**The *global portfolio model*: costing component**

Sandip Mandal, Srinath Satyanarayana, Carel Pretorius

and the global portfolio model advisory group

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# Overview

This document details the implementation of the costing component of the global portfolio model. This costing model is designed to meet the costing needs of the TB Global Plan 2023-2030, the Global Fund’s Investment Case analysis which is closely aligned with the objectives of the TB Global Plan and with estimating the impact of expected resources for the 2027-2029 replenishment cycle in relation to the resource of the full implementation of the TB Global Plan 2023-2030.

The costing model presented here is structured around algorithms that are tailored for specific population groups. These algorithms are aligned with WHO’s recommendation for appropriate screening, diagnosis, treatment and prevention services for specific population groups.

This costing model was developed in a collaboration between the Global Fund, TBMAC, Avenir Health, and advisory partners including WHO and the Stop TB Partnership (STB). A STB working group provided much of the inputs required to complete the costing model.

This document should be reviewed together with [technical doc for impact model].

# Modelling financial needs at a global level

A bottom-up, ingredients-based approach was used to estimate resource needs. Interventions and services were organized into algorithms and linked to specific target populations. A summary of the approach is given below:

* Algorithms are structured into sections: screening, diagnosis, treatment and prevention.
* Algorithms vary, in one or more of the sections and by at least one variable among: age, pulmonary status, HIV status, MDR status, passive or active TB, etc.
* Approximately 70 interventions are costed as part of these algorithms, each with a unit cost by year (in US$).
* Coverage, population in need (PIN) and intervention quantity settings were made consistent with Global Plan strategy targets.
* Patient in- and out-days were costed directly as part of these algorithms (and not as separate unit cost components).
* Unit cost came directly from Value TB studies, were based on Value TB data, or came from the Global Drug Facility (GDF) in the case of regimen unit costs.
* Value TB data were collected in five countries in roughly 20 facilities per country, and the recommended method was applied for extrapolation (by country and by year).
* WHO financing and expenditure data were used to determine markups (costs above the patient-level) for programme costs.

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For each population-algorithm pair, the resource needs were determined by summing over the algorithms and the underlying services, specifying the factors for each:

**Resource needs(t) = Target population(t) x Population in need(t) x Coverage(t) x Unit cost(t)**, where:

* **All the variables are time-dependent, with t between 2023 and 2030:**
* **Target population:**
  + Interventions are linked to a population meant to receive the intervention or health service. For example, diagnosis with Xpert for bacteriologically positive notified cases.
* **Population in need (PIN):**
  + Specification for a proportion of the population that is eligible for the intervention. For example, a proportion of all notified cases may need patient support.

PIN can also be used to achieve other types of adjustments. For example, a PIN for diagnosis of 4000% by 2030 assumes that 40 people with signs and symptoms of TB will need to be tested to find and notify one case by 2030.

Note that all interventions/services require the specification of a PIN value. May of their values are not directly based on data but are normative as per TB GP specification, for example that all diagnosis must be done with rapid molecular methods.

* **Coverage:** 
  + Coverage targets are specified for 2023 and 2030. For example, diagnosis with Xpert may increase from 40% in the first year of the plan, costed to 100% by 2023.
* **Unit costs as determined by ingredients:** 
  + This will typically comprise the following:
    - tradeable: commodities (e.g., all the commodities needed for a given diagnostic test)
    - non-tradeable: capital costs and overheads
    - staff time, e.g., staff time provided by technicians, doctors, community health workers and other types of staff.
    - outpatient and inpatient days are handled separately.
    - A quantity setting is used to control how many units of cost to apply for a given intervention.

## Unit costs

To estimate unit costs (in US$) for the years 2023–2030, we have used the following methods:

* Data from the Value TB project[[1]](#footnote-1) that have recently been made available for five countries were used, namely, Ethiopia, Georgia, India, Kenya and Philippines. Local currency data for the base year and a inflate/convert methodology[[2]](#footnote-2) were used to arrive at the unit costs for 2023.
* A US$ GDP deflator is used to project unit costs from 2022, after conversion to US$ was done in 2022 for each country and exchange rate.
* The programme cost markup is estimated (as a proportion of direct costs) in the base year of the analysis and is then inflated according to the inflation settings applied to direct costs.
* For the remaining ~157 countries, unit costs were extrapolated from the five Value TB project countries:
  + Georgia was used as a reference for upper-middle-income high TB burden countries.
  + India was used as a reference for lower middle-income high TB burden countries in South Asia.
  + The Philippines was used as a reference for middle-income high TB burden countries in the Western Pacific Region.
  + Kenya was used as a reference for middle-income high TB burden countries in Africa.
  + Ethiopia was used as a reference for lower income high TB burden countries.

To extrapolate the unit costs from the reference country to the target country, an ingredients-based approach was used, as suggested by Sergio et al.[[3]](#footnote-3) Each cost input in the ingredients-costing approach was classified as a tradable good (consumables), non-tradable good (overheads + capital costs) or staff cost. To convert the tradable goods from the reference country (R) to the target country (T), the cost of the tradable good was converted into US$ in the base year. Tradable goods were inflated using US$-based inflation rates or taking the latest price from the GDF Medicines or Diagnostics Catalog.[[4]](#footnote-4),[[5]](#footnote-5) For extrapolating costs of non-tradable goods (NT) from the base country to the target country, the ratio of purchasing power parity[[6]](#footnote-6) was used to obtain the equivalent costs in local currency for the base year, inflated in local currency using local country-specific inflation rates for the target year, and then converted back to US$ using the target year currency conversion rates. To convert staff costs (S) for a particular service from a base country to the second country, the staff time (in minutes) to conduct the activity and the estimated staff cost per minute in the base country were used. Staff time (in minutes) was extrapolated to the target country without any modifications from the base country. For converting the staff cost (per minute), the conversion rates from Serge et al. were used.[[7]](#footnote-7) GDP per capita multipliers and the nominal GDP ratios were used to convert the staff wages per minute from the base country base year to the target country base year; this cost was multiplied by country-specific inflation rates, and the target year staff cost values in the local currency were obtained and then converted to US$ in the target year conversion rates. The total unit cost in the target country for the target year is the sum of T, NT and S.

For the cost of medicines (for TPT) and consumables, the prices in US$ from the latest GDF Diagnostics and Medicines Catalogs were also used. It was estimated that CAD would cost an additional US$ 1 per person (assuming high volumes) undergoing digital chest X-ray.

For all unit cost calculations, the latest country-specific GDP deflation and US$ conversion rates published by the World Bank[[8]](#footnote-8),[[9]](#footnote-9) were used to adjust the inflation and currency conversions from the base year (2022) to the target year (2030).

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## Markups

The programme expenditure data reported to WHO are used to estimate the markup of the cost of direct services (diagnosis, treatment and so on) represented by “programme costs”, or costs above the patient level. Globally, this cost is more than 50%.

* There continues to be a lack of investment in key enabling activities. As with the previous Global Plan, it was recommended by the Global Plan task force to uniformly increase projected budgets to include fixed percentages of specific “enabling” activities, including direct patient support (5%), advocacy & communications (1%), CRG (6%, based on NSP budgets of programmes implementing CRG) and PPM (12%, for countries with a high degree of private-sector involvement).

Detailed budgets of a few countries, such as Democratic Republic of Congo, Georgia, India, Philippines and Tajikistan, judged to be representative in terms of budgeting for enabling activities were used to estimate the size of enabling cost categories.

## List of interventions/services included for costing

The list of interventions is shown in Table 1. Each intervention is shown with its “Method”, which indicates 1) if it is based on the Value TB extrapolation method directly; 2) if its consumables are given, but its non-tradable goods are based on a comparable Value TB unit cost; and 3) if it is specified as a single value or “Lump sum”, such as all the treatment costs from the GDF Catalogs.

Table 1:List of services, their explanation and the source of Unit cost. The rightmost table indicates whether a unit cost is established from Value TB data, derived from value TB data or if it is direct input, such as regimen costs from GDF.

|  |  |  |
| --- | --- | --- |
| **Service/intervention code** | **Explanation** | **Method** |
| **Testing for DS- and DR-TB** |  |  |
| OPD-Scr | screening visit to health facility | Value TB |
| OPD-Dx | diagnostic visit to health facility | Value TB |
| SCT | sputum/specimen collection and transportation | Value TB |
| CXR | chest X-ray | Value TB |
| CAD | computer-aided detection | Input |
| P-CXR | portable-chest X-ray | Input |
| GA | gastric aspiration (for collecting specimens for diagnosis of TB in children <5 years of age) | From Value TB |
| LF-LAM | lateral flow urine lipoarabinomannan assay | Value TB |
| mWRD-1 | molecular WHO-recommended rapid diagnostic test | From Value TB |
| mWRD RR-1 | molecular WHO-recommended rapid diagnostic test for detection of rifampicin resistance | From Value TB |
| mWRD-2 | molecular WHO-recommended rapid diagnostic test for detection of rifampicin resistance | From Value TB |
| mWRD-3 | molecular WHO-recommended rapid diagnostic test for detection of resistance to first- and second-line drugs | From Value TB |
| LC | liquid culture | Value TB |
| CV | community visit | Value TB |
| LPA-FLD | line probe assay for first-line drug | Value TB |
| LPA-SLD | line probe assay for second-line drug | Value TB |
| CRP | c-reactive protein | From Value TB |
| TGS | targeted gene sequencing | Input |
| FNAC | fine needle aspiration cytology | From Value TB |
| CT-scan | computed tomography scan | Value TB |
|  |  |  |
| **Testing for LTBI** |  |  |
| CT visit | contact tracing visit | Value TB |
| TST | tuberculin skin test | Value TB |
| IGRA | interferon-gamma release assay | Value TB |
| TBST | TB antigen-based skin tests (TBSTs) | From Value TB |
| **Treatment monitoring and follow up** |  |  |
| TM | treatment monitoring | Value TB |
| OPD treatment | outpatient department treatment visit | Value TB |
| SSM | sputum smear microscopy | Value TB |
| SSC | sputum culture monthly | Value TB |
| FU-PTT | follow-up post-TB treatment | Value TB |
| FU-TT | follow-up during TB treatment | Value TB |
| LTFU tracing | tracing those who are lost to follow-up | Value TB |
| **Other tests and procedures** |  |  |
| HIV-Dx | HIV diagnostic testing | Value TB |
| DM | diabetes mellitus | Value TB |
| RFT | renal function test | Value TB |
| ECG | electrocardiogram | From Value TB |
| LFT | liver function test | Value TB |
| SGPT | serum glutamic pyruvic transaminase | Value TB |
| SGOT | serum glutamic-oxaloacetic transaminase | Value TB |
| Biopsy | biopsy | From Value TB |
| USG | ultrasonography | Value TB |
| MRI | magnetic resonance imaging | Value TB |
| **Treatment-related** |  |  |
| DOT | directly observed treatment | Value TB |
| DAT | digital adherence technology | Input |
| PSC | patient support costs | Input |
| PC | patient counselling | Value TB |
| BeddayDS | In patient management of Drug sensitive TB | Value TB |
| BeddayMDR | In patient management of Drug resistant TB | Value TB |
| aDSM | active TB drug safety monitoring and management | Value TB |
| AE | adverse event management through IP care | Value TB |
| Surgery | elective partial lung resection (lobectomy or wedge resection) | Input |
| **Children/paediatric: regimens for treating active TB** | |  |
| 2HRZE/4HR (pediatric) | Treatment of Pulmonary TB pediatric six-month TB treatment regimen containing isoniazid, rifampin, pyrazinamide and ethambutol for two months/isoniazid plus rifampin for four months | Input (GDF) |
| 2HRZ/4HR (pediatric) | 6-month TB regimen for children | Input (GDF) |
| 6HRZEto (Pediatric) | In children and adolescents with bacteriologically confirmed or clinically diagnosed TB meningitis (without suspicion or evidence of MDR/RR-TB), a 6-month intensive regimen (ETO= Ethionamide) | Input (GDF) |
| 4-month shorter regimen [2HRZ(E)/2HR] | In children and adolescents between 3 months and 16 years of age with non-severe TB (without suspicion or evidence of MDR/RR-TB), a 4-month treatment regimen (2HRZ(E)/2HR) should be used. | Input (GDF) |
| Hr-TB regimen (pediatric) | paediatric six-month regimen for rifampicin-susceptible and isoniazid-resistant TB. rifampicin, ethambutol, pyrazinamide and levofloxacin | Input (GDF) |
| Short all-oral BDQ regimen (pediatric) | shorter all-oral bedaquiline-containing regimen for MDR-/RR-TB of 9–12 months’ duration | Input (GDF) |
| BPAL (pediatric) | BPAL regimen | Input (GDF) |
| Delamanid-based regimen (pediatric) | pediatric treatment regimen for MDR-TB or XDR-TB containing delamanid | Input (GDF) |
| Longer DR-TB regimens (pediatric) | TB treatment regimen for DR TB, which may last 18-24 months | Input (GDF) |
| **Adults: regimens for treating active TB** | |  |
| 2HRZE/4HR | six-month TB treatment regimen containing isoniazid, rifampin, pyrazinamide and ethambutol for two months/isoniazid plus rifampin for four months | Input (GDF) |
| Four-month RPT-MOX regimen | four-month rifapentine-moxifloxacin regimen for the treatment of DS pulmonary TB | Input (GDF) |
| Hr-TB regimen | six-month regimen for rifampicin-susceptible and isoniazid-resistant TB | Input (GDF) |
| BPaL M | regimen of bedaquiline, pretomanid and linezolid + Moxifloxacin for 6–9 months | Input (GDF) |
| BPaL | regimen of bedaquiline, pretomanid and linezolid for 6–9 months | Input (GDF) |
| Short all-oral BDQ regimen | shorter all-oral bedaquiline-containing regimen for MDR-/RR-TB of 9–12 months’ duration | Input (GDF) |
| Longer DR-TB regimens | TB treatment regimen for DR TB, which may last 18-24 months | Input (GDF) |
| Long regimen for DR-TB, containing delamanid | TB treatment regimen for MDR-/RR-TB containing delamanid, which lasts at least 18 months | Input (GDF) |
| **Adults and children: Post TB treatment** | |  |
| PTLD care | Post TB lung disease care | Input |
| Palliative care | Palliative care |  |
| **TB Preventive treatment** |  |  |
| 3 HR (pediatric) | Prevention, children | Input (GDF) |
| 3 HP (adult) | Prevention, adults | Input (GDF) |
| 6 levofloxacin daily (pediatric) | Preventive treatment of MDR-TB, children | Input (GDF) |
| 6 levofloxacin daily (adults) | Preventive treatment of MDR-TB, adults | Input (GDF) |
| **Vaccine** |  |  |
| Vaccine | TB vaccine | Input |
| **Other** |  |  |
| Social support costs | Social support costs to patients | Input |

# Target population groups

The population groups were classified as either patient initiated (passive case finding) or provider initiated (active/systematic screening).

|  |  |
| --- | --- |
|  | **Group Description** |
| **Patient Initiated groups** |  |
| 1 | Pulmonary TB: HIV-negative, Children aged < 15 years |
| 2 | Pulmonary TB: HIV-negative, Adults 15 years and above |
| 3 | Pulmonary TB: PLHIV not on ART, Children aged 0 to 9 years |
| 4 | Pulmonary TB: PLHIV not on ART, Children aged 10 to 14 years |
| 5 | Pulmonary TB: PLHIV not on ART, Adults aged 15 years and above |
| 6 | Extra-Pulmonary TB: HIV-negative, Children aged < 15 years |
| 7 | Extra-Pulmonary TB: HIV-negative, Adults 15 years and above |
| 8 | Extra-Pulmonary TB: PLHIV not on ART, Children aged 0 to 9 years |
| 9 | Extra-Pulmonary TB: PLHIV on ART, Children aged 10 to 14 years |
| 10 | Extra-Pulmonary TB: PLHIV not on ART, Adults aged 15 years and above |
| **Provider Initiated groups, HH contacts** |  |
| 11 | HH Contacts, Pulmonary TB: HIV-negative, Children aged 0 to 4 years |
| 12 | HH Contacts, Pulmonary TB: HIV-negative, Children aged 5 to 14 years |
| 13 | HH Contacts, Pulmonary TB: HIV-negative, Adults aged 15 years and above |
| **Provider Initiated groups, PLHIV on ART** |  |
| 14 | CLHIV, Pulmonary TB: PLHIV on ART with severe disease, Children aged 0 to 9 years |
| 15 | CLHIV, Pulmonary TB: PLHIV on ART without severe disease, Children aged 0 to 9 years |
| 16 | CLHIV, Pulmonary TB: PLHIV on ART with severe disease, Children aged 10 to 14 years |
| 17 | CLHIV, Pulmonary TB: PLHIV on ART without severe disease, Children aged 10 to 14 years |
| 18 | PLHIV, Pulmonary TB: PLHIV on ART with severe disease, Adults aged 15 years and above |
| 19 | PLHIV, Pulmonary TB: PLHIV on ART without severe disease, Adults aged 15 years and above |
| **Provider initiated high-risk clinical groups (at health facility level)** |  |
| 21 | Persons initiating anti-TNF treatment |
| 22 | Persons receiving dialysis |
| 23 | Persons preparing for an organ or haematological transplant |
| 24 | Persons with Silicosis |
| **Provider Initiated groups, other High-risk groups (at community level)** |  |
| 25 | Prisoners |
| 26 | Miners (exposed to silica dust) |
| 27 | People with risk factors for TB seeking health care (for e.g., diabetes) |
| 28 | Populations with structural risk factors for TB |
| 29 | General population in settings with ≥ 0.5% general prevalence |

# Estimating the size of the target populations

## The Target Population Model

We developed a Target Population (TP) model (technically it is a component of the costing model) to interface between the costing and the impact model, and to ensure a good alignment between impact and cost scenarios.

* The purpose of the TP model is to estimate the various target population needed for costing of ~20 patient population-based algorithms (10 in patient-initiated programs and 10 in provider-initiated programs).
* Most of these target populations are used to cost TB treatment and care cascades, comprising interventions which are designed to meet WHO guidelines and recommendations which are specific to different populations at risk of TB infection and TB disease:
  + Clinical Evaluation and Systematic Screening
  + Diagnosis and DST
  + Appropriate treatment, first line and second line
  + Preventive treatment, either presumptively or following testing for TB infection
* These TP structures are too many for the epidemic & impact model to handle efficiently and doing it in the epidemic impact model would make statistical fitting impossible.
* The TP model was developed to handle these TP calculations, following closely the approach of WHO’s IHT TB model. Essentially it processes the care cascade for each patient population.

To capture the necessary variations in screening and diagnosis, population at risk of TB disease are differentiated according to how they access services, namely patient- or provider-initiated screening, and by properties that influence intervention details such as age, pulmonary and HIV status.

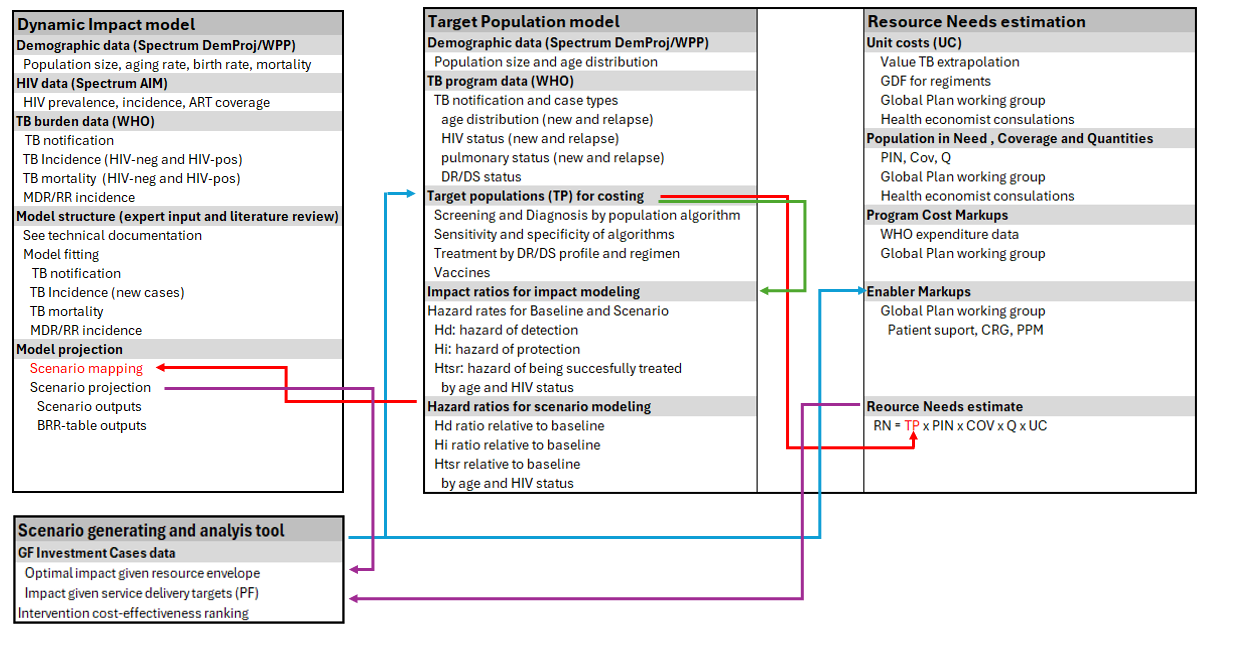
Treatment varies according to age, resistance profile and severity of disease although the number of diagnosed in need of treatment is calculated at the level of the individual population groups. There are also target populations that do not fall within a TB treatment and care cascade, including those needed to cost HIV-TB collaboration and TB vaccination.

## Interaction between the epidemic, target population and costing models

The diagram below (Figure 1) summarizes data sources and other inputs required by each model component.

* The epidemic model is calibrated to WHO TB data, with demographic and HIV data also playing a critical role.
* The Target Population (TP) model processes all population-algorithm details and sends target populations (TPs) to the costing calculation engine for resource needs estimation. It constructs impact ratios that are sent to the epidemic model for impact estimation.
* The costing model combines TPs with inputs for Population in Need (PIN), Coverage (Cov), Quantities (Q) and Unit Costs (UC), with markups for program costs and enablers, to estimate resource of given scenario.
* There is also an ancillary scenario generation and analysis tool which constructs scenarios and coordinates interaction between the target population and costing model. These determine target population construction (for example TB notification inputs) and enabler adjustments for costing (enabler components are linked to scenario details). Outputs from the epidemic and costing model are used in scenario analysis. These details are discussed in more detail in model application documents.

Figure 1: The Target Population model as an interface between the Dynamic Impact and Resource Needs/Costing models



## General structure of the Target Population model

The Target Population calculations are facilitated by a general structure that uses a combination of data or expert inputs (same inputs provided to the TB Global Plan 2023-2030) to define:

* Population size
  + The calculation of populations sizes is straightforward and directly based on inputs for provider-initiate programs:
    - For HH contacts and PLHIV on ART this information is obtained from calculation and from the IHT HIV component respectively
    - For HR groups the user must define population sizes, for example the size of a prison population (as a percentage of the overall 15+ population) or of a displaced population to be screened for TB disease.
    - The calculation of populations sizes patient-initiated programs is detailed below.
* Prevalence estimates for active (for the treatment branch) and latent TB (for the prevention branch)
  + For HH contacts and PLHIV on ART default estimates for the prevalence of active and latent TB are provided.
  + For HR groups the user defines active TB prevalence via a relative risk (RR) variable which expresses TB prevalence in a HR group relative to the general population.
* A screening and clinical assessment algorithms
  + TB Global Plan recommended algorithms are used for screening, as detailed below.
  + Each screening algorithm is associated with an overall (displayed) sensitivity and specificity which are used in the estimation of true and false positives cases referred for diagnoses from the screening step.
* A diagnostic algorithm
  + While the mechanism allows for the specification of the proportion of cases referred for diagnostic evaluation that are evaluated with different methods, e.g., smear microscopy and Xpert, we use the TB Global Plan’s specification of universal molecular tests. The sensitivity and specificity of the methods are again used for estimating the number of true and false positive cases who are diagnosed and linked to treatment.

## Clinical evaluation of target populations in patient-initiated programs

While screening volumes for provider-initiated populations are directly calculated, it must be back-calculated for patient-initiated populations. Meaning, we start with the number of each patient type that is notified and then, based on the selected clinical evaluation algorithm and an assumed prevalence of TB in a patient population, calculate how many people attending a health facility must have been screened to result in the final notified number (which is the result of a notification target setting mechanism).

The first step in this calculation is to estimate the number of notifications of each patient type. This cannot be obtained directly from notification split explained in the previous section because the notifications database from WHO does not indicate the population groups linked to notifications – it reports the total number of notifications only.

Therefore, we remove the provider-initiated groups from the notification split and then call the remaining numbers patient-initiated. This is done according to age and pulmonary status, noting that all provider-initiated notifications are assumed to have pulmonary TB (a simplifying assumption) and that there is no overlap with respect to HIV status since PLHIV not on ART are accounted for in the patient-initiated program while PLHIV on ART are accounted for in the provider-initiated program. This simplification is justified as PLHIV not on ART a) in the age of universal ART will seek care themselves b) this group is declining in size as ART approaches universal coverage.

## Distribution-types of TB patients

Diagnosed patients are then split according to pulmonary status, age and HIV status is obtained from the notification database:

**The proportion of extra-pulmonary TB among notified new and relapse cases:**

c\_ep=(new\_ep+ ret\_ep) / (new\_labconf+new\_clindx+new\_ep + ret\_rel\_labconf +ret\_rel\_clindx + ret\_rel\_ep)

**The proportion of pulmonary TB among new and relapse cases:**

1-c\_ep

**The proportion of notified new and relapse cases in different age groups is given by the fields:**

newrel\_m04+ newrel\_f04, newrel\_m59+ newrel\_f59, newrel\_m1014+ newrel\_f1014+…

The proportion of HIV-positive patients TB among notified new and relapse cases:

**newrel\_hivpos**

The proportion of HIV-positive patients on ART TB among notified new and relapse cases:

**newrel\_art**

This so-called notification split is based on the final year of WHO data, and it is applied to the user-input notification target to obtain projections beyond the final year of WHO data for different patient types. It is used, among other purposes, to identify proportions that receive different screening and diagnostic methods.

## TB Preventative Treatment (TPT)

After the number of patients with a positive diagnostic evaluation in provider-initiated programs is estimated the remaining population is eligible for TP prevention, either:

* Presumptively due to being at very high risk, e.g., child contacts or PLHIV with low CD4 count, or
* Following testing for latent TB infection

Since the patient-initiated model structure does not capture any further detail beyond the size of the screened population (i.e. no assumptions are made about the prevalence of TB infection in these populations). Therefore, there is no TPT modeled in the patient-initiated groups, and we limit TB prevention (TPT) to provider-initiated programs – i.e. HH contacts, PLHIV on ART and HR groups.

The model also currently does not handle sensitivity and specificity of different used for testing for TB infection:

* Tuberculin Skin Test (TST).
* Interferon-Gamma Release Assay (IGRA).
* The proportion of LTBI diagnosis done with each tool is configured to the specifications of the TB Global Plan. The bulk of the tests are done with IGRA.

## Drug resistance testing and treatment

The total number of patients diagnosed and initiated on treatment for TB disease is determined by aggregating patient types over the population variations by age and pulmonary status. The group that a notified patient comes from: patient initiated, household contacts, PLHIV on ART or high-risk groups, plays no role in the selection of appropriate regimen used for treatment.

Regimen volumes recommended for defined patient groups are based on two elements:

* A resistance profile, which amounts to specifying the proportion of patients that are:
  + Rifampicin sensitive
    - Isoniazid sensitive
    - Isoniazid resistant
  + Rifampicin resistant
    - Fluoroquinolone sensitive
    - Fluoroquinolone resistant, Pre-XDR
    - XDR (Pre-XDR and resistant to at least one of Bedaquiline, Linezolid, Levofloacin, Moxifloxacin)
* This resistance profile (see Figure 1) can only be established with full coverage of drug sensitivity testing:
  + Rifampicin or simultaneous Rifampicin and Isoniazid resistance testing among patients with unknown Rifampicin and Isoniazid resistance
  + Isoniazid resistance testing, among Rifampicin sensitive patients
  + Fluoroquinolone resistance testing, among bacteriologically confirmed Rifampicin resistant patients
  + Proportion tested for resistance to Bedaquiline, Linezolid, Levofloxacin, Moxifloxacin (Pre-XDR or XDR)
  + Patients who receive no DST receive default treatment for Rifampicin and Isoniazid sensitive patients.
  + Rifampicin resistant patients receiving no DST for fluoroquinolone resistance receive the same regimen as those with confirmed fluoroquinolone sensitivity.

## Large-scale vaccines

The model estimates the target population for a large-scale vaccine, with 60% efficacy in preventing TB disease, to be rolled out among the population 10 years and older.

The model achieves and then maintains the stated annual coverage of the vaccine in the 10+ population. Once the stated final scale-up level is achieved it is maintained: a) by vaccinating enough individuals to account for the balance between those entering an age category (by aging in) and those leaving it (by aging in or by death) and b) vaccinating

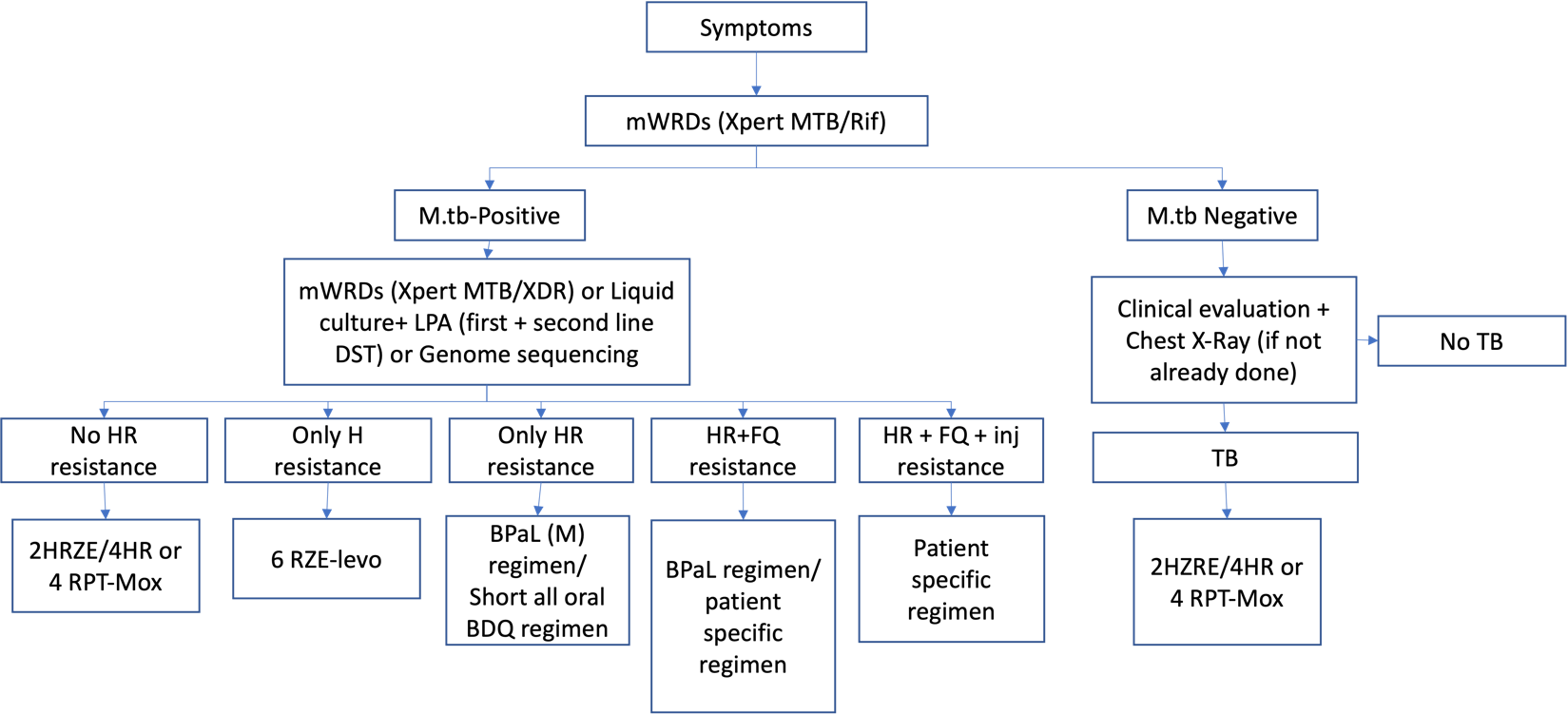
individuals entering the 10-year-old age group.

# Algorithms for patient-initiated programs

**Pulmonary TB**

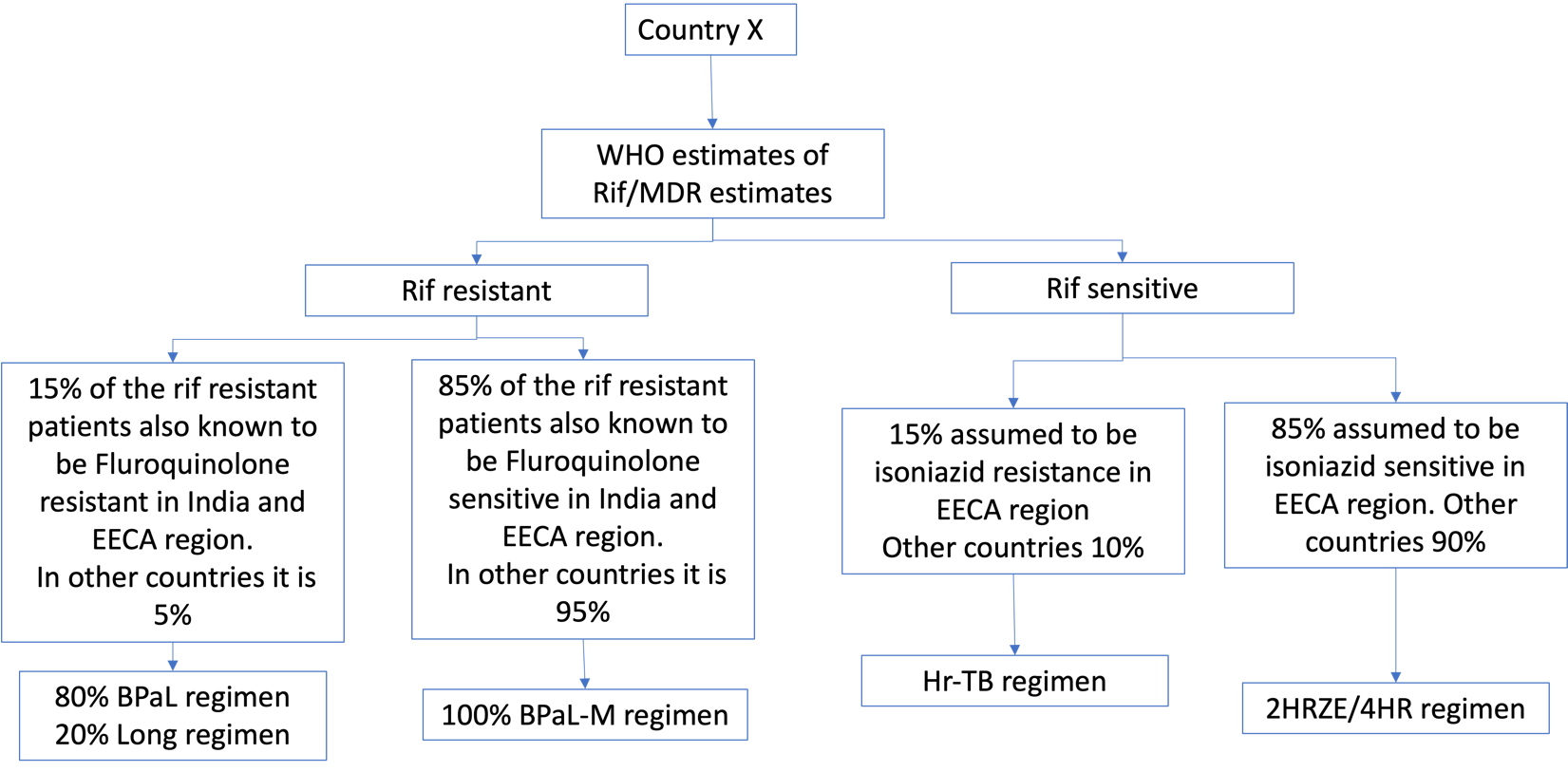
Description: For all persons attending health facilities with TB symptoms, the model assumes that all of them will be offered a WHO recommended molecular rapid diagnostic test. Those who test Mtb positive will be further offered other DR-TB tests such Xpert MTB/XDR test or liquid culture test with first- and second-line DST or targeted genome sequencing test (when it becomes available) to identify the resistance pattern and to assess the choice of anti-TB treatment regimen. Based on the results of the diagnostic tests, patients will be classified into the following five categories. Patients without resistance to HR, patients with H resistance (mono or poly) without resistance to rifampicin, patients with R or HR resistance only, patients with HR+FQ resistance and finally patients with HR+FQ+BDQ or injectable resistance and will be offered TB treatment regimen accordingly.

**Figure 1: Algorithm-1 for diagnosis and treatment of Pulmonary TB in persons presenting with TB symptoms at health facilities (patient initiated)**



The distribution of patients to various TB treatment regimens is based on the following assumptions given in Figure 2

**Figure 2: The methodology for estimating the proportion of TB patients eligible for various TB treatment regimens is as follows. Note that the assumed proportions can be varied by region or country, although for global modeling purpose we expect to use one set of assumed/estimated proportions.**



In any given country, information about the prevalence of RR/ MDR-TB was obtained from the WHO’s Global TB report 2023. All patients with H and R sensitive TB (irrespective of resistance to other drugs) would receive the standard 2HRZE/4 HR TB treatment regimen. In patients with rifampicin sensitive TB, 15% in ECCA region and 10% in other countries were presumed to have Isoniazid mono or poly resistance and, in such patients, Hr-TB regimen will be provided. In those with RR/MDR-TB, 15% of such patients in India and EECA were assumed to be having fluroquinolone resistance and in other countries 5% of the patients were assumed to be having fluroquinolone resistance. 80% of the patients with fluroquinolone resistance would receive BPAL regimen and the remaining would receive longer DR-TB treatment regimen. In those with rifampicin resistant TB without fluroquinolone resistance, 100% of them would receive a BPaL-M regimen.

**Extra-pulmonary TB**

Description: For persons attending health facilities with extra-pulmonary TB symptoms, the model assumes that all of them will be offered a Chest Xray+ CAD, and a certain proportion will be additionally offered one or more of the following: CT-Scan, Ultrasound, FNAC Biopsy. This will be followed by a WHO recommended molecular rapid diagnostic test (Children would additionally receive a gastric lavage and PLHIV would receive a Urine LAM test). Those who test Mtb positive will be further offered other DR-TB tests such Xpert MTB/XDR test or liquid culture test with first- and second-line DST or targeted genome sequencing test (when it becomes available) to identify the resistance pattern and to assess the choice of anti-TB treatment regimen. Those who have a Mtb negative test will undergo clinical evaluation to determine if they have TB. If they have TB, they will receive an anti-TB treatment regimen (mostly drug sensitive anti-TB regimen with a few patients receiving DR-TB treatment regimen).

**Figure 3:** Algorithm for persons attending health facilities with extra-pulmonary TB symptoms.



# Algorithms for provider-initiated programs

**Household contacts/ Contacts and other high risk clinical groups**

**Description:** For household contacts, the model assumes that all of them will be screened for TB symptoms and offered a Chest X-Ray with CAD (CAD for adults aged >15 years). Those who screen positive will be offered a mWRDT such as Xpert MTB/Rif and will follow the evaluation process as discussed for pulmonary (as shown in algorithm 1) and extra-pulmonary TB. In those without TB, TPT will be offered to everyone under the age of 5 years and to those aged > 5 years, TPT will be offered to those who test positive for TB infection (IGRA test).

**Figure 4: Algorithm-2 for TB case detection, assessing TPT eligibility and TPT provision among household contacts and other clinical high-risk groups**

A screenshot of a computer

Description automatically generated with medium confidence

**People living with HIV**

**Description**

* For newly diagnosed with HIV, the model assumes that they would undergo screening for TB disease at the time of diagnosis. The screening methods includes 4 symptom screening along with a test for C-Reactive protein.
* For PLHIV who are already on ART, the model assumes that they would undergo systematic screening for TB disease once every year. The screening methods includes 4 symptom screening along with a Chest Radiography with CAD.
* Those who screen positive will be evaluated for pulmonary and extra-pulmonary TB disease using a combination of Urine LF-LAM test and mWRDT (Xpert MTB/Rif test) and will be treated for TB (if diagnosed). Newly diagnosed PLHIV without TB disease will be initiated on TPT.

**Figure 5: Algorithm-3 for systematic screening of PLHIV on ART for TB disease. Practically, screening and diagnosis for PLHIV not on ART is treated in the patient-initiated program, partly to avoid overlap between patient and provider-initiated programs with respect to PLHIV.**

Graphical user interface, application, Teams

Description automatically generated

**Systematic screening in general population groups (at the community level)**

* Algorithm for systematic screening for TB (Figure 6)

Description: All persons in the high-risk groups will be offered symptom screening and Chest X-Ray with CAD. Those who screen positive to either of the two screening methods will be offered mWRDs (Xpert MTB/Rif) test.

**Figure 6: Algorithm-5 for systematic screening of high-risk groups for TB**

Graphical user interface

Description automatically generated

# Quantity and Population in Need (PIN) of screening and diagnostic interventions/service

1. **For diagnosis: Patient-initiated Pulmonary TB among children aged <15 years, the following services, quantities and population in-need (PIN) are included for costing.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Intervention/service** | **Quantity** | Pulmonary TB: HIV-negative, Children aged < 15 years (PIN) | Pulmonary TB: PLHIV not on ART, Children aged 0 to 9 years (PIN) | Pulmonary TB: PLHIV not on ART, Children aged 10 to 14 years (PIN) |
| **Screening and Diagnosis** |  |  |  |  |
| screening visit to health facility | 1 | 100% | 100% | 100% |
| diagnostic visit to health facility | 1 | 100% | 100% | 100% |
| sputum/specimen collection and transportation | 1 | 40% | 40% | 40% |
| chest X-ray | 1 | 90% | 90% | 90% |
| computer-aided detection | 1 | 90% | 90% | 90% |
| portable-chest X-ray | 1 | 0% | 0% | 0% |
| sputum smear microscopy | 1 | 100% | 100% | 100% |
| gastric aspiration (for collecting specimens for diagnosis of TB in children) | 1 | 30% | 50% | 0% |
| lateral flow urine lipoarabinomannan assay | 1 | 0% | 20% | 20% |
| molecular WHO-recommended rapid diagnostic test | 1 | 40% | 40% | 40% |
| molecular WHO-recommended rapid diagnostic test for detection of rifampicin resistance | 1 | 40% | 40% | 40% |
| molecular WHO-recommended rapid diagnostic test for detection of rifampicin resistance | 1 | 60% | 60% | 60% |
| molecular WHO-recommended rapid diagnostic test for detection of resistance to first and second-line drugs | 1 | 100% | 100% | 100% |
| liquid culture | 1 | 100% | 100% | 100% |
| community visit | 1 | 0% | 0% | 0% |
| line probe assay for first-line drug | 1 | 5% | 5% | 5% |
| line probe assay for second-line drug | 1 | 5% | 5% | 5% |
| c-reactive protein | 1 | 0% | 15% | 15% |
| targeted gene sequencing | 1 | 0% | 0% | 0% |
| fine needle aspiration cytology | 1 | 0% | 0% | 0% |
| computed tomography scan | 1 | 0% | 0% | 0% |
| contact tracing visit | 1 | 0% | 0% | 0% |
| tuberculin skin test | 1 | 0% | 0% | 0% |
| interferon-gamma release assay | 1 | 0% | 0% | 0% |
| TB antigen-based skin tests (TBSTs) | 1 | 0% | 0% | 0% |
| biopsy | 1 | 0% | 0% | 0% |
| ultrasonography | 1 | 0% | 0% | 0% |
| magnetic resonance imaging | 1 | 0% | 0% | 0% |

1. **For diagnosis: Patient-initiated extra-pulmonary among children aged <15 years, the following services, quantities and population in-need (PIN) are included for costing.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Intervention** | **Quantity** | Extra-Pulmonary TB: HIV-negative, Children aged < 15 years (PIN) | Extra-Pulmonary TB: PLHIV not on ART, Children aged 0 to 9 years (PIN | Extra-Pulmonary TB: PLHIV on ART, Children aged 10 to 14 years (PIN) |
| **Screening and Diagnosis** |  |  |  |  |
| screening visit to health facility | 1 | 100% | 100% | 100% |
| diagnostic visit to health facility | 1 | 100% | 100% | 100% |
| sputum/specimen collection and transportation | 1 | 50% | 50% | 50% |
| chest X-ray | 1 | 100% | 100% | 100% |
| computer-aided detection | 1 | 100% | 100% | 100% |
| portable-chest X-ray | 1 | 0% | 0% | 0% |
| sputum smear microscopy | 1 | 100% | 100% | 100% |
| gastric aspiration (for collecting specimens for diagnosis of TB in children) | 1 | 30% | 50% | 0% |
| lateral flow urine lipoarabinomannan assay | 1 | 0% | 20% | 20% |
| molecular WHO-recommended rapid diagnostic test | 1 | 40% | 40% | 40% |
| molecular WHO-recommended rapid diagnostic test for detection of rifampicin resistance | 1 | 40% | 40% | 40% |
| molecular WHO-recommended rapid diagnostic test for detection of rifampicin resistance | 1 | 60% | 60% | 60% |
| molecular WHO-recommended rapid diagnostic test for detection of resistance to first and second-line drugs | 1 | 100% | 100% | 100% |
| liquid culture | 1 | 100% | 100% | 100% |
| community visit | 1 | 0% | 0% | 0% |
| line probe assay for first-line drug | 1 | 5% | 5% | 5% |
| line probe assay for second-line drug | 1 | 5% | 5% | 5% |
| c-reactive protein | 1 | 0% | 15% | 15% |
| targeted gene sequencing | 1 | 0% | 0% | 0% |
| fine needle aspiration cytology | 1 | 60% | 60% | 60% |
| computed tomography scan | 1 | 20% | 20% | 20% |
| contact tracing visit | 1 | 0% | 0% | 0% |
| tuberculin skin test | 1 | 0% | 0% | 0% |
| interferon-gamma release assay | 1 | 0% | 0% | 0% |
| TB antigen-based skin tests (TBSTs) | 1 | 0% | 0% | 0% |
| biopsy | 1 | 60% | 60% | 60% |
| ultrasonography | 1 | 50% | 50% | 50% |
| magnetic resonance imaging | 1 | 20% | 20% | 20% |

1. **For diagnosis: Patient-initiated, Pulmonary adults (age >15 years)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Intervention** | **Quantity** | Pulmonary TB: HIV-negative, Adults 15 years and above (PIN) | Pulmonary TB: PLHIV not on ART, Adults aged 15 years and above (PIN) |
| **Screening and Diagnosis** |  |  |  |
| screening visit to health facility | 1 | 100% | 100% |
| diagnostic visit to health facility | 1 | 100% | 100% |
| sputum/specimen collection and transportation | 1 | 40% | 40% |
| chest X-ray | 1 | 90% | 20% |
| computer-aided detection | 1 | 90% | 20% |
| portable-chest X-ray | 1 | 0% | 0% |
| sputum smear microscopy | 1 | 100% | 100% |
| gastric aspiration (for collecting specimens for diagnosis of TB in children) | 1 | 0% | 0% |
| lateral flow urine lipoarabinomannan assay | 1 | 0% | 20% |
| molecular WHO-recommended rapid diagnostic test | 1 | 40% | 40% |
| molecular WHO-recommended rapid diagnostic test for detection of rifampicin resistance | 1 | 40% | 40% |
| molecular WHO-recommended rapid diagnostic test for detection of rifampicin resistance | 1 | 60% | 60% |
| molecular WHO-recommended rapid diagnostic test for detection of resistance to first and second-line drugs | 1 | 100% | 100% |
| liquid culture | 1 | 100% | 100% |
| community visit | 1 | 0% | 0% |
| line probe assay for first-line drug | 1 | 5% | 5% |
| line probe assay for second-line drug | 1 | 5% | 5% |
| c-reactive protein | 1 | 0% | 15% |
| targeted gene sequencing | 1 | 0% | 0% |
| fine needle aspiration cytology | 1 | 0% | 0% |
| computed tomography scan | 1 | 0% | 0% |
| contact tracing visit | 1 | 0% | 0% |
| tuberculin skin test | 1 | 0% | 0% |
| interferon-gamma release assay | 1 | 0% | 0% |
| TB antigen-based skin tests (TBSTs) | 1 | 0% | 0% |
| biopsy | 1 | 0% | 0% |
| ultrasonography | 1 | 0% | 0% |
| magnetic resonance imaging | 1 | 0% | 0% |

1. **For diagnosis: Patient-initiated extra-pulmonary (age>15 years)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Intervention** | **Quantity** | Extra-Pulmonary TB: HIV-negative, Adults 15 years and above (PIN) | Extra-Pulmonary TB: PLHIV not on ART, Adults aged 15 years and above (PIN) |
| **Screening and Diagnosis** |  |  |  |
| screening visit to health facility | 1 | 100% | 100% |
| diagnostic visit to health facility | 1 | 100% | 100% |
| sputum/specimen collection and transportation | 1 | 50% | 50% |
| chest X-ray | 1 | 100% | 50% |
| computer-aided detection | 1 | 100% | 50% |
| portable-chest X-ray | 1 | 0% | 0% |
| sputum smear microscopy | 1 | 100% | 100% |
| gastric aspiration (for collecting specimens for diagnosis of TB in children) | 1 | 0% | 0% |
| lateral flow urine lipoarabinomannan assay | 1 | 0% | 20% |
| molecular WHO-recommended rapid diagnostic test | 1 | 40% | 40% |
| molecular WHO-recommended rapid diagnostic test for detection of rifampicin resistance | 1 | 40% | 40% |
| molecular WHO-recommended rapid diagnostic test for detection of rifampicin resistance | 1 | 60% | 60% |
| molecular WHO-recommended rapid diagnostic test for detection of resistance to first and second-line drugs | 1 | 100% | 100% |
| liquid culture | 1 | 100% | 100% |
| community visit | 1 | 0% | 0% |
| line probe assay for first-line drug | 1 | 5% | 5% |
| line probe assay for second-line drug | 1 | 5% | 5% |
| c-reactive protein | 1 | 0% | 15% |
| targeted gene sequencing | 1 | 0% | 0% |
| fine needle aspiration cytology | 1 | 60% | 60% |
| computed tomography scan | 1 | 20% | 20% |
| contact tracing visit | 1 | 0% | 0% |
| tuberculin skin test | 1 | 0% | 0% |
| interferon-gamma release assay | 1 | 0% | 0% |
| TB antigen-based skin tests (TBSTs) | 1 | 0% | 0% |
| biopsy | 1 | 60% | 60% |
| ultrasonography | 1 | 50% | 50% |
| magnetic resonance imaging | 1 | 20% | 20% |

1. **For diagnosis: Provider-initiated, Household contacts**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Intervention** | **Quantity** | HH Contacts, Pulmonary TB: HIV-negative, Children aged 0 to 4 years (PIN) | HH Contacts, Pulmonary TB: HIV-negative, Children aged 5 to 14 years (PIN) | HH Contacts, Pulmonary TB: HIV-negative, Children aged 15 years and above (PIN) |
| **Screening and Diagnosis** |  |  |  |  |
| screening visit to health facility | 1 | 100% | 100% | 100% |
| diagnostic visit to health facility | 1 | 10% | 10% | 5% |
| sputum/specimen collection and transportation | 1 | 75% | 75% | 10% |
| chest X-ray | 1 | 90% | 90% | 90% |
| computer-aided detection | 1 | 90% | 90% | 90% |
| portable-chest X-ray | 1 | 0% | 0% | 0% |
| sputum smear microscopy | 1 | 100% | 100% | 100% |
| gastric aspiration (for collecting specimens for diagnosis of TB in children) | 1 | 40% | 0% | 0% |
| lateral flow urine lipoarabinomannan assay | 1 | 0% | 0% | 0% |
| molecular WHO-recommended rapid diagnostic test | 1 | 40% | 40% | 40% |
| molecular WHO-recommended rapid diagnostic test for detection of rifampicin resistance | 1 | 40% | 40% | 40% |
| molecular WHO-recommended rapid diagnostic test for detection of rifampicin resistance | 1 | 60% | 60% | 60% |
| molecular WHO-recommended rapid diagnostic test for detection of resistance to first- and second-line drugs | 1 | 100% | 100% | 100% |
| liquid culture | 1 | 100% | 100% | 100% |
| community visit | 1 | 0% | 0% | 0% |
| line probe assay for first-line drug | 1 | 5% | 5% | 5% |
| line probe assay for second-line drug | 1 | 5% | 5% | 5% |
| c-reactive protein | 1 | 0% | 0% | 0% |
| targeted gene sequencing | 1 | 0% | 0% | 0% |
| fine needle aspiration cytology | 1 | 15% | 15% | 5% |
| computed tomography scan | 1 | 5% | 5% | 1% |
| contact tracing visit | 1 | 100% | 100% | 100% |
| tuberculin skin test | 1 | 0% | 10% | 10% |
| interferon-gamma release assay | 1 | 0% | 90% | 90% |
| TB antigen-based skin tests (TBSTs) | 1 | 0% | 0% | 0% |
| biopsy | 1 | 15% | 15% | 5% |
| ultrasonography | 1 | 15% | 15% | 1% |
| magnetic resonance imaging | 1 | 2% | 2% | 0% |

1. **For diagnosis: Provider-initiated, CLHIV**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Intervention** | **Quantity** | CLHIV, Pulmonary TB: PLHIV on ART with severe disease, Children aged 0 to 9 years (PIN) | CLHIV, Pulmonary TB: PLHIV on ART without severe disease, Children aged 0 to 9 years (PIN) | CLHIV, Pulmonary TB: PLHIV on ART with severe disease, Children aged 10 to 14 years (PIN) | CLHIV, Pulmonary TB: PLHIV on ART without severe disease, Children aged 10 to 14 years (PIN) |
| **Screening and Diagnosis** |  |  |  |  |  |
| screening visit to health facility | 1 | 100% | 100% | 100% | 100% |
| diagnostic visit to health facility | 1 | 40% | 40% | 40% | 40% |
| sputum/specimen collection and transportation | 1 | 50% | 20% | 50% | 20% |
| chest X-ray | 1 | 90% | 90% | 90% | 90% |
| computer-aided detection | 1 | 90% | 100% | 90% | 100% |
| portable-chest X-ray | 1 | 0% | 0% | 0% | 0% |
| sputum smear microscopy | 1 | 100% | 100% | 100% | 100% |
| gastric aspiration (for collecting specimens for diagnosis of TB in children) | 1 | 50% | 40% | 0% | 0% |
| lateral flow urine lipoarabinomannan assay | 1 | 20% | 20% | 20% | 20% |
| molecular WHO-recommended rapid diagnostic test | 1 | 40% | 40% | 40% | 40% |
| molecular WHO-recommended rapid diagnostic test for detection of rifampicin resistance | 1 | 40% | 40% | 40% | 40% |
| molecular WHO-recommended rapid diagnostic test for detection of rifampicin resistance | 1 | 60% | 60% | 60% | 60% |
| molecular WHO-recommended rapid diagnostic test for detection of resistance to first and second-line drugs | 1 | 100% | 100% | 100% | 100% |
| liquid culture | 1 | 100% | 100% | 100% | 100% |
| community visit | 1 | 0% | 0% | 0% | 0% |
| line probe assay for first-line drug | 1 | 5% | 5% | 5% | 5% |
| line probe assay for second-line drug | 1 | 5% | 5% | 5% | 5% |
| c-reactive protein | 1 | 15% | 15% | 15% | 15% |
| targeted gene sequencing | 1 | 0% | 0% | 0% | 0% |
| fine needle aspiration cytology | 1 | 40% | 10% | 40% | 10% |
| computed tomography scan | 1 | 10% | 1% | 10% | 1% |
| contact tracing visit | 1 | 0% | 0% | 0% | 0% |
| tuberculin skin test | 1 | 0% | 0% | 0% | 0% |
| interferon-gamma release assay | 1 | 0% | 0% | 0% | 0% |
| TB antigen-based skin tests (TBSTs) | 1 | 0% | 0% | 0% | 0% |
| biopsy | 1 | 40% | 10% | 40% | 10% |
| ultrasonography | 1 | 40% | 10% | 40% | 10% |
| magnetic resonance imaging | 1 | 5% | 1% | 5% | 1% |

1. **For diagnosis: Provider-initiated, PLHIV adults >15 years**

|  |  |  |  |
| --- | --- | --- | --- |
| **Intervention** | **Quantity** | PLHIV, Pulmonary TB: PLHIV on ART with severe disease, Adults aged 15 years and above (PIN) | PLHIV, Pulmonary TB: PLHIV on ART without severe disease, Adults aged 15 years and above (PIN) |
| **Screening and Diagnosis** |  |  |  |
| screening visit to health facility | 1 | 100% | 100% |
| diagnostic visit to health facility | 1 | 100% | 40% |
| sputum/specimen collection and transportation | 1 | 20% | 20% |
| chest X-ray | 1 | 90% | 90% |
| computer-aided detection | 1 | 90% | 90% |
| portable-chest X-ray | 1 | 0% | 0% |
| sputum smear microscopy | 1 | 100% | 100% |
| gastric aspiration (for collecting specimens for diagnosis of TB in children) | 1 | 0% | 0% |
| lateral flow urine lipoarabinomannan assay | 1 | 20% | 20% |
| molecular WHO-recommended rapid diagnostic test | 1 | 40% | 40% |
| molecular WHO-recommended rapid diagnostic test for detection of rifampicin resistance | 1 | 40% | 40% |
| molecular WHO-recommended rapid diagnostic test for detection of rifampicin resistance | 1 | 60% | 60% |
| molecular WHO-recommended rapid diagnostic test for detection of resistance to first and second line drugs | 1 | 100% | 100% |
| liquid culture | 1 | 100% | 100% |
| community visit | 1 | 0% | 0% |
| line probe assay for first-line drug | 1 | 5% | 5% |
| line probe assay for second-line drug | 1 | 5% | 5% |
| c-reactive protein | 1 | 15% | 15% |
| targeted gene sequencing | 1 | 0% | 0% |
| fine needle aspiration cytology | 1 | 25% | 10% |
| computed tomography scan | 1 | 25% | 5% |
| contact tracing visit | 1 | 0% | 0% |
| tuberculin skin test | 1 | 0% | 0% |
| interferon-gamma release assay | 1 | 0% | 0% |
| TB antigen-based skin tests (TBSTs) | 1 | 0% | 0% |
| biopsy | 1 | 10% | 10% |
| ultrasonography | 1 | 25% | 10% |
| magnetic resonance imaging | 1 | 10% | 0% |

1. **For diagnosis: Provider-initiated, high-risk groups**

|  |  |  |
| --- | --- | --- |
| **Intervention** | **Quantity** | HR groups, Pulmonary TB: HIV-negative, Adults aged 15 years and above (PIN) |
| **Screening and Diagnosis** |  |  |
| screening visit to health facility | 1 | 100.0% |
| diagnostic visit to health facility | 1 | 5.0% |
| sputum/specimen collection and transportation | 1 | 2.5% |
| chest X-ray | 1 | 0.0% |
| computer-aided detection | 1 | 90.0% |
| portable-chest X-ray | 1 | 90.0% |
| sputum smear microscopy | 1 | 100.0% |
| gastric aspiration (for collecting specimens for diagnosis of TB in children) | 1 | 0.0% |
| lateral flow urine lipoarabinomannan assay | 1 | 0.0% |
| molecular WHO-recommended rapid diagnostic test | 1 | 40.0% |
| molecular WHO-recommended rapid diagnostic test for detection of rifampicin resistance | 1 | 40.0% |
| molecular WHO-recommended rapid diagnostic test for detection of rifampicin resistance | 1 | 60.0% |
| molecular WHO-recommended rapid diagnostic test for detection of resistance to first and second-line drugs | 1 | 100.0% |
| liquid culture | 1 | 100.0% |
| community visit | 1 | 100.0% |
| line probe assay for first-line drug | 1 | 5.0% |
| line probe assay for second-line drug | 1 | 5.0% |
| c-reactive protein | 1 | 0.0% |
| targeted gene sequencing | 1 | 0.0% |
| fine needle aspiration cytology | 1 | 0.0% |
| computed tomography scan | 1 | 0.0% |
| contact tracing visit | 1 | 0.0% |
| tuberculin skin test | 1 | 10.0% |
| interferon-gamma release assay | 1 | 90.0% |
| TB antigen-based skin tests (TBSTs) | 1 | 0.0% |
| biopsy | 1 | 0.0% |
| ultrasonography | 1 | 0.0% |
| magnetic resonance imaging | 1 | 0.0% |

# Quantity and Population in Need (PIN) of treatment interventions/service

1. **Pediatric TB treatment: Interventions/services (quantities, in accordance with WHO guidelines)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Intervention/services** | **2HRZE/**  **4HR** | **6HRZEto** | **4-month shorter regimen [2HRZ(E)/2HR]** | **Regimen for Isoniazid resistant TB (Hr-TB )** | **BPaL M** | **Short all-oral BDQ** | **BPAL** | **Delamanid-based regimen longer regimen** |
| patient counselling | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| treatment monitoring | 6 | 6 | 4 | 6 | 6 | 9 | 6 | 18 |
| outpatient department treatment visit | 3 | 6 | 2 | 3 | 6 | 9 | 6 | 18 |
| In patient management of Drug sensitive TB | 5 | 10 | 5 | 0 | 0 | 0 | 0 | 0 |
| In patient management of Drug-resistant TB | 0 | 0 | 0 | 5 | 5 | 5 | 5 | 10 |
| directly observed treatment | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| digital adherence technology | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| gastric aspiration (for collecting specimens for diagnosis of TB in children) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| sputum smear microscopy | 2 | 2 | 2 | 2 | 6 | 9 | 6 | 18 |
| sputum culture monthly | 0 | 0 | 0 | 1 | 6 | 9 | 6 | 18 |
| electrocardiogram | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 4 |
| liver function test | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4 |
| diabetes mellitus | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| renal function test | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 4 |
| serum glutamic pyruvic transaminase | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 6 |
| serum glutamic-oxaloacetic transaminase | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 6 |
| ultrasonography | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| contact tracing visit | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| magnetic resonance imaging | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| tracing those who are lost to follow-up | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| patient support costs | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| active TB drug safety monitoring and management | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| adverse event management through IP care | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| elective partial lung resection (lobectomy or wedge resection) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| follow-up post-TB treatment | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 |
| Post TB lung disease care | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Palliative care | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

1. **Pediatric TB treatment: Interventions/services (PINs)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Intervention** | **2HRZE/**  **4HR** | **6HRZEto** | **4-month shorter regimen [2HRZ(E)/2HR]** | **Regimen for Isoniazid resistant TB (Hr-TB )** | **BPaL M** | **Short all-oral BDQ** | **BPAL** | **Delamanid-based regimen longer regimen** |
| patient counselling | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| treatment monitoring | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| outpatient department treatment visit | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| In patient management of Drug sensitive TB | 20% | 100% | 5% | 0% | 0% | 0% | 0% | 0% |
| In patient management of Drug-resistant TB | 0% | 0% | 0% | 20% | 20% | 20% | 20% | 50% |
| directly observed treatment | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| digital adherence technology | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| gastric aspiration (for collecting specimens for diagnosis of TB in children) | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| sputum smear microscopy | 95% | 95% | 95% | 95% | 95% | 95% | 95% | 95% |
| sputum culture monthly | 0% | 0% | 0% | 0% | 95% | 95% | 95% | 95% |
| electrocardiogram | 0% | 0% | 0% | 0% | 100% | 100% | 100% | 100% |
| liver function test | 10% | 10% | 10% | 100% | 100% | 100% | 100% | 100% |
| diabetes mellitus | 10% | 100% | 10% | 10% | 100% | 100% | 100% | 100% |
| renal function test | 10% | 100% | 10% | 10% | 100% | 100% | 100% | 100% |
| serum glutamic pyruvic transaminase | 10% | 100% | 10% | 10% | 20% | 20% | 20% | 100% |
| serum glutamic-oxaloacetic transaminase | 10% | 100% | 10% | 10% | 20% | 20% | 20% | 100% |
| ultrasonography | 20% | 100% | 0% | 20% | 20% | 20% | 20% | 100% |
| contact tracing visit | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| magnetic resonance imaging | 5% | 100% | 0% | 10% | 10% | 10% | 10% | 10% |
| tracing those who are lost to follow-up | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| patient support costs | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| active TB drug safety monitoring and management | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| adverse event management through IP care | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 10% |
| elective partial lung resection (lobectomy or wedge resection) | 1% | 0% | 0% | 0% | 5% | 5% | 5% | 50% |
| follow-up post-TB treatment | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% |
| Post TB lung disease care | 10% | 50% | 0% | 10% | 20% | 20% | 20% | 50% |
| Palliative care | 5% | 50% | 5% | 10% | 50% | 50% | 50% | 100% |

1. **Adult TB treatment: Interventions/services (quantities)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Intervention** | **2HRZE/**  **4HR** | **Four-month RPT-MOX regimen** | **Hr-TB regimen** | **BPaL M** | **Short all-oral BDQ regimen** | **BPaL** | **Long regimen for DR-TB, containing delamanid** |
| patient counselling | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| treatment monitoring | 6.0 | 4.0 | 6.0 | 6.0 | 9.0 | 6.0 | 18.0 |
| outpatient department treatment visit | 3.0 | 2.0 | 3.0 | 6.0 | 9.0 | 6.0 | 18.0 |
| In patient management of Drug sensitive TB | 5.0 | 5.0 | 5.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| In patient management of Drug-resistant TB | 0.0 | 0.0 | 0.0 | 5.0 | 5.0 | 5.0 | 10.0 |
| directly observed treatment | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| digital adherence technology | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| gastric aspiration (for collecting specimens for diagnosis of TB in children) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| sputum smear microscopy | 2.0 | 2.0 | 2.0 | 6.0 | 9.0 | 6.0 | 18.0 |
| sputum culture monthly | 0.0 | 0.0 | 0.0 | 6.0 | 9.0 | 6.0 | 18.0 |
| electrocardiogram | 1.0 | 1.0 | 1.0 | 3.0 | 3.0 | 3.0 | 4 |
| liver function test | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 4 |
| diabetes mellitus | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1 |
| renal function test | 1.0 | 1.0 | 1.0 | 2.0 | 2.0 | 2.0 | 4 |
| serum glutamic pyruvic transaminase | 1.0 | 1.0 | 1.0 | 2.0 | 2.0 | 2.0 | 6 |
| serum glutamic-oxaloacetic transaminase | 1.0 | 1.0 | 1.0 | 2.0 | 2.0 | 2.0 | 6 |
| ultrasonography | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| contact tracing visit | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| magnetic resonance imaging | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| tracing those who are lost to follow-up | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| patient support costs | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| active TB drug safety monitoring and management | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| adverse event management through IP care | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| elective partial lung resection (lobectomy or wedge resection) | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| follow-up post-TB treatment | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Post TB lung disease care | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Palliative care | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |

1. **Adult TB treatment: Interventions/services (PINs)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Intervention** | **2HRZE/**  **4HR** | **Four-month RPT-MOX regimen** | **Hr-TB regimen** | **BPaL M** | **Short all-oral BDQ regimen** | **BPaL** | **Long regimen for DR-TB, containing delamanid** |
| patient counselling | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| treatment monitoring | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| outpatient department treatment visit | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| In patient management of Drug sensitive TB | 20% | 20% | 20% | 0% | 0% | 0% | 0% |
| In patient management of Drug resistant TB | 0% | 0% | 0% | 20% | 20% | 20% | 50% |
| directly observed treatment | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| digital adherence technology | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| gastric aspiration (for collecting specimens for diagnosis of TB in children) | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| sputum smear microscopy | 95% | 95% | 95% | 95% | 95% | 95% | 95% |
| sputum culture monthly | 0% | 0% | 0% | 95% | 95% | 95% | 95% |
| electrocardiogram | 0% | 0% | 0% | 100% | 100% | 100% | 100% |
| liver function test | 10% | 10% | 10% | 100% | 100% | 100% | 100% |
| diabetes mellitus | 1% | 10% | 10% | 100% | 100% | 100% | 100% |
| renal function test | 10% | 10% | 100% | 100% | 100% | 100% | 100% |
| serum glutamic pyruvic transaminase | 10% | 10% | 10% | 20% | 20% | 20% | 100% |
| serum glutamic-oxaloacetic transaminase | 10% | 10% | 10% | 20% | 20% | 20% | 100% |
| ultrasonography | 20% | 20% | 20% | 20% | 20% | 20% | 100% |
| contact tracing visit | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| magnetic resonance imaging | 5% | 0% | 10% | 10% | 10% | 10% | 10% |
| tracing those who are lost to follow-up | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| patient support costs | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| active TB drug safety monitoring and management | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| adverse event management through IP care | 5% | 5% | 5% | 5% | 5% | 5% | 10% |
| elective partial lung resection (lobectomy or wedge resection) | 1% | 0% | 0% | 5% | 5% | 5% | 50% |
| follow-up post-TB treatment | 90% | 90% | 90% | 90% | 90% | 90% | 90% |
| Post TB lung disease care | 10% | 0% | 10% | 20% | 20% | 20% | 50% |
| Palliative care | 5% | 50% | 5% | 10% | 50% | 50% | 50% |

# Quantity and Population in Need (PIN) of prevention interventions/service

1. **TB preventive treatment related interventions/services (quantities)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Intervention /service** | **DS: 3 HR (pediatric)** | **DS:3 HP (adult)** | **DR: 6 levofloxacin daily (pediatric)** | **DR: 6 levofloxacin daily (adult)** |
| patient support costs | 1 | 1 | 1 | 1 |
| directly observed treatment | 1 | 1 | 1 | 1 |
| liver function test | 1 | 1 | 1 | 1 |
| serum glutamic pyruvic transaminase | 1 | 1 | 1 | 1 |
| patient counselling | 1 | 1 | 1 | 1 |
| In patient management of Drug sensitive TB | 1 | 1 | 1 | 1 |
| contact tracing visit | 1 | 1 | 1 | 1 |
| patient support costs | 1 | 1 | 1 | 1 |

1. **TPT related interventions/services (PINs)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Intervention abbreviation** | **DS: 3 HR (paediatric)** | **DS:3 HP (adult)** | **DR: 6 levofloxacin daily (paediatric)** | **DR: 6 levofloxacin daily (adult)** |
| patient support costs | 0% | 0% | 0% | 0% |
| directly observed treatment | 10% | 10% | 10% | 10% |
| liver function test | 5% | 5% | 5% | 5% |
| serum glutamic pyruvic transaminase | 5% | 5% | 5% | 5% |
| patient counselling | 1% | 1% | 1% | 1% |
| In patient management of Drug sensitive TB | 1% | 1% | 1% | 1% |
| contact tracing visit | 0% | 0% | 0% | 0% |

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