-CXR reading register

Republic of Uganda
Ministry of Health
National Tuberculosis and Leprosy Program
*National Tuberculosis Prevalence Survey*Sub-County: _____ Parish: _____ Village: _____ Cluster number:_____

Chest X-Ray reader signature _____ Date _____

N	PIN	Surname	Name	Age (years)	Sex		Field reading			Remarks
					M	F	Normal	Abnormal, lung field	Abnormal, other abnormality	

Tool 06-Sputum collection register

Republic of Uganda
Ministry of Health
National Tuberculosis and Leprosy Program
National Tuberculosis Prevalence Survey

Sub-County: _____ Parish: _____ Village: _____ Cluster number: _____

N	PIN	Surname	Name	Age	Sex		Sputum sample	Date of collection	Appearance*	Volume	Date sent	Remarks	LAB NO.
					M	F							
							SPOT						
							MORNING						
							SPOT						
							MORNING						
							SPOT						
							MORNING						
							SPOT						
							MORNING						
							SPOT						

							MORNING						
							SPOT						
							MORNING						

***Appearance**: 1 – muco-purulent; 2 –blood stained; 3 – saliva

Lab tech signature: _____

Transportation officer's signature: _____ Date: ___/___/_____(Please count and verify sample PIN before signing)

Receiving officer's signature: _____Date: ___/___/_____ (Please count and verify sample PIN before signing)

Tool 07-HIVTesting register

Republic of Uganda
Uganda Ministry of Health
National Tuberculosis and Leprosy Program
National TB Prevalence Survey

Sub-County: _____ Parish: _____ Village: _____ Cluster number:_____

N	PIN	Surname	Name	Age	Sex		Test Kit Used			Date Of HIV Test	RESULTS	Serial number	Remarks
					M	F	Determine	Statpak	Unigold				

HCT's signature: _____

Transportation officer's signature: _____ Date: ___/___/_____(Please count and verify sample PIN before signing)Receiving officer's signature: _____ Date: ___/___/_____ (Please count and verify sample PIN before signing)

Tool 8-HIV results form

Republic of Uganda
Uganda Ministry of Health
National Tuberculosis and Leprosy Program
National TB Prevalence Survey

CLIENTS' SLIP

Client's Surname / Name: _____ Sex ____ Age____

District Name _____Village name _____ PIN. _____

Test Result: ☐ Positive ☐ Negative ☐ Indeterminate

Comments: (if the test is positive refer participant to nearest facility)
_____
_____
_____

Counselor's Name: _____ Date ____/____/____

Name of the Person who compiled the report	Designation

Implementation Place(s)	Dates
…….. cluster, …… parish, …….. Sub county,…… District	

Other project staff I involved in the activity	Non-project staff (Names and their organizations) involved in the activity

Submission date

An outline of the following:(Name and number of Enumeration areas (EAs) in the cluster, Population of each EA, Number of EAs surveyed, EA blocked and <u>detailed description of how blocking was done</u>

Cluster summary (tool 9)

1. Census/Registration (persons)	**Day 1**	**Day2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Total**
□ Number of registered households							
□ Total population of the cluster							
□ Eligible individuals							
• Eligible invited							
□ Adults not eligible							
• Individuals with age less than 15 years							
□ Individuals who consented							
□ individuals who refused							
□ Individuals who were absent							
2. Interview (persons)							
□ Individuals interviewed at site							
□ Individuals interviewed via outreach							
□ Eligible for sputum by cough of ≥14 days							
3. Chest X-ray (persons)							
□ Individuals with X-ray taken							
□ Individuals without X-ray taken							
□ Result of x-ray reading							
o Normal							
o Abnormal, lung field							

o Other abnormal

4. Sputum collection (persons)

- Eligible for sputum collection
- Collected sputum specimen

o 1st specimen (spot)
o 2nd specimen (morning)

6. Shipment of sputum specimen (Bottles)

1st time, Date: / /2015
2nd time, Date: / /2015
3rd time, Date: / /2015
4th time, Date: / /2015

Challenges

Recommendations

Tool 9- cluster summary report form

Republic of Uganda
Uganda Ministry of Health

National Tuberculosis and Leprosy Program

National TB Prevalence Survey

Cluster Name …… Cluster Number ……

All respondents with positive TB results will be communicated by the Survey Coordinator to the DTLS

Thank you for participation

Field Team Leader's signature _____ Date___/____/_____

Tool 10-Central CXR reading form

Republic of Uganda

Uganda Ministry of Health

National Tuberculosis and Leprosy Program

National TB Prevalence Survey

Section A: Identification

PIN __ _____/__ _____/__ _____

Date of central reading of the CXR __ __/__ __/__ __ __ _

SPECIFIC RADIOGRAPHIC FINDINGS

1. **What is the overall quality of the film?***(Circle one)*
   1-Adequate 2- Inadequate
2. **Does the chest radiograph appear normal?***(Circle one)*
   1 – Yes*(Go to Q 14)* 2- No (*Go to Q 3)*

FINDINGS	RIGHT	LEFT
3.Consolidation/Alveolar infiltrates	1-Yes 2-No	1-Yes 2-No
Upper	1-Yes 2-No	1-Yes 2-No
Mid	1-Yes 2-No	1-Yes 2-No
Lower	1-Yes 2-No	1-Yes 2-No
2.Nodules	1-Yes 2-No	1-Yes 2-No
3.Masses	1-Yes 2-No	1-Yes 2-No
4. Atelectasis/collapse/ fibrosis	1-Yes 2-No	1-Yes 2-No
5. Cavity (ies)	1-Yes 2-No	1-Yes 2-No
Upper	1-Yes 2-No	1-Yes 2-No
Mid	1-Yes 2-No	1-Yes 2-No
Lower	1-Yes 2-No	1-Yes 2-No
6. Milliary pattern	1-Yes 2-No	1-Yes 2-No

7. Calcifications	1-Yes 2-No	1-Yes 2-No
8. Hilar/ Mediastinal Adenopathy	1-Yes 2-No	1-Yes 2-No
9. Pleural effusion	1-Yes 2-No	1-Yes 2-No
10. Pleural fibrosis	1-Yes 2-No	1-Yes 2-No
11. Others	1-Yes 2-No	1-Yes 2-No

If yes to Q 12 (Others), please specify_____

_____

12. Summary of CXR findings*(Circle one)*

1-Normal
2-Active TB disease suggestive
3-Inactive/healed TB
4-Other lung conditions that need follow up
5-Other lung conditions that do not need follow up
6-Extra-pulmonary abnormalities e.g. cardiovascular, muscle, bone etc

Radiologist's signature: _____

Tool 11-Survey TB case ascertainment form
Section A: Identification

Surname / Name_____ PIN __ __/__ __/__ ___

Date__ __/__ __/__ __ __ _

1. **Screened positive in the field for**

   1-Cough of two weeks or more duration
   2-Abnormal CXR
   3-Both cough and abnormal CXR
   4- CXR not taken

2. **Central CXR reading**

   1-Normal
   2-Active TB disease suggestive
   3-Inactive/healed TB
   4-Other findings consistent with TB
   5-Other findings not consistent with TB
   6-Extrapulmonary abnormalities e.g. cardiovascular, muscle, bone etc

3. **Sputum smear**

   Spot
   1-Positive
   2-Negative
   3-NA

   Morning
   1- Positive
   2-Negative
   3-NA

4. **GeneXpert**

   Spot
   1- Positive
   2-Negative
   3- Indeterminate
   4-Not done

   Morning
   1- Positive
   2- Negative
   3- Indeterminate
   4-Not done

5. **Culture**

   Spot
   1- Positive MTB (>20col) (>20col)

   Morning
   1- Positive MTB

2- Positive MTB (<20col) (<20col)	2-Positive MTB
3- Positive MOTT	3-Positive MOTT
4- Negative	4- Negative
5- Contaminated	5- Contaminated
6- Not done	6- Not done
7- NA	7- NA

Final survey TB case status

1- Definite S+ TB case
2- Probable S+ TB case
3- Definite S-C+ TB case
4- Probable S-C+ TB case
5- Not survey TB case

Medical Panelist's signature. _____ Date: ___/___/_____

Monitor's signature: _____ Date: ___/___/_____

Survey TB Case Definitions

Definite S+ TB case
Smear-positive in at least one sample, culture positive for MTB in at least one culture
Or
Smear-positive in at least one sample, culture not positive/NA, Xpert positive in at least one sample
Or
Smear-positive in at least one sample, culture MOTT, Xpert positive in at least one sample

Probable S+ TB case
Smear-positive in at least one sample, culture not positive/NA, Xpert pending/NA AND CXR consistent with TB

Definite S-C+ TB case
Smear negative, strong culture positive (> 20 col) according to the WHO classification in at least one sample
Or
Smear negative, weak culture in two different samples
Or
Smear negative, weak culture in one sample AND Xpert positive in another sample
Or
Smear negative, weak culture in one sample AND Xpert positive on the same sample AND CXR consistent with TB
Or
Smear negative, weak culture in one sample, Xpert negative AND CXR consistent with TB
Or
Smear negative, culture not positive/NA, Xpert positive AND CXR consistent with TB
Or
Smear negative, culture MOTT, Xpert positive AND CXR consistent with TB
Probable S-C+ TB case
Smear negative, weak culture in one sample only, Xpert pending/NA without negative evidence from CXR

To be used for referral of respondents from the TB Prevalence survey clusters

Respondent's name _____

Referred from _____ (name of the cluster)

Referred to _____(Name of health facility)

Reasons for
Referral:_____
_____
_____

Name of referring Field Team Leader (FTL)
_____

Signed: _____ Date: _____

MEDICAL REFERRAL FORM

To be used for referral of respondents from the TB Prevalence survey clusters

Respondent's name _____

Referred from _____ (name of the cluster)

Referred to _____(Name of health facility)

Reasons for Referral:_____
_____
_____

Name of referring Field Team Leader (FTL)
_____

Signed: _____ Date: _____