World Health Organization

Task Force on definitions, criteria and indicators for interruption of transmission and elimination of leprosy

Report of the final meeting

Chengalpattu, India, 24-26 March 2021

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1. Introduction

Addressing the leprosy burden is passing through different stages in different countries. Most countries have eliminated leprosy as a public health problem; several have already achieved interruption of transmission, while others are progressing to this. Some other countries have already eliminated the disease, i.e. they were formerly endemic.

Encouraged by having achieved the milestone of elimination as a public health problem, countries would like to move to next phases: interruption of transmission and absence of disease. Annual leprosy statistics submitted by countries indicate that several countries have consistently reported zero new cases of leprosy in recent years.

The number of countries with zero new autochthonous leprosy cases (target: 120 by 2030) is one of the indicators of the Road map for Neglected Tropical Diseases and Global Leprosy Strategy 2021–2030. This achievement will need to be ascertained, which may include the submission of a dossier and/or independent review. Following an informal consultation on the same subject, held in Mexico in February 2020, a Task Force on definitions, criteria and indicators for interruption of transmission and elimination of leprosy (TFCEL) was set up to draft definitions for concepts concerning interruption of transmission and elimination of leprosy as a disease with criteria and milestones for assessment. The Task force met virtually on a monthly basis.

The final meeting of TFCEL was held as a blended meeting, i.e. a day-time face-to-face with TFCEL members and additional experts based in India; and virtual sessions in the evening with TFCEL members based elsewhere. This meeting was held at the Central Leprosy Teaching and Research Institute (CLTRI), Chengalpattu, India from 24 to 26 March 2021. The purpose of the meeting was to reach an agreement on criteria to define interruption of transmission and elimination of disease, to recommend a template for country dossier and propose a verification exercise.

2. Inaugural session

2.1. Welcome remarks by WHO

Dr Erwin Cooreman, Team Leader, Global Leprosy Programme (GLP), welcomed the participants and informed that a Task Force was set up a year ago to specifically look into coming up with criteria to define ‘elimination of leprosy’. The Task Force’s work encompassed drafting practical definitions to define interruption of transmission and elimination of disease; identifying criteria of different phases in leprosy control; drafting a framework that can be used for verification purpose. Several meetings were held with the task force and its subcommittees. While developing these documents references were also taken from other diseases.

During this final meeting there would be further discussions on the documents developed by TFCEL and recommendations were expected on how to verify the end disease elimination.

2.2. Inaugural address by Government of India

Ms Rekha Shukla, Joint Secretary, Ministry of Health and Family Welfare, Government of India, gave the inaugural address. She expressed sincere thanks to WHO for the opportunity given to contribute to the particular issue. Recalling her participation in the Global Training of National Leprosy Programme (NLP) Managers from Priority Leprosy Endemic Countries (Bangkok, Thailand, 23-25 April 2019), she got much inspired by WHO's vision for zero leprosy and the collaboration of partners – under the umbrella of the Global Partnership for Zero Leprosy – towards 'zero discrimination, zero disease and zero disability'. These three zeros indicated prompted for a change in India's leprosy programme, moving beyond elimination as a public health problem at sub-national level towards interruption of transmission and elimination of the disease. Action plans are prepared accordingly. Political commitment has gained a new momentum as is reflected in a ten-fold increase in proposed budget for achieving a leprosy-free India. The honourable Prime Minister personally appealed for *"Kusthrog Mukht Bharat"* ("Leprosy-free India").

Being in charge of control of NTDs In India, Ms Shukla is also privy to the NTD Road map 2021–2030. She expressed her happiness with the next leprosy milestone of interruption of transmission and elimination of disease.

India's leprosy programme is an integrated programme. It is part of the country's National Health Mission. There is convergence with other health programmes such as School Health Programme, Adolescent Health Programme, Health and Wellness Centres as well as screening in slums by Urban Primary Health Centres. India is a huge country with a population of 1.38 billion and more than 700 districts. She, therefore, urged to consider applying the different phases and indicators to define interruption of transmission and elimination of the leprosy at the sub-national level (state or – even better – district level).

She expressed her gratitude for the support from WHO to India's National Leprosy Eradication Programme. She said that she was looking forward to a productive meeting.

2.3. Objectives and expected outcomes of the meeting

Dr VRR Pemmaraju, Technical Officer GLP, briefed the meeting participants on the objectives and expected outcomes of the meeting.

The general Objective of the meeting was to discuss and draft the 'verification process' for defining interruption of transmission/elimination of leprosy.

The specific objectives were:

1. To discuss the documents developed by TFCEL and its subcommittees; and make recommendations on the process of verification;
2. To decide on the criteria for defining different phases and specific indicators to be considered to define interruption of transmission and elimination of disease, taking into consideration the NTD Road map 2020–2030;

3. To advise on a template for *Country Dossier* to be submitted at the time of claiming achievement of interruption of transmission and elimination of disease;
4. To validate criteria and tools with data from very low or nil burden districts/blocks in India and countries.

The expected results of the meeting included the following:

- ✓ Agreement on criteria to define interruption of transmission/elimination of disease;
- ✓ Template for Country Dossier developed and ready for field-testing;
- ✓ Verification exercise (epidemiological part) conducted for selected districts/blocks in India.

3. Task force on definitions, criteria and indicators for transmission and elimination of leprosy

3.1. Informal Consultation on defining criteria to declare elimination of leprosy: Conclusions and recommendations

Dr Md. Jamsheed Ahmed, Regional Adviser (NTDs), WHO South-East Asia Region, presented a summary of the Informal Consultation on defining criteria to declare elimination of leprosy which was held in Mexico City, Mexico, from 10-12 February 2020.

The main conclusions were:

- ✓ Elimination of leprosy as a public health problem has been achieved in almost all countries, often many years ago. An acknowledgement of such achievement can be given to countries, requesting this.
- ✓ The meeting agreed that past achievements should be built on and directly linked to the preparations needed to work towards interruption of transmission, as specified in the NTD Roadmap 2021–2030.
- ✓ To move forward certain conditions should be met. This would include (but is not limited to) a country roadmap towards zero leprosy, a case-based management information system (including additional indicators such as grade-2 disability (G2D), child cases, duration of symptoms), a well-performing surveillance system, sustained capacity to detect and manage (sporadic) cases.

Recommendations included:

- ➢ Countries should conduct a detailed analysis of available data, especially looking at data trends and indicators that capture interruption of transmission (which may already have occurred or is near), e.g. age at the time of diagnosis, number of child cases, proportion of multi-bacillary (MB) leprosy among new cases, proportion of cases with known cases in the family, etc.;
- ➢ Countries should conduct mapping of all cases detected during at least the past five years to visualize the distribution and level of clustering;

- Contact tracing and post-exposure prophylaxis (PEP) should be universally applied;
- Research should be undertaken to better understand the role of armadillos in the natural history of leprosy;
- Criteria for interruption of transmission and zero incidence of disease should be consolidated and further developed. A Taskforce should be set up to do this;
- Until a valid laboratory test to diagnose infection is available, criteria for interrupting transmission will rely on proxy measures;
- Verification of interruption of transmission can be based on the absence of new child cases during a given minimum period of time. The exact cut-off point for these criteria will be recommended by the Taskforce after further analysis of available data;
- Acknowledgement of zero incidence of disease can be based on the absence of autochthonous cases with other stringent conditions in place (such as strong surveillance and case management system);
- Surveillance will continue to be required even after a country has officially been ascertained of having interrupted transmission or eliminated the disease, and this in view of the possibility for rare cases due to the possible very long incubation time.

3.2. Overview and processes of TFCEL

Dr Erwin Cooreman explained about the task force and its activities. On the request from (very low burden) countries to be recognized by WHO for having achieved or achieving 'leprosy-free' status; and as recommended in the meeting in Mexico, WHO set up TFCEL to define a practical way for declaring within a reasonable time frame interruption of transmission and/or elimination of disease. With the experience of achieving elimination as a public health problem, the countries would like to move to next phases of interruption of transmission / absence of disease (elimination) / (eradication). A pragmatic way is to be defined since the 'certain' achievement would take many years to confirm. To report on the number of countries with zero new autochthonous leprosy cases, a verification mechanism is to be designed which may include submission of a Country Dossier and/or independent review.

3.2.1. Terms of reference

The main objectives of TFCEL were two-fold:

- To define criteria for countries to be ascertained for having made significant progress towards interruption of transmission and elimination of leprosy disease;
- To establish criteria and indicators that best define interruption of transmission of *M. leprae* and elimination in term of zero incidence leprosy disease.

The specific objectives were:

- To determine criteria for readiness to move into the next phase of leprosy elimination;
- To determine definitions for concepts concerning interruption of transmission and elimination of leprosy as a disease;
- To identify indicators that best define interruption of transmission and elimination of leprosy disease;
- To determine criteria (including cut-offs) for when (different stages of) interruption of transmission and elimination of leprosy as a disease have been achieved;
- To develop a draft protocol and guidelines for testing/piloting potential indicators and guidelines.

The expected outcomes were:

- ✓ Recommendation on how best to define interruption of transmission/elimination of disease (theoretically, but more importantly, pragmatically);
- ✓ Guidance on how to ascertain this;
- ✓ Framework for varication process drafted, e.g. Leprosy Elimination Assessment Survey
- ✓ Template for Country Dossier developed.

3.2.2. Activities undertaken by TFCEL

The activities undertaken by TFCEL included:

- ✓ Use of serological testing as a transmission indicator: literature review;
- ✓ Analysis of PGL-I laboratory data from field surveys;
- ✓ Analysis of available field data from national programmes;
- ✓ Trend analysis of epidemiological indicators;
- ✓ Draft criteria for readiness to move to 'next phase';
- ✓ Draft definitions for concepts related to interruption of transmission and elimination of disease;
- ✓ Identify and define indicators that best define interruption of transmission/elimination of leprosy disease;
- ✓ Draft criteria and propose cut-offs for when (different stages of) interruption of transmission and elimination of disease has been achieved;
- ✓ Draft a protocol and guidelines for testing/piloting potential indicators and guidelines;
- ✓ Draft outline protocol for armadillo studies.

The task force held nine virtual meetings between May 2020 and March 2021. The task force has developed a draft for defining interruption of transmission/elimination of disease; framework for verification process and a draft template for dossier.

4. Concepts, definitions and indicators for interruption of transmission and elimination of disease

4.1. Migration in leprosy

Mr John Kurian George, Country Coordinator, FAIRMED-India, gave a presentation on a three-year pilot project to understand the impact of migration among persons affected by leprosy.

It is estimated that 307 million people migrated internally in India; this represents 29% of the country's population. Migration is one of the key obstacles in elimination of leprosy. There is no focused programme to manage leprosy patients who migrate and there is a lack of understanding of migration among leprosy patients. Hence, it is important to establish a thorough understanding of migration among leprosy patients in order to inform policy and programmes at national level and to provide strategic directions globally.

FAIRMED India, in partnership with Novartis, is undertaking a three-year pilot project to better understand the impact of migration among persons affected by leprosy and its consequences on treatment and other health seeking behavior. The project is taking place in four states and union territories: Bihar, Chandigarh, Delhi and Uttar Pradesh. The proposed approach focuses around three pillars: (i) Bring leprosy stakeholders in India together; (ii) Understand the landscape of migration among leprosy patients; and (iii) Provide recommendations for leprosy programmes with regard to migration.

The main expected output of the project is evidence-based recommendations for leprosy management, policy or programme that are acceptable and have an in-principle buy-in of NLEP as well as the other major partners in the leprosy ecosystem in India. The presentation gave insights about possible factors affecting continuity of treatment in a partucular group of patients, who migrate from one place to another within the country. The possible influence on transmission because of migration were also considered during the discussion. Factors identified in general are also applicable to migration between the countries. This can be applied to address factors or situations leading to migration in elimination and mitigate the risk of its impact on interrupting trasnsmisison and reaching the goal of elimination of leprosy.

4.2. Framework of control, elimination and eradication of NTDs and other factors in transmission of leprosy

Dr Pemmaraju made a presentation on the definitions used in NTDs.

- **Control**: reduction of disease incidence, prevalence, morbidity, and/or mortality to a locally acceptable level as a result of deliberate efforts; continued intervention measures are required to maintain the reduction

- **Elimination as a public health problem:** is a term related to both infection and disease. It is defined by achievement of measurable global targets set by WHO in relation to a specific disease. For leprosy, this was defined as "Registered prevalence of less than one case on treatment per 10 000 population" (it was believed that transmission would stop when this threshold was reached).

  When reached, continued actions are required to maintain the targets and/or to advance the interruption of transmission.

  The process of documenting elimination as a public health problem is called **validation**. However, in the case of leprosy, no formal validation process was developed as the indicator could be determined through a straightforward mathematical calculation.

  With very few exceptions, almost all countries have achieved this benchmark at least at the national level. Though some countries are focusing on achieving this at first and subsequent sub-national tiers, most countries have expressed the wish to focus now on elimination.

- **Elimination of transmission (interruption of transmission)** is the reduction to zero of the incidence of infection caused by a specific pathogen in a defined geographical area, with a minimal risk of reintroduction, as a result of deliberate efforts. Continued actions to prevent re-establishment of transmission may be required.

  In leprosy, as infection cannot be unequivocally determined, absence of new autochthonous child leprosy cases for at least three years is considered a proxy indicator for interruption of transmission.

- **Elimination of disease** (as related to leprosy): zero new autochthonous leprosy cases (all ages) in a defined geographical area for three consecutive years. This definition is not absolute. It is acknowledged that sporadic new cases may continue to occur for some years due to the very long incubation period in some individuals. continued surveillance is required for at least ten more years to detect any autochthonous sporadic case in the community. Sporadic cases should be unrelated. Unless established otherwise, one case per year in two consecutive years or two cases in one year in the same area is no longer considered as 'sporadic'. If such non-sporadic cases occur after three years of zero leprosy, it reverses the situation to pre-elimination.

  The process of ascertaining elimination is called '**verification'**.

- **Eradication:** permanent reduction to zero of a specific pathogen, as a result of deliberate efforts, with no more risk of reintroduction.

  The process of documenting eradication is called '**certification'**.

  Eradication implies absence of disease globally. However, absence of the pathogen with nil risk of re-introduction may not be possible due to a zoonotic transmission pathway. Therefore, eradication may, as of now, not be applicable to leprosy.

- **Extinction:** eradication of the specific pathogen so that it no longer exists in nature or the laboratory, which may occur with or without deliberate efforts.

4.3. Validation and verification: lessons learnt in the WHO South-East Asia Region

Dr Zaw Lin, Technical Officer (NTD), SEARO shared some lessons learned with regard to validation and verification of other NTDs in the WHO South-East Asia Region. He referred to the following documents: (i) *Generic framework for control, elimination and eradication of neglected tropical diseases*; and (ii) *Process of validation of elimination of kala-azar as a public health problem in South-East Asia*.

The process for validating elimination as a public health problem, verifying elimination of transmission and certifying eradication of disease included the following:

- The definitions of elimination as a public health problem, elimination of transmission and eradication of disease, as well as the indicators used to assess their achievement, are specific to each disease and have to be established through a consultative process by WHO and partners.
- The NTD Roadmap targets for elimination as a public health problem, elimination of transmission and eradication, at the national level and global level, need to be developed.
- Standard operating procedures for validating elimination as a public health problem or verifying elimination of transmission need to be established and standardized for preparation, review and feedback on dossiers for validation, verification or certification in a Member State. The principles that will regulate those standard operating procedures are: preparation of dossiers for validation, verification or certification; submission and assessment of dossiers for validation, verification or certification; feedback on dossiers; acknowledgement of validation, verification or certification; activities after validation, verification or certification.

4.4. Definitions, concepts and indicators for interruption of transmission

Dr Vivek Lal, Chief Executive Officer, Sasakawa-India Leprosy Foundation and member of TFCEL, presented the concepts, basic terms and indicators as they have been drafted by TFCEL during the past months. The definitions of control, elimination and eradication used as formulated in the *Framework of control, elimination and eradication of NTDs* were agreed.

Concepts more specifically relevant to leprosy were defined, as described below.

4.4.1. Definitions of basic terms

- **Autochthonous case**

  Definition: a case of leprosy *presumed* to have acquired the infection following local transmission in the reporting area.

  This definition builds on the (theoretical) concept that the case resulted from a locally acquired infection. It accommodates within-country situations of cases detected who are not resident of the area (district, province, state) where they are detected.

- **Population at risk**

  Definition: every individual in a leprosy-endemic area who resides or has resided for at least six months in the close vicinity of an untreated leprosy case

- **Persons requiring leprosy-related interventions**

  Definition: persons affected by leprosy who are in need of leprosy-related interventions such as diagnostic services, treatment, care during and after treatment, rehabilitative support and assistance for other forms of related disabilities or mental health problems; as well as chemoprophylaxis.

  This is in line with the NTD targets for populations requiring interventions (to measure progress towards reaching the SDGs).

4.4.2. Definitions related to epidemiological status

The elimination pathway of leprosy can be divided into three phases: elimination as a public health problem (reached by most countries), elimination of transmission (until interruption of transmission is reached); and elimination of disease (until zero incidence is reached).

The phases are generally sequential though in jurisdictions with a small population, elimination as a public health problem may not necessarily be achieved before interruption of transmission. Elimination of leprosy needs to be defined in terms of two separate phases: (i) interruption of transmission; and (ii) elimination of disease. Due to the long incubation time, there can be many years between the two points. Definitions as proposed by TFCEL were presented.

- **Elimination as public health problem**

  Recording a registered prevalence of less than one case per ten thousand population (usually at the end of the year) in a geographical area. This target was set through a World Health Assembly resolution and has been achieved by most countries. TFCEL felt that, while reaching elimination as a public health problem remains an important milestone, countries need to look beyond this towards elimination of the disease.

- **Elimination (interruption) of transmission**

  Definition: an epidemiological state in a leprosy-endemic country or area where there is no more local transmission of *M. leprae*.

  This would be evidenced by zero new autochthonous cases among children (less than 15 years old) for at least five years. The cut-off point of five years is, however, not absolute and sporadic autochthonous child cases with leprosy may still occur after interruption of transmission has been reached.

  The most appropriate age cut-off to define 'children' was discussed. Based on absence of symptoms, 'less than 15 years' was considered as appropriate. However, should a serological marker be validated in future, a lower cut-off point (e.g. 'less than 7 years') could be considered when based on such serology study.

- **Elimination (absence) of disease**

  Definition: zero new autochthonous leprosy cases for at least three consecutive years.

  Declaration of elimination of disease should not occur before elimination of transmission has been declared, which may in some circumstances mean four or even five consecutive years of zero new autochthonous cases.

- **Eradication**

  Definition: permanent reduction to zero of the specific pathogen *M. leprae*, as a result of deliberate efforts, with no more risk of reintroduction.

  In view of possible zoonotic transmission, eradication is currently not relevant for leprosy.

4.4.3. Proposed indicators to assess interruption of transmission and elimination of disease

- **Child proportion among new cases**

  Definition: proportion of new autochthonous child cases (<15 years old) among all new autochthonous cases detected in a defined period (typically one year).

  This indicator is expressed as percentage. However, in low-endemic areas, **absolute number of children** may be preferable to monitor as the denominator may be too small, leading to difficult-to-interpret trends.

  Leprosy among children represents recent transmission. Absence of leprosy in children may point towards interruption of transmission, provided there are no inefficiencies in case detection (such as delay in diagnosis).

- **New child case detection rate**

  Definition: number of new child (<15 years old) leprosy cases detected in a given period (typically one year) and a specific area, in relation to the child population in that area.

  This indicator is expressed per million children (mid-year child population). This indicator is useful as a proxy for incidence of leprosy among children. The indicator is more stable then percentage, especially when the number of new cases is small. It allows also comparison between different populations.

- **Number of new autochthonous child cases detected**

  Definition: absolute number of new autochthonous child (<15 years old) cases detected in a given population in the reporting year.

  Presence of leprosy in children reflects recent transmission. The absolute number is also useful to forecast requirements for MDT child blisters. The indicator is more suitable than 'child proportion among new cases', especially when the total number of new cases becomes very small (<50).

- **Age at the time of detection of leprosy**

  Definition: age that an autochthonous new leprosy case has at the time of diagnosis.

  Age groups reflect the distribution of new autochthonous leprosy cases detected during a given period (typically one year) in a given area. A frequency distribution can be shown in a histogram.

  When comparing different time periods, an increase in mean age at detection, a shift in the mode towards older age groups and a decreasing proportion of children among new cases (or child rate) all suggest that a country or area has achieved or is moving towards elimination of transmission.

- **Seroprevalence of anti-*M. leprae* PGL-1 IgM antibody among children**

  Definition: Number of children (5-7 years old) who test positive for anti-*M. leprae* PGL-1 IgM antibodies expressed as a percentage of the total number of children tested in a given sample.

  The age group is proposed for pragmatic reasons to still have a good indicator for recent transmission. It is still subject to further evaluation. Yields in younger age children may be too low as children should have had sufficient chance to be exposed and infected; while including of older children may be reflect less recent transmission.

  Testing of seroprevalence of anti-*M. leprae* PGL-1 antibody is still in research mode and should, therefore, not (yet) be generalized. Validation of this test may require follow-up within a population, potentially after specific interventions or periodically (e.g. serosurvey every five years). The areas in which such surveys are to be conducted and the sampling method need to be defined operationally for verification of interruption of transmission

- **Proportion of cases with MB leprosy among new cases**

  Definition: Proportion of new cases with MB leprosy among all new cases detected during a given period (typically one year). This indicator is expressed as a percentage.

  Long incubation periods are more associated more with MB leprosy. Patients with leprosy due to recent infection are more likely to have PB disease. An increase in MB proportion among new cases might indicate that transmission is declining or may already have been interrupted.

  Variations in definition over time and incorrect classification (often with preponderance for MB disease) may constitute problems for undertaking and interpreting trend analyses.

- **Proportion of new autochthonous leprosy cases with a known leprosy case in the family**

  Definition: Proportion of new leprosy cases for whom another leprosy case has been identified in the family within the past ten years among all new leprosy cases diagnosed during a given period (typically one year). This indicator is expressed as a percentage.

  The cut-off point of ten years is proposed as it points to a higher probability that the other case in the family has been a source of infection. However, in case of children, only other cases in the family with leprosy will be considered if leprosy occurred after the birth of the child, i.e. a family member who was treated for leprosy before the child was born will not be considered.

  Because other human sources of infection are declining as untreated cases of leprosy are disappearing from a population, one might expect that the proportion of cases with close family or household contact will increase.

4.4.4. Indicators related to elimination of leprosy disease

- **New case detection rate**

  Definition: number of new cases detected in a given population in a given period (typically one year) in relation to the population of the area. The indicator is expressed per million population (mid-year population)

  This rate indicates the burden relative to the population in the area or country.

- **New case detection rate (autochthonous cases only)**

  Definition: number of new autochthonous cases detected in a given population in a given time period (typically one year) in relation to the population of the area. This indicator is expressed per million population.

  'Leprosy among foreign-born' is a proxy measure for non-autochthonous leprosy (i.e. where the infection with *M. leprae* is likely not locally acquired). Since data on autochthonous cases are not collected separately, the numerator would need to be derived by subtracting the new foreign-born cases from the total number of new cases detected.

- **Number of new autochthonous case detected**

  Definition: absolute number of new autochthonous cases detected in a given population in a given time period (typically one year).

  The target of elimination of leprosy disease in a given area is zero new autochthonous cases. The number of new autochthonous cases are a direct indicator. It is especially useful when new case numbers become very small.

- **Proportion of foreign-born among total new cases detected**

  Definition: proportion of new cases born abroad among the total new cases detected. This indicator is expressed as a percentage.

- **Rate of new cases with grade-2 disability (G2D)**

  Definition: number of new cases with G2D detected in a given area during a given period (typically one year) in relation to the population of the area. The indicator is expressed per million population (mid-year population).

- **Sporadic autochthonous leprosy case**

  Definition: autochthonous case of leprosy that occurs in an area after elimination of disease was achieved in that area.

  If two such cases occur in one year or if there are cases in two consecutive years after elimination of disease was achieved, then such cases are considered as “clustered” and the status of the area is reversed to pre-elimination. However, if there is a very high likelihood that such cases are not related to each other, then they will continue to be considered as sporadic and the elimination status of the area can be maintained.

5. Phases on the pathway to elimination of leprosy

Dr V R R Pemmaraju explained the phases on the pathway to elimination of leprosy.

A matrix was developed with the description, definitions, milestones/cut off criteria and indicators to assess the progress towards interruption of transmission and elimination of leprosy disease. The matrix will be useful to countries in developing dossiers claiming elimination of disease and wanting verification by WHO.

Four consecutive phases are considered for a leprosy programme in its journey towards elimination and beyond:

- Phase 1: till elimination as a public health problem. In some cases (especially jurisdictions with a small population), this phase can follow interruption of transmission.
- Phase 2: till interruption of transmission
- Phase 3: till elimination of leprosy disease

- Phase 4: post-elimination surveillance

The matrix (Table 1) presents different phases a country/area will pass through in its journey towards elimination. For each phase, programmes have to achieve a set of criteria/considerations and ensure availability of certain facilities/interventions. The indicators and cut-off levels presented in the matrix will be used for measuring the progress towards elimination.

As most countries have reached the goal of elimination as a public health problem, further discussions focused mainly on interruption of transmission, elimination of the disease and post-elimination surveillance.

Table 1: *Phases in the pathway towards elimination of leprosy*

	Phase 1	Phase 2	Phase 3	Phase 4	Remarks
Description	Till 'elimination as public health problem'	Till 'interruption of transmission'	From 'interruption of transmission till elimination of disease'	Post-elimination	To de defined in terms of number or rate of new cases detected in phases 2,3 and 4
Definition	Registered prevalence of <1 per 10,000 population	Zero new autochthonous child cases for five consecutive years	Zero autochthonous cases, to be sustained for at least three years	Sporadic new cases	PHASE 4 Zero case reports to be submitted for ten years Leprosy surveillance part of integrated disease surveillance
Milestones/ cut-offs for moving to the next phase	<1 case on treatment per 10,000 population	Zero new autochthonous child cases for five consecutive years	No new autochthonous cases for at least three years	Sporadic new cases allowed	

5.1. Criteria, action points and facilities, interventions and activities

A set of criteria or considerations were identified which need to be fulfilled by countries. Facilities, implement certain interventions or activities that are essential for national programme and to be implemented to fulfil the criteria or considerations (identified for each phase) are listed.

While reaching cut-off levels is crucial for moving from one phase to another phase, fourteen criteria/considerations are identified which will have to be fulfilled. These will be assessed internally for moving from interruption of transmission to elimination of disease at sub-national (typically second-tier) levels; and by an external team for verifying elimination of disease at national level. The evaluation will be carried out in a bottom-up approach from sub-national level to national level. The fourteen criteria or considerations are elaborated.

1. Political commitment

Successful implementation of national programmes is dependent on commitment expressed and demonstrated at national and sub-national levels. The availability of a country-owned national

strategic plan which takes into consideration social determinants of health in the country and is in line with the Global Leprosy Strategy 2021–2030 and the NTD Roadmap 2021–2030 demonstrates political commitment. Allocation of budgets and channelization of funds to the operational level are also proof of commitment national and/or local governments. The national strategic plan should be accompanied by standard operating procedures (SoPs) for all leprosy-related interventions. They form the basis for assessments by internal teams and also for verification by the external team to ascertain elimination of the disease.

Political commitment, like some other criteria/considerations, needs to be assessed in all phases from interruption of transmission (Phase 2) to post-elimination of leprosy disease (Phase 4). Suitable verifiable indicators or tangible targets need to be selected depending on local programme situation and national policy.

2. **Allocation of dedicated staff and capacity building of health care workers for providing quality leprosy services**

Presence of adequate numbers and appropriately trained health care staff in programme management and service provision is crucial for implementing the leprosy programme particularly while moving from interruption of transmission to post-elimination. Availability of health care staff at operational level to implement services will be measured in addition to knowledge levels of the health care staff in treatment and care facilities. Training programmes dedicated to the leprosy programme or integrated with other disease control programmes will be verified at national and sub-national levels. Use of available training materials and number of health staff trained during the year are some indicators that will be used to assess fulfilling the criteria of allocation or availability of dedicated skilled staff for providing quality services.

3. **Raising awareness on leprosy among the general population and among health care workers**

Early detection and prompt treatment with multidrug therapy (MDT) is the key to interrupt transmission and subsequently eliminate disease in a geographical area. Awareness about symptoms and early response early are crucial and is linked to improved awareness on leprosy. The modes of enhancing awareness will also be recorded in the process.

Awareness raising is not a mandatory criterion in countries passing through the phases of interruption of transmission and elimination of disease; it is of lower priority in countries where leprosy is almost entirely among foreign-born persons or countries in the post-elimination phase. The number of new cases with G2D and G2D rate will be included in the evaluation as it is related to awareness in the community and response to occurrence of new cases in the community.

4. **Advocacy for leprosy with authorities**

Policy makers need to be apprised of the current leprosy situation in terms of its endemicity in the country and distribution at sub-national levels in order to garner political support for ultimately eliminating the disease and sustaining surveillance in the post-elimination phase. The interventions required to meet the purpose are regular communications with policy makers and bureaucrats through direct meetings, briefings and releasing status reports in the form or

brochures. Meeting minutes, published reports and brochures will constitute verifiable indicators for this criterion at national or sub-national level.

5. Partnerships

WHO, the International Federation of Anti-leprosy Associations (ILEP), the Global Partnership for Zero Leprosy (GPZL), networks of persons affected by leprosy, academic institutions and professional associations (e.g. of dermatologists) have traditionally been participating in leprosy control activities, particularly in endemic countries. In a few countries – in particular without functional national leprosy programme – leprosy services are mainly or solely provided by partner organizations. Presence of organized partnerships at national and sub-national level helps in ensuring concerted efforts in eliminating leprosy; they also can help in preventing duplication of interventions. It is recommended to organize national partnerships constituted by all players to define clear roles for each player and monitor implementation. Presence of an organized national or sub-national partnership will be a verifiable indicator in the evaluation carried out for elimination of transmission or elimination of the disease. This would be an important consideration rather than a criterion; this may not be seen in some countries particularly when the number of cases reported annually are very few (less than ten).

6. Leprosy services ensuring (early) case detection and treatment

For interruption of transmission or elimination of disease, sustaining leprosy interventions in terms of early detection, diagnosis and provision of treatment (MDT) for all new cases and relapses is an essential criterion. The evaluation will assess availability and access to such services to the people in sub-national geographical areas, where required. In some countries availability of a sensitive disease notification system or a surveillance system may be operational in place of activities resulting in early detection. In such instances a presence of a well-established referral system will be a consideration to evaluate.

The evaluation will verify availability of diagnosis and leprosy treatment facilities accessible to persons affected by leprosy. In addition to availability and accessibility, the evaluation will verify trends of leprosy in women and children to ascertain access. Number and rate of new cases with G2D will be included in the evaluation as it informs on early detection. Capacity to detect relapses is also considered as a criterion as relapse cases may lead to continuing transmission of infection. The number of relapses registered annually and trends over a few years will be reviewed to comment on implementation of leprosy services.

7. Prevention and management of complications

Assessing quality of services, evaluations in different phases will review the leprosy service facilities or interventions available to prevent and manage complications such as reactions and disabilities. Counselling services and mental health services will also be observed as part of such evaluations. The availability of services will also be evaluated in terms of availability of skilled staff and infrastructure for these services. The indicators to verify include the details of patients provided with management services to prevent or treat reactions and disabilities. The source of information for these data would be the treatment registers available in the health facilities.

8. Effective surveillance and improved data management systems

Presence of effective surveillance and data management systems are considered essential criteria while evaluating leprosy programmes in different phases of elimination. A surveillance system can be considered sensitive if cases are detected before disabilities develop. An improved data management system will be an important adjuvant that enhances effectiveness of the system. The availability will be checked at sub-national levels where leprosy treatment services are provided. The number of cases detected early (i.e. with no G2D) would be the outcome indicator for presence of an effective surveillance system. The criteria can be considered in different forms in different countries. It could be in an integrated form in some countries, while in others, it may be combined with other NTDs or with TB. In countries with very low numbers, the presence of an effective system to detect all cases will be verified.

This effective surveillance system – including regular submission of zero-reports – should be maintained in the sub-national area during the post-elimination surveillance phase for at least ten years to pick up any sporadic cases that may still occur. Any case occurring after the ten-year post-elimination surveillance period should still be notified though zero-reporting is no longer necessary.

9. Contact tracing

Evidence is available from different studies that contacts of a leprosy patient have a higher probability of being infected than others. This is especially true in low-endemic areas where new leprosy cases very often can identify a former case in their family. Contact tracing and screening is emphasized as a mandatory intervention in both high and low endemic settings. Evaluations would review if contact screening is routinely undertaken.

The indicators to verify include coverage of contacts screened and trends of case detection rates among contacts. The information would be drawn from programme documents and the data management systems.

10. Post-exposure prophylaxis

The Global Leprosy Strategy 2021–2030 recommends post-exposure prophylaxis (PEP) with single-dose rifampicin (SDR) as an important strategic direction. PEP would be included as a consideration during evaluation of national programmes to assess their journey towards elimination of disease. In countries where PEP is adopted, it will be reviewed in terms of coverage of contacts provided with SDR and number of new cases detected during chemoprophylaxis activities. This consideration might not be applicable in those countries where only non-autochthonous leprosy cases are seen.

11. Documentation at sub-national level and Country Dossier

Many countries would have some sub-national level units (e.g. districts, islands) which have reached the stage of interruption of transmission and even elimination of disease. The national programmes are encouraged to map out such areas and evaluate internally with all criteria or considerations mentioned in the matrix. These exercises will help the national programme to document that the sub-national units have fulfilled all the criteria or considerations for

interruption of transmission. Evaluation reports of all sub-national units need to be presented while the whole country moves to the phase of elimination of leprosy. Countries are expected to prepare a dossier demonstrating that they have reached elimination of the disease. The dossier and evaluation reports on sub-national units will be presented to the external team tasked with verifying disease elimination for the country as a whole.

Presentation of dossier and evaluation of sub-national units are considered as indicators for fulfilling these criteria. Countries which have not reported a single autochthonous case for more than ten consecutive years would be requested to submit a declaration to this effect as an alternative way to declare leprosy elimination at national level.

12. Leprosy Transmission Assessment Survey

Leprosy Transmission Assessment Survey (LTAS) is an activity that is carried out by internal teams when a sub-national jurisdiction (typical second-tier) reaches the interruption of transmission, i.e. zero autochthonous child cases for a consecutive period of five years. LTAS will be carried out to document that all criteria have been met and examine trends of epidemiological indicators in such jurisdiction. The LTAS also includes assessment of health facilities that provide leprosy services. When all sub-national health administrative units qualify in LTAS, a dossier will be developed to substantiate the claim for elimination of disease in the country as whole. This dossier will be submitted for verification by WHO.

13. Monitoring, evaluation and verification

Monitoring of leprosy situation in all sub-national level units will be a continuous activity to ascertain that the sub-national units reach the designated cut-off levels in their journey towards elimination of leprosy disease in the country. Evaluations will be carried out by internal teams using LTAS when a second sub-national tier unit reaches the cut-off level of interruption of transmission.

Once the internal evaluation of all sub-national units is completed a dossier will be prepared including the LTAS reports. The dossier will be submitted when the country claims to have reached elimination of disease. An external evaluation team will be invited to verification elimination of disease for the country as a whole.

14. Research

National programmes are encouraged to carryout basic and operational research in improving diagnostic capabilities, treatment regimens and defining markers to assess transmission of leprosy and elimination of the disease. One of the indicators suggested is PGL-1 antibody levels in children in a defined community. This will also be considered as a potential indicator to assess the magnitude of infection prevailing in the community.

5.2. Phase 2: till interruption of transmission

Most countries have reached the status of elimination of leprosy as a public health problem at the national level and are moving towards the second phase, i.e. 'Interruption of transmission'. Even in high-endemic countries, the cut-off level of 'zero autochthonous child cases for five consecutive years' may have been reached already in several second sub-national tier units. It is to be noted that in jurisdictions with small population, 'interruption of transmission' – defined as five consecutive years without new child leprosy cases – may be reached before 'elimination as a public health problem' – defined as less than 1 case on treatment per 10 000 population – has been achieved (e.g. if only adult cases are detected). While this may be confusing, it is paramount to focus on interruption of transmission and subsequently elimination of disease.

Table 2 shows the interventions and indicators applied to the 14 criteria and considerations for declaring 'interruption of transmission'.

Table 2: *Interventions, indicators and targets by criterion/consideration to declare 'interruption of transmission*

Criterion / consideration	Facility / intervention/ activity	Outcome indicator / target
1. Political commitment	- National Strategic Plan to achieve interruption of transmission for Zero leprosy roadmap with details of milestones and budgets identified for all resources and interventions - Allocation of adequate resources for leprosy control - Development of National Strategic plan for elimination of leprosy towards Zero leprosy (considering current leprosy situation and taking into account social determinants of health and aligning with global leprosy strategy 2021–2030 and NTD Roadmap 2021–2030)	- Well documented plan for zero leprosy with details of adequate budgetary support - National Strategic Plan with SoPs for all leprosy interventions
2. Allocation of dedicated staff and capacity building of health care workers for leprosy quality services (including private sector staff)	- Training of health staff (leprosy-specific, integrated with other NTDs or other programmes) - Trained health staff at all levels - E-learning modules - Counselling - Private sector providing leprosy services	- Availability of trained staff - Trained staff at all levels - Health staff trained (certificates available)
3. Raising awareness on leprosy in the general population and among health care workers	- Awareness raising among targeted populations, i.e. general population, at-risk people, school students, media, workplace - Awareness programmes disseminating early symptoms and signs to evoke health seeking behaviour	- Health care workers aware of signs and symptoms of leprosy - Target population aware of signs and symptoms

Criterion / consideration	Facility / intervention/ activity	Outcome indicator / target
4. Advocacy with authorities (e.g. politicians and bureaucrats)	- Communicate through direct meetings, brochures and write-ups - Schedule meetings to sensitise on needs of the programme to achieve interruption of transmission	- Sensitised decision makers - Informed decisions in programme management
5. Partnerships	- Establish partnerships with WHO, NGOs, philanthropists and other relevant agencies and sectors - Communicate needs and appeals to WHO, NGOs, philanthropists and other relevant agencies and sectors	- Partnerships established - Adequate funding for activities - Specific tasks accomplished
6. Early detection, diagnosis and treatment; diagnosis of relapses	- Availability of adequate facilities to suspect, diagnose and treat leprosy - Accessibility of services (at community level, close to the patient's home) - Ensure diagnosis and treatment of services for patients in difficult-to-reach areas - Health facilities at referral level to be designated as leprosy service centre - Flexible treatment administrative models ensure completion of treatment	- New autochthonous cases (by age group) - New child cases - New cases with G2D - Case detection rates - Treatment completion rate - Relapses
7. Prevention and management of complications (e.g. reactions, disabilities)	- Health facilities for diagnosis and management of nerve damage and deformities, and addressing mental health needs of people affected by leprosy - Continued care of persons affected with primary and secondary disabilities	- Availability of skilled health staff - Availability of infrastructure - Patients under disability care
8. Effective surveillance and improved data management systems	- Mapping of patients' sub-national units autochthonous (all age groups) leprosy patients linked with health facilities - Digitalisation of data and availability of web-based data management system - Analysis of data to be used in planning Zero Leprosy Roadmap - Synchronizing data management with drug request and supply management	- Proportion of health facilities reporting in this format. - Case-based data management system for all cases - Availability and utilisation of web-based data management system linked with surveillance
9. Contact tracing	- Listing of the contacts of all new leprosy cases and cases detected for the past five years for screening/examination - Counselling to seek consent for examining contacts - Screening of neighbours and social contacts annually for five years - Mapping contacts for non-autochthonous cases for local screening and, subject to feasibility, in the source country	- Confirmed cases among contacts of index cases - Coverage of contact tracing and examination

Criterion / consideration	Facility / intervention/ activity	Outcome indicator / target
10. Post-exposure prophylaxis	- Availability of rifampicin - Counselling services - Screening of household and social contacts - Administration of SDR chemoprophylaxis to eligible contacts	- Number of contacts receiving SDR per case of leprosy - Preventive chemotherapy provided to maximum number of eligible contacts
11. Documentation at sub-national level and Country Dossier	- Documents for each sub-national unit on the same lines of Dossier to be prepared for internal review - Preparation of Country Dossier when claiming elimination of leprosy	- Dossier submitted
12. Leprosy Transmission Assessment Survey (LTAS)	- Facility assessment - Desk review of data - Assessment of epidemiological situation at second sub-national tier level for zero autochthonous child cases for consecutive five years	- Health facilities in line with referral system planned and with SoPs
13. Monitoring, evaluation and verification (to ascertain cut-off levels)	- Internal evaluation for assessment of interruption of transmission through LTAS at second sub-national tier unit by a national team - Mechanism to continued monitoring of leprosy situation - Dossier submission - Verification by WHO (international team)	- Mechanisms in place to retrieve data to compile indicators each year - Mechanisms in place to compare trends for all indicators each year
14. Research	- Laboratories with facilities for research - Institutes capable of conducting research are available and/or involved in leprosy research, as relevant	

5.3. Phase 3: till elimination of disease

Once a country has reached the cut-off level of no autochthonous child cases for five consecutive years, the country needs to sustain this status and move towards elimination of the disease. Elimination of disease is defined as 'zero autochthonous cases for three years or till interruption of transmission is also declared' (thus up to five consecutive years of zero leprosy). A country which has fulfilled both criteria of five years zero autochthonous child cases and three years zero autochthonous cases in all sub-national areas as well as the other programmatic criteria can claim that it has reached disease elimination, even if sporadic cases occur.

Countries will be supported to carry out evaluations using LTAS at sub-national levels and in preparation of a dossier. On receipt of the dossier, WHO commissions an international team to carry out verification on the basis of the dossier. Once all the criteria and considerations set for reaching the phase of elimination of leprosy are fulfilled, elimination of leprosy will be declared. Detailed criteria and considerations with activities, indicators and targets are presented in Table 3 to declare elimination of disease (end of Phase 3).

Table 3: *Interventions, indicators and targets by criterion/consideration to declare 'elimination of disease'*

Criterion / consideration	Facility / intervention/ activity	Outcome indicator / target
1. Political commitment	- Allocation of adequate resources for leprosy control - Development of National Strategic plan for elimination of leprosy towards Zero leprosy - National Strategic Plan to sustain interruption of transmission and to reach the goal of elimination of leprosy disease	- Well documented plan for zero leprosy with details of adequate budgetary support - National Strategic Plan with SoPs for all leprosy interventions
2. Allocation of dedicated staff and capacity building of health care workers for leprosy quality services (including private sector staff)	- Training of health staff (leprosy-specific, integrated with other NTDs or other programmes) - Trained health staff at all levels - E-learning modules - Counselling services - Private sector also providing leprosy services where needed	- Availability of trained staff - Trained staff at all levels - Health staff trained (certificates available)
3. Raising awareness on leprosy in the general population and among health care workers	- Awareness raising among targeted populations, i.e. general population, at-risk people, school students, media, workplace - Awareness programmes disseminating early symptoms and signs to evoke health seeking behaviour	- Health care workers aware of signs and symptoms of leprosy - Target population aware of signs and symptoms
4. Advocacy with authorities (e.g. politicians and bureaucrats)	- Communicate through direct meetings, brochures and write-ups - Schedule meetings to sensitise on needs of the programme to achieve elimination of disease	- Sensitised decision makers - Informed decisions in programme management
5. Partnerships	- Sustain partnerships with partners, WHO and donors - Inform programme needs	- Partnerships established - Specific tasks for partners identified
6. Early detection, diagnosis and treatment; diagnosis of relapses	- Availability of adequate facilities to suspect, diagnose and treat leprosy - Accessibility of services (at community level, close to the patient's home) - Ensure diagnosis and treatment of services for patients in difficult-to-reach areas - Health facilities at referral level to be designated as leprosy service centre - Flexible treatment administrative models ensure completion of treatment	- New autochthonous cases (by age group) - New child cases - New cases with G2D - Case detection rates - Treatment completion rate - Relapses
7. Prevention and management of complications	- Health facilities for diagnosis and management of nerve damage and deformities, and addressing mental health needs of people affected by leprosy	- Availability of skilled health staff - Availability of infrastructure

Criterion / consideration	Facility / intervention/ activity	Outcome indicator / target
(e.g. reactions, disabilities)	- Continued care of persons affected with primary and secondary disabilities	- Patients under disability care
8. Effective surveillance and improved data management systems	- Mapping of new autochthonous (all age groups) - Digitalisation of data and availability of web-based data management system - Analysis of data to be used in planning Zero Leprosy Roadmap - Synchronizing data management with drug request and supply management	- Proportion of health facilities reporting in this format. - Case-based data management system for all cases - Availability and utilisation of web-based data management system linked with surveillance
9. Contact tracing	- Listing of the contacts of all new leprosy cases and cases detected for the past five years for screening/examination - Counselling to seek consent for examining contacts - Screening of neighbours and social contacts annually for five years - Mapping contacts for non-autochthonous cases for local screening or, subject feasibility, in source country	
10. Post-exposure prophylaxis	- Availability of rifampicin - Counselling services - Screening of household and social contacts - Administration of SDR chemoprophylaxis to eligible contacts	- Number of contacts receiving SDR per case of leprosy - Preventive chemotherapy provided to maximum number of eligible contacts
11. Documentation at sub-national level and Country Dossier	- Preparation of Country Dossier when claiming elimination of leprosy	- Dossier submitted together with request for verification
12. Leprosy Transmission Assessment Survey (LTAS)	- Facility assessment surveys to ascertain elimination of disease and move to post-elimination - Assessment of epidemiological situation at sub-national level for zero autochthonous cases for three consecutive years	- Health facilities in line with referral system planned and with SoPs
13. Monitoring, evaluation and verification (to ascertain cut-off levels)	- Dossier submission for claiming leprosy elimination - Verification by WHO (international team)	- Mechanisms in place to retrieve data to compile indicators each year - Mechanisms in place to compare trends for all indicators each year
14. Research	- Laboratories with facilities for research - Institutes capable of conducting research are available and/or involved in leprosy research, as relevant	

5.4. Phase 4: post-elimination phase

Table 4 applies the fourteen criteria and considerations to the post-elimination phase.

Table 4: *Interventions, indicators and targets by criterion/consideration during the post-elimination phase*

Criterion / consideration	Facility / intervention / activity	Outcome indicator / target
1. Political commitment	- National health plan to include post-elimination surveillance (for ten years in the sub-national areas where elimination is achieved) and web-based data management system - Surveillance through sentinel/referral centres and apex health centres (national or for a group of countries in a geographical region)	- National health plan indicating continuation of leprosy surveillance - SoPs for surveillance of leprosy programme
2. Allocation of dedicated staff and capacity building of health care workers for leprosy quality services (including private sector staff)	- E-learning modules - Trained health staff at referral level - Integrated disability care	- Referral centres with trained staff - Screening of contacts of confirmed leprosy cases routinely undertaken
3. Raising awareness on leprosy in the general population and among health care workers	- Awareness raising among general population and targeted population (i.e. contacts, migrants, refugees, students, media, work places)	- Health care workers aware of signs and symptoms of leprosy - Target population aware of signs and symptoms
4. Advocacy with authorities	- Communicate with concerned politicians and bureaucrats through brochures and write-ups to communicate occurrence of sporadic cases and advocate for critical incident investigation	- Sensitised office bearers in positions of authorities - Sensitized decision makers
5. Partnerships	- Sustain (if necessary) partnerships with WHO and NGOs and philanthropists essentially to maintain essential leprosy services	- Partnerships established - Adequate funding for activities
6. Early detection, diagnosis and treatment; diagnosis of relapses; established referral system for management of leprosy complications	- Diagnostic and treatment services available at designated centres of excellence/apex hospitals at referral level - Diagnostic and treatment services to be extended/ ensured to non-autochthonous population, i.e. migrants/refugees - Flexible administrative models of treatment to ensure completion of treatment,	- New autochthonous cases - New non-autochthonous cases - Treatment completion rate - Relapses
7. Prevention and management of complications (e.g. reactions, disabilities)	- Trained personnel, infrastructure facilities at referral level	- Availability of skilled personnel (health care works) at referral level

Criterion / consideration	Facility / intervention / activity	Outcome indicator / target
8. Effective surveillance and improved data management systems	- Digitalisation of data and availability of web-based data management system - Mapping of new (all age group) leprosy patients at sub-national level units - Case-based data management system for any cases that still occur	- Availability of web-based data management system linked with surveillance
9. Contact tracing	- Listing and mapping of the contacts of all new cases - Counselling	- Coverage of contact screening
10. Post-exposure prophylaxis	- Screening of contacts (non-autochthonous cases) to ensure eligibility for administration of SDR chemoprophylaxis	- Preventive chemotherapy provided to maximum number of eligible contacts
11. Documentation at sub-national level and Country Dossier	- Proper documentation and investigation of all new cases (clustered or sporadic)	
12. Leprosy Transmission Assessment Survey (LTAS)	- Not applicable	
13. Monitoring, evaluation and verification (to ascertain cut-off levels)	- Internal monitoring by the programme or country health services - Web-based reporting systems to alert occurrence of new cases - Mandatory notification of leprosy	- Surveillance system to pick up sporadic new cases
14. Research	- Research on innovations to reach refugees, migrants and displaced populations	

6. Application of cut-off levels and analysis: examples from countries

The data from sub-national levels were collected and analyzed to review the possible trends in terms of reaching the cut-off levels. Data at sub-national units in Brazil and two districts in India were reviewed to apply cut-off levels for verifying the use of cut-off levels in defining the phases of elimination for countries.

Data from four low-endemic countries – Maldives, Morocco, Thailand and Viet Nam – at second sub-national level were collected and applied to observe the utility of cut-off levels and issues related to sustaining post-elimination surveillance.

6.1. Analysis of data from Brazil (by municipality)

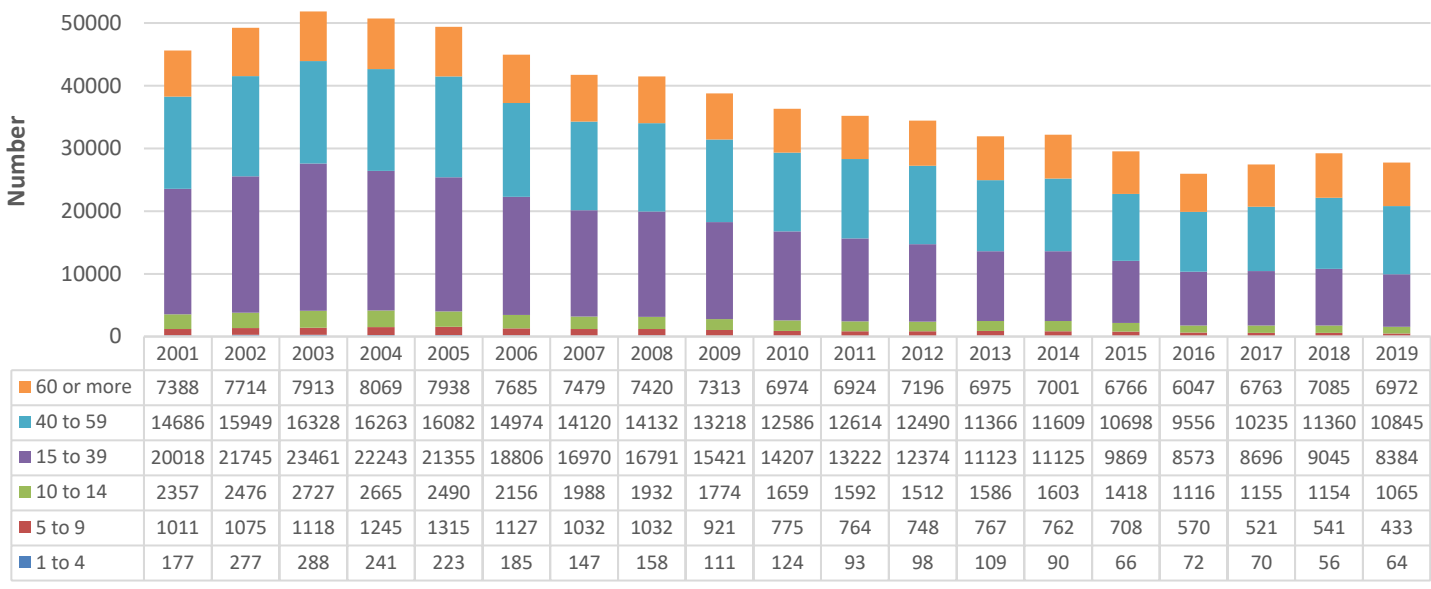
Dr Mauricio L Nobre, TFCEL member from Brazil, gave a presentation on analysis of data from Brazil by municipality.

Brazil is one of the top-three endemic countries reporting 28,000 new cases on average in recent years. In 2019, the country had a population of 211 755 692. The country is divided in 27 states and 5570 municipalities. Data from 2001 to 2019 at national level and child case data pertaining to 20 municipalities (where the total number of new cases decreased by 75% or more) were analyzed to understand the transmission trends. Table 5 shows some key indicators at national level. Figure 1 shows the trend in new case detection.

Table 5: *Key leprosy indicators, Brazil (2001 and 2019)*

Indicator	2001	2019
Number of new cases	48,497	27,863
New case detection rate	266.1 per million	131.5 per million
New child cases	3,545	1,545
Proportion of children among new cases	7.3%	5.5%
Proportion of MB among new cases	53.5%	78.4%
Proportion of new cases with G2D	6.0%	8.4%
Registered prevalence	195.4 per million	150 per million

Fig. 1: ***Trend in new case detection by age group, Brazil, 2001-2019***
(Source: SINAN, MOH, Brazil)



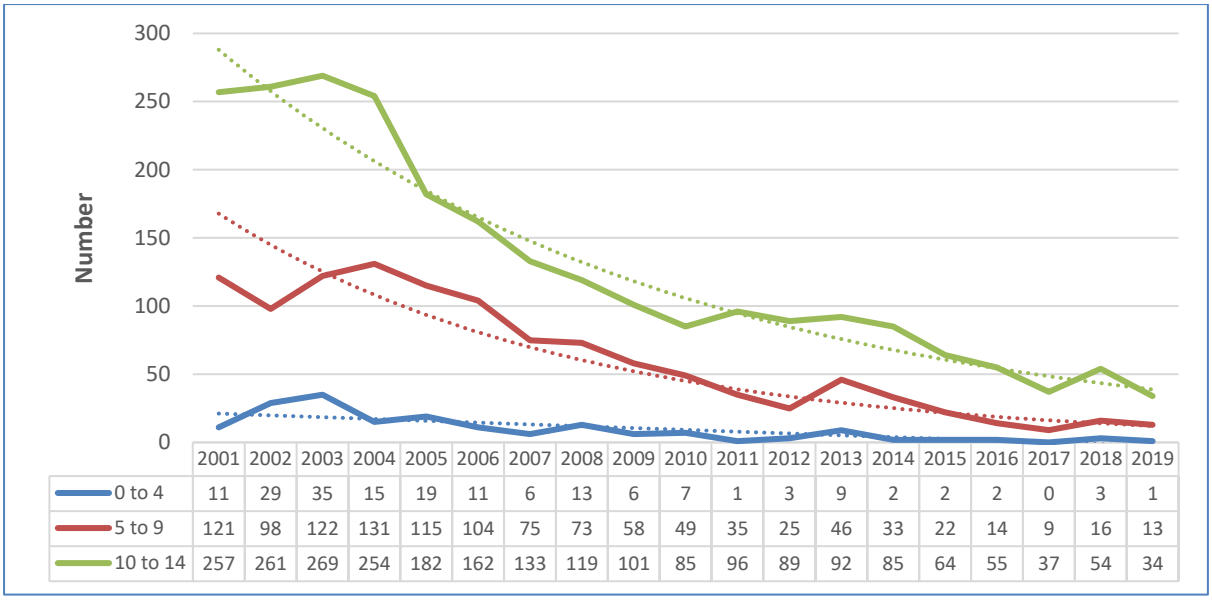
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
60 or more	7388	7714	7913	8069	7938	7685	7479	7420	7313	6974	6924	7196	6975	7001	6766	6047	6763	7085	6972
40 to 59	14686	15949	16328	16263	16082	14974	14120	14132	13218	12586	12614	12490	11366	11609	10698	9556	10235	11360	10845
15 to 39	20018	21745	23461	22243	21355	18806	16970	16791	15421	14207	13222	12374	11123	11125	9869	8573	8696	9045	8384
10 to 14	2357	2476	2727	2665	2490	2156	1988	1932	1774	1659	1592	1512	1586	1603	1418	1116	1155	1154	1065
5 to 9	1011	1075	1118	1245	1315	1127	1032	1032	921	775	764	748	767	762	708	570	521	541	433
1 to 4	177	277	288	241	223	185	147	158	111	124	93	98	109	90	66	72	70	56	64

Brazil still has to achieve elimination of leprosy as public health problem (prevalence rate 1.5 per 10 000 population in 2019). Although there was a reduction of new child cases over the period of ten year (reduction with 56%), a substantial number of children continued to be diagnosed with leprosy (more than 1500 in 2019).

A study was carried out with the objective to analyze long-term trends in Hansen's Disease case detection, to observe whether different age cut-offs for children can be used for indicators that relate to transmission of *M. leprae* and to observe registered trends on new case detection in the

country as a whole and in selected sub-national areas. The data source was the number of cases reported through SINAN and the period of study was 2001 to 2019. Population data were obtained from the *Instituto Brasileiro de Geografia e Estatistica* (Brazilian Institute of Geography and Statistics) (Figure 2 and Table 6).

Fig. 2: ***Trend in case detection, by child age group, 20 selected municipalities in Brazil, 2001-2019***



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
0 to 4	11	29	35	15	19	11	6	13	6	7	1	3	9	2	2	2	0	3	1
5 to 9	121	98	122	131	115	104	75	73	58	49	35	25	46	33	22	14	9	16	13
10 to 14	257	261	269	254	182	162	133	119	101	85	96	89	92	85	64	55	37	54	34

Table 6: *Results of study of leprosy in child age groups between 2001 and 2019, 20 selected municipalities, Brazil*

Age group	New cases detected				Difference (decrease)	
	2001		2019			
	Number	Percentage	Number	Percentage	Number	Percentage
0 – 4 years	11	2.8%	1	2.0%	(10)	(90.9%)
5 – 9 years	121	31.1%	13	27.1%	(108)	(89.2%)
10 – 14 years	257	66.1%	34	70.8%	(223)	(86.6%)
Total children	**389**	**100.0%**	**48**	**100.0%**	**(341)**	**(87.6%)**

The findings in the study of 20 municipalities with a significant overall decrease in leprosy were:

- ✓ New case detection has dropped, especially in young adults and children, which suggests reduction on leprosy transmission;
- ✓ Most child cases occurred in those aged 10 to 14 years old (approximately 65% in almost all studies);
- ✓ Reduction in the new case detection was accompanied by a greater reduction in those younger than 5 years old than compared to those aged 5-9 and 10-14, but this pattern was not the same in all selected states and municipalities;

- ✓ Cases in children younger than 5 years old seem to be sporadic in different epidemiological settings. Many consecutive years without cases in this age group were observed, even in municipalities with an increase in new case detection;

Data from municipalities without evident decrease or even an increase in annual new case detection show a significant decline in the youngest child age group (-50%), a modest decline in the medium child age group (-5.7%) and an increase in the oldest children (11%).

This suggests that new case detection in 10-14 year old children seems to better reflect ongoing transmission but a reduction in 5-9 year old children may "potentially" be used to indicate a decrease in transmission.

6.2. Application of data on two endemic districts in Tamil Nadu, India

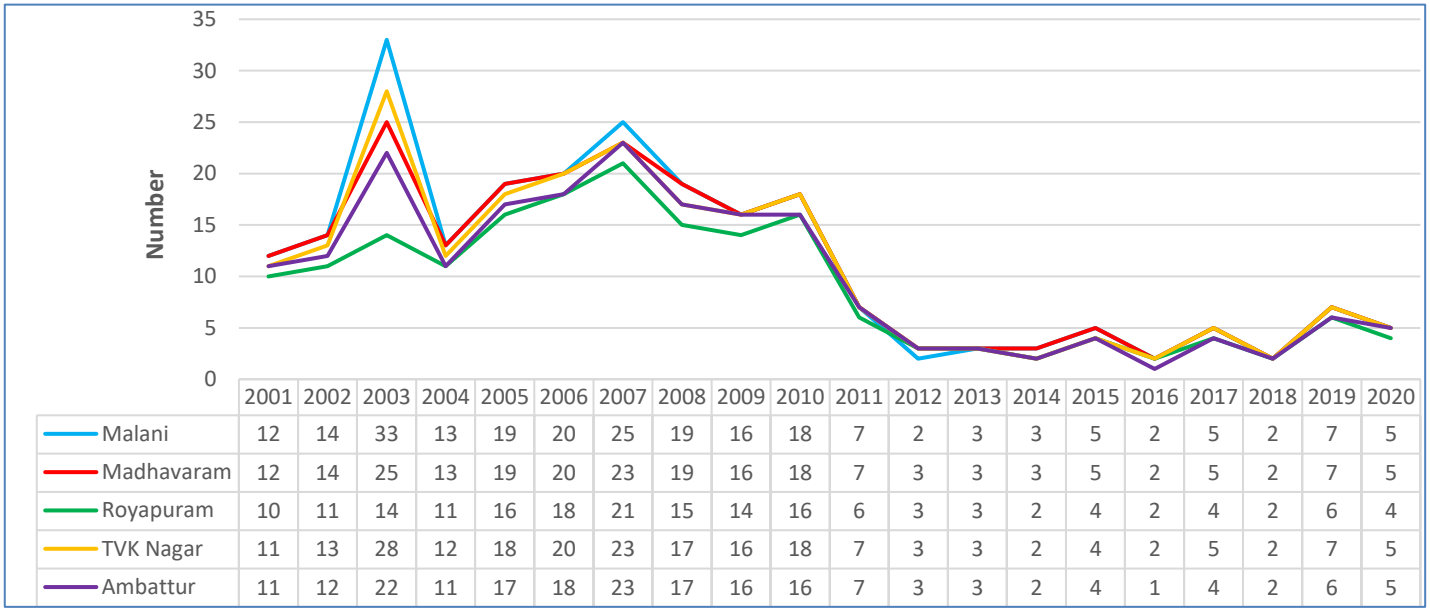
The leprosy profile of two low endemic districts in Tamil Nadu were presented: Chennai district by Dr V. Dharmalingam, Deputy Director of Medical Services (Leprosy); and Thoothukudi district by Dr P. Yamuna, Deputy Director of Medical Services (Leprosy).

6.2.1 Chennai district

There was a decline of new cases from 185 in 2016 to 65 in 2020. The number of new child cases showed a decline from 29 in 2016 to 2 in 2020 while the G2D rate was 0.4 per million in 2020, down from 1.8 per million in 2016. Chennai district has five divisions (*taluks*): Malani, Madhavaram, Royapuram, TVK Nagar and Ambattur. The following graphs show that the new child cases over the period of 20 years in the five divisions have shown a declining trend but new child cases continue to occur.

The district is, however, not low-endemic; the data, therefore, did not contribute much to the purpose of application of the cut-off levels. The trends of all the *taluks* are presented in Figure 3. None of the *taluks* have reported zero child cases or zero adult cases till 2020.

Fig. 3: ***Trends in child case detection by taluk, Chennai, 2001-2020***

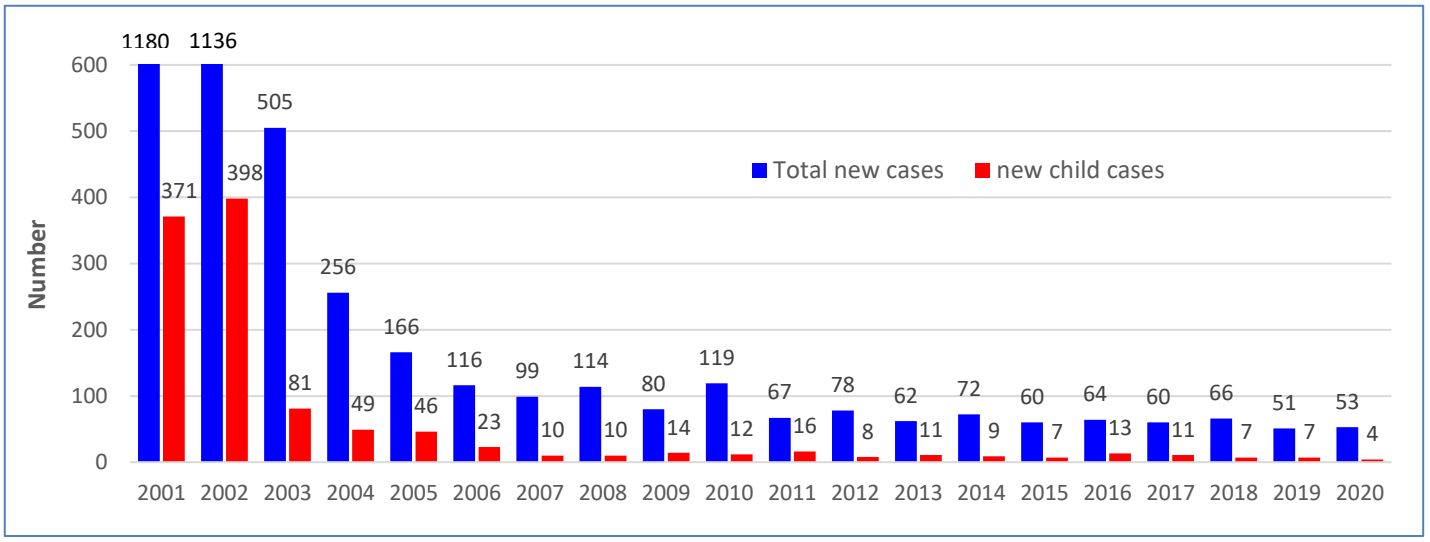


	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Malani	12	14	33	13	19	20	25	19	16	18	7	2	3	3	5	2	5	2	7	5
Madhavaram	12	14	25	13	19	20	23	19	16	18	7	3	3	3	5	2	5	2	7	5
Royapuram	10	11	14	11	16	18	21	15	14	16	6	3	3	2	4	2	4	2	6	4
TVK Nagar	11	13	28	12	18	20	23	17	16	18	7	3	3	2	4	2	5	2	7	5
Ambattur	11	12	22	11	17	18	23	17	16	16	7	3	3	2	4	1	4	2	6	5

6.2.2. Thoothukudi district

Figure 4 shows the trends in total new cases and new child cases in Thoothukudi district between 2001 and 2020.

Fig. 4: ***Trends in new cases (all and children), Thoothukudi district, 2001-2020***



Active case detection was carried out in two high endemic blocks of the district in 2013 through trained Accredited Social Health Activists (ASHAs). They examined 63 227 persons. Of them, 235 had symptoms suspect of leprosy; leprosy was diagnosed in nine patients. It was then concluded that active search is necessary in endemic areas.

6.3. Application of indicators in low-burden countries

Dr Erwin Cooreman presented the application of proposed indicators and cut-offs in two low-endemic countries: Maldives and Morocco. Data over the last twenty years were analysed for the second-tier and first-tier administrative units. Data for two other countries (Viet Nam and Thailand) were also analysed. The detailed data are shown in Annexes 4-7.

6.3.1. Maldives

Maldives was characterized by a high leprosy endemicity in 1982 when the registered prevalence was 97 per 10 000 population. Multidrug therapy (MDT) was introduced and 100% coverage was achieved by end of 1982. Elimination of leprosy as a public health problem – i.e. less than 1 case per 10 000 population or a 99% reduction compared to 1982 – was achieved in 1997. Since then, the number of new cases reported by Maldives gradually reduced; between 2012 and 2020, between three and nine new cases were detected annually. In 2020 the total population of Maldives was 540 544, including a significant number of foreigners. The country is divided into 18 atolls (further subdivided in 189 inhabited islands).

Data were analyzed by island in line with the Government's strategy of declaring "100 islands free of leprosy by 2025". As the average island population (except the municipality islands) is very small, a good number of islands has already reached five years of no children with leprosy and three years of no leprosy cases; many islands have already completed a ten-year follow-up period after the benchmark of at least[1] three years no leprosy was achieved. During these ten years, sporadic cases did occur in few islands, but did not undo the 'elimination' status. The only exception was Male' (capital city) where three years of no cases was not sustained, reversing the local status to pre-elimination in 2010 and again in 2016.

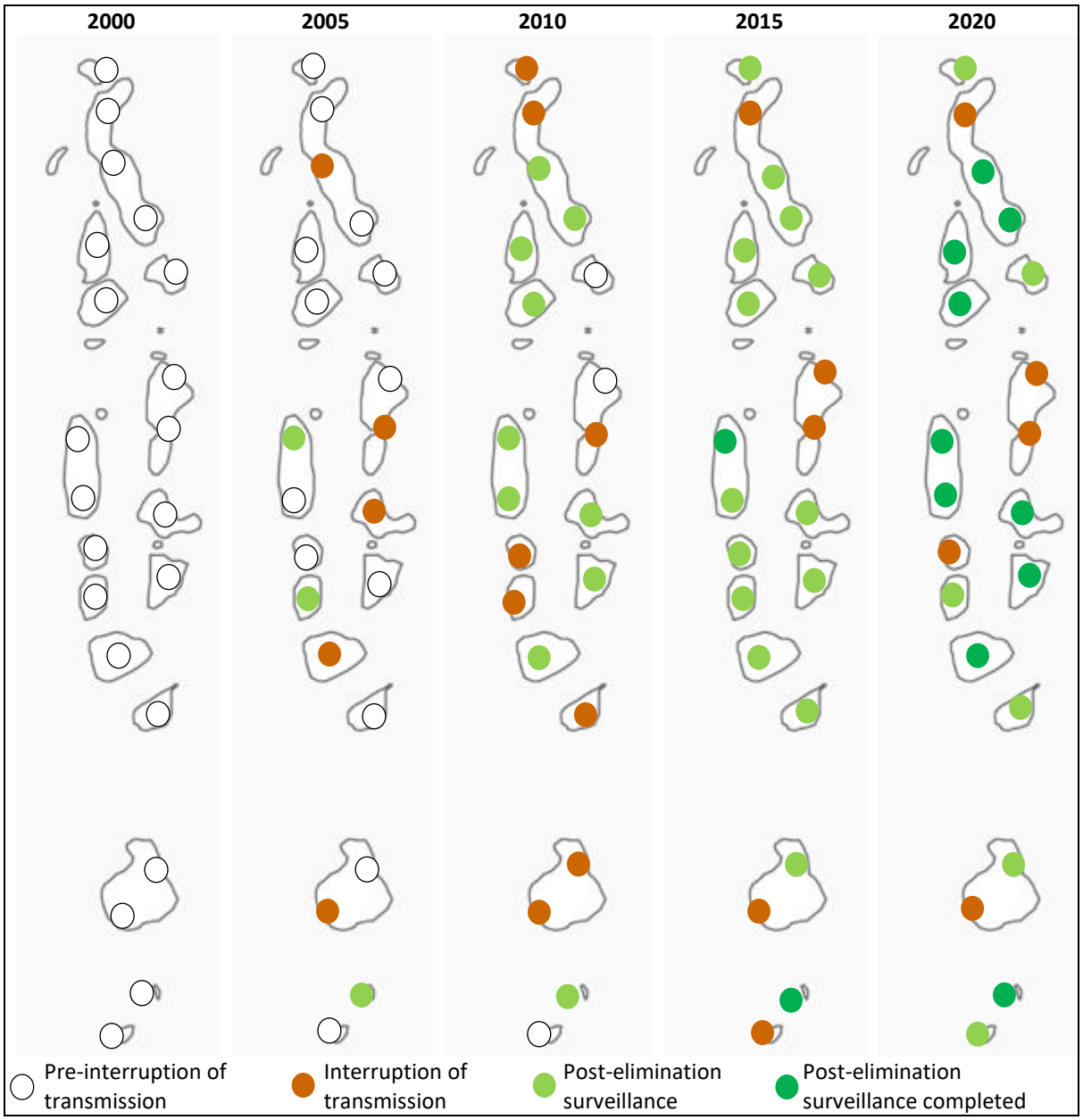
When all islands in one atoll had achieved the status of 'interruption of transmission', the whole atoll was considered as having achieved this; when all atolls had achieved 'interruption of transmission', the country was considered as having achieved this. Similarly, when all islands in one atoll had achieved the status of 'disease elimination', the whole atoll was considered as having eliminated leprosy. When all islands in one atoll has completed ten years of post-elimination surveillance, the atoll was considered as having achieved this. At atoll level, there were not necessarily three consecutive years without leprosy to declare 'elimination' as there were sporadic cases during the post-elimination surveillance period and this follow-up period was often not synchronous for all islands within one atoll.

The analysis did not distinguish between autochthonous and non-autochthonous leprosy cases (since the information was not available). If non-autochthonous cases were not considered, then some islands and atolls may have reached disease elimination earlier. The analysis also only considered epidemiological data, not other programmatic data (e.g. quality of surveillance system,

[1] In some islands, instead of three years, four of five years of no new leprosy cases were counted. This was done in order to avoid that Phase 3 (post-elimination surveillance) would start before interruption of transmission (five consecutive years with no children) was completed.

diagnostic and treatment facilities, disability care, etc.). These also will need to be considered before declaring the islands/atolls or country "leprosy-free".

Fig. 5: ***Map of Maldives, indicating atolls that have reached 'interruption of transmission', 'elimination of disease' or have completed 10 years of post-elimination surveillance***



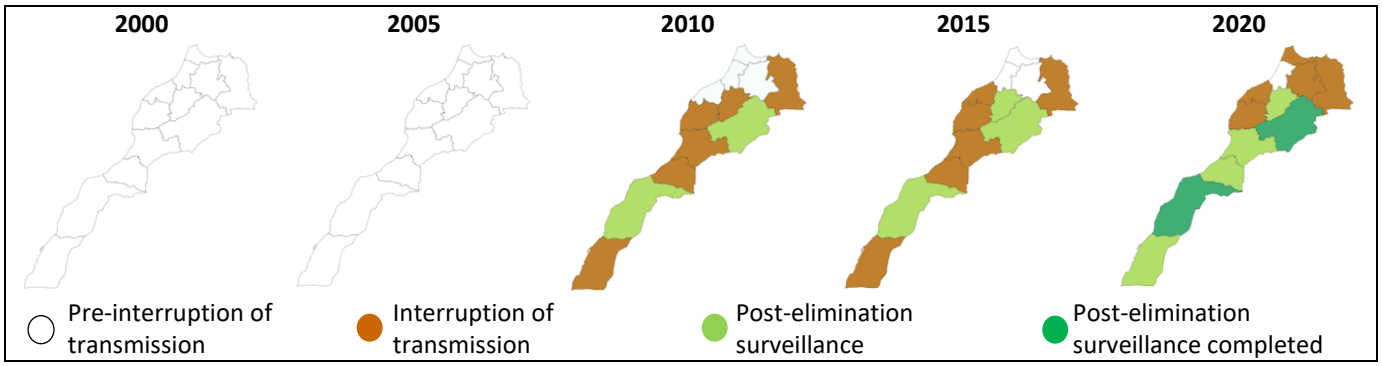
6.3.2. Morocco

Morocco is administratively divided into regions (first tier) and prefectures and provinces (second-tier administrative divisions). Data pertaining to new cases (both child and total cases) detected between 2002 and 2020 are presented in Annex 5.

When all prefectures and provinces in one region had achieved 'interruption of transmission', the region was considered as having achieved this. In 2020, only one province – Sidi Kacem in Rabat-Salé-Kénitra Region – was yet to achieve this status (likely in 2021 as 2020 was the fifth year without

leprosy being diagnosed in children). Elimination of disease is yet to be achieved in 13 prefectures/ provinces in 6 regions.

Fig. 6: ***Map of Morocco, indicating regions that have reached 'interruption of transmission', 'elimination of disease' or have completed 10 years of post-elimination surveillance***



Reversal to pre-elimination status occurred in 14 prefectures/provinces. This is more than what was observed in Maldives and is explained by the significantly larger population in the administrative divisions. The analysis here assumed that the new clusters (defined as 'two new cases in one year' or 'cases in two consecutive years' after elimination was earlier achieved) consisted of related cases. If it can, however, be demonstrated that these patients are not linked to each other (e.g. far away from each other), then they can be considered as sporadic cases, in which case the status of 'disease elimination' can be maintained in the prefecture/province instead of reversal. It is thus imperative that every case detected during the post-elimination surveillance period is thoroughly investigated.

Five cases were detected after more than ten years following 'elimination of disease' in a prefecture or province. This calls into question if ten years of post-elimination surveillance is sufficient. The ten years cut-off for the follow-up period is a rather arbitrary trade-off between maintaining capacity to detect leprosy (including trained human resources, periodic reporting, etc.) and missing rare cases. Especially in an integrated surveillance system, rare cases can be picked up even after this ten-year period.

6.3.3. Thailand and Viet Nam

Reference is made to Annexes 6 and 7, which present a similar analysis made for Thailand and Viet Nam. The maps in Figures 7 and 8 shows how provinces in both countries move towards interruption of transmission and subsequently to elimination of disease.

Though the maps show 'pre-interruption' status in 2000 in all countries, this may be artefactual in several subnational jurisdictions. Reason is that this is based on assessing data for the last 20 years. Some areas may have reached five years of zero child leprosy before the year 2000; as such data were not available, the map for 2000 could not reflect this. This doesn't matter much as programmes are interested in knowing which areas have reached 'interruption of transmission' or 'disease elimination' rather than knowing when this has occurred.

Fig. 7: ***Map of Thailand, indicating provinces that have reached 'interruption of transmission', 'elimination of disease' or have completed 10 years of post-elimination surveillance***

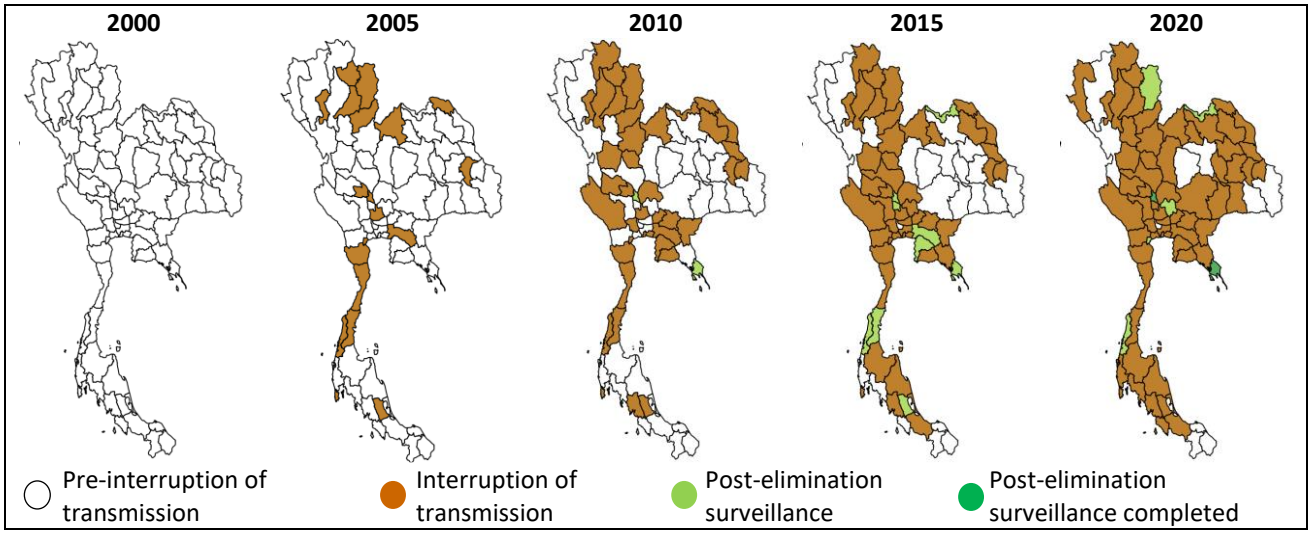
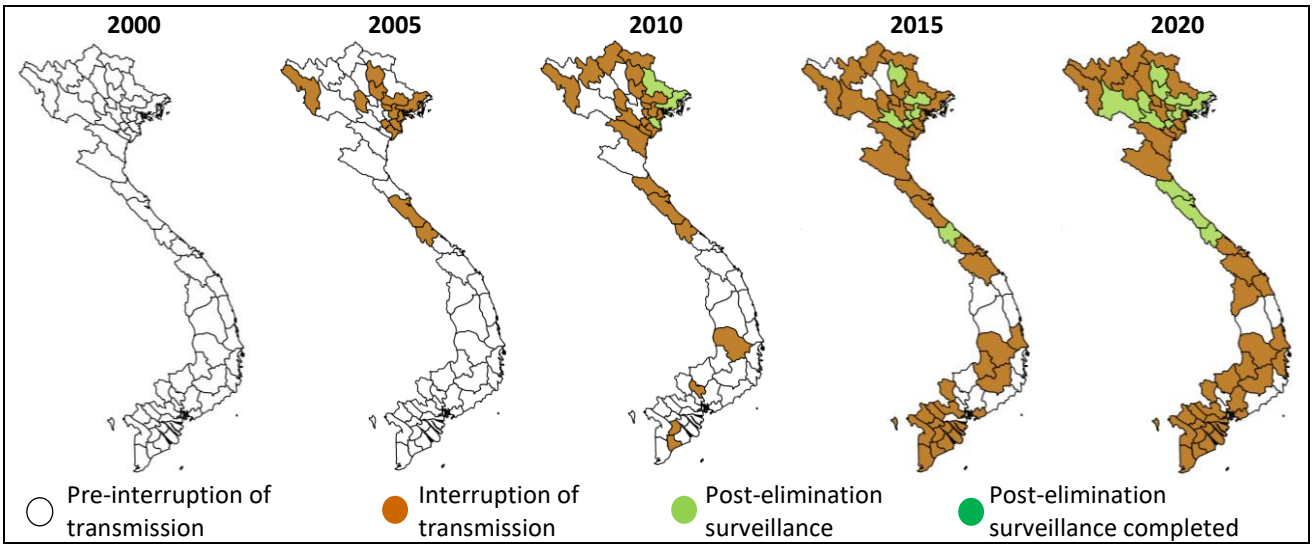


Fig. 8

: Map of Viet Nam, indicating provinces that have reached 'interruption of transmission', 'elimination of disease' or have completed 10 years of post-elimination surveillance



In theory, such analysis could be done at even lower administrative levels. The advantage would be that interruption of transmission and disease elimination can likely be declared earlier. It is, however, not recommended to do this as declaration of these achievements should be properly assessed by an (internal) team; there may simply be too many assessments to be made if lower administrative tiers are also considered.

6.4. Learning from tuberculosis: Monitoring progress towards a TB-free India

Dr Manoj Murhekar, Director, National Institute of Epidemiology (Chennai, India), presented surveillance indicators used in TB as well as the process that is recommended for verification of sub-national claims. The verification process includes review of programmatic data (TB score, number of cases to treat prophylactically to prevent one case, sales of medicines (public and private consumption data) and community-based surveys.

The National Tuberculosis Programme has the following targets and indicators:

- End tuberculosis by 2023:
    - 80% reduction in the TB incidence rate by 2020, compared to 2015;
    - 90% reduction in annual number of TB deaths by 2030, compared to 2015;
    - No TB-affected households face catastrophic costs by 2020.
- Impact indicators:
    - To reduce the estimated TB incidence rate (per 100 000 population);
    - To reduce the estimated TB prevalence rate (per 100 000 population);
    - To reduce the estimated TB mortality rate (per 100 000 population);
    - To achieve zero catastrophic costs incurred by TB-affected families.

Monitoring progress towards "TB-free" status at sub-national level is crucial. A system to incentivize and reward well performing districts and/or states has been initiated.

Programmatic data collection includes: review of records; interview with stakeholders; and visits to facilities (health facility, centre for anti-retroviral treatment) and patients (home visits).

Community-based survey includes inverse sampling method, i.e. a fixed number of bacteriologically positive TB cases to be found in each district and the objectives are to estimate the incidence of TB in the districts and estimate underreporting of notification in *Nikshay*. The sampling strategy is as follows:

- ✓ Each district is divided into survey units based on the number of TB Units;
- ✓ One village/ward is selected from each survey unit by probability proportional to population size sampling method;
- ✓ A household is randomly selected from the cluster;
- ✓ Eligible individuals were identified from each household as per the recommended scheme;
- ✓ Individuals were enrolled till 30 bacteriologically positive TB cases were found in each district.

The following indicators are used in the community-based surveys:

- ✓ Proportion of participants who are: (i) eligible for sputum sample collection; (ii) symptomatic;
- ✓ Incident cases: (i) new cases identified during survey; AND (ii) patients on TB treatment; AND (iii) persons with history of TB after March 2020;
- ✓ Underreporting: proportion of participants who are currently treated for TB and with past history of TB not found in *Nikshay.*

As part of the verification process, it is recommended to verify sub-national claims as shown in Table 7.

Table 7: *Verification of sub-national TB-free claim*

Recommendation	Criteria
Not recommended under any category	Any of the three incidence estimates higher than 10% of the baseline estimate
Recommended under claimed category	Any two (out of the three) point estimates of decline in incidence support claimed category No estimate of incidence shows an increase from baseline incidence
Recommended for higher than claimed category	Any two (out of three) point estimates of decline in incidence support higher than the claimed category If the decline in incidence based on lower bounds of CIs of incidence estimates support higher category
TB-free status	All three incidence estimates are <44/100,000 population

Table 8 shows the distribution of districts and states by TB status.

Table 8: *Distribution of districts and states by TB status/award, India, 2020*

Reduction in TB incidence in 2020 as compared to 2015	Award / Status	Number of districts	Number of states / union territories
20%-40%	Bronze	55	2
41%-60%	Silver	9	0
61%-80%	Gold	2	1
>80%	"TB-free"	1	0
Total		**67**	**3**

7. Leprosy Transmission Assessment Survey

A discussion was initiated based on the criteria/considerations for different phases of leprosy which were presented earlier. A 'leprosy *elimination* assessment survey' was proposed as one of the criteria for ascertaining zero leprosy status and announcing interruption of transmission at second sub-national level and elimination of disease at national level. In line with the suggestions from the participants, the procedure was renamed to 'leprosy *transmission* assessment survey' (LTAS).

LTAS is proposed to ensure availability of services for detecting all cases in the community early enough (before deformities have developed and transmission occurs among healthy individuals). LTAS comprises of review of epidemiological data, health facility assessment and data validation through field survey and verification of the criteria/considerations.

- **Review of epidemiological data**

Epidemiological analysis through review of data at second sub-national level for a period of 10-20 years. The data will be presented in the format used for analysis of data – i.e. new child cases and total cases – as applied for Maldives, Morocco, Thailand and Viet Nam (see annexes). These data can easily be linked to serial country maps, showing the evolution from pre-interruption over interruption of transmission to disease elimination and eventually completion of ten years post-elimination surveillance.

- **Health facility assessment**

Health facility assessment will be carried out in a sample of health facilities to verify availability of diagnostic services, knowledge and skills of staff and MDT at health facilities providing treatment for the patients. Care for ulcers or disabilities and measures to reduce stigma and improve mental health will also be assessed.

- **Data validation through field survey**

A field survey is included in LTAS as there is currently no objective test available to confirm infection in the community. A sample of contacts – children and population at-risk – would be checked for leprosy. The calculation of sample size for each sub-national unit will be recommended after detailed discussion with epidemiologists and statisticians.

- **Verification of the criteria/considerations**

LTAS is recommended to be undertaken by internal teams for the sub-national (typical second-tier) level units at the time of reaching the stage of 'Interruption of transmission'. LTAS will be used as a pre-qualification tool for ascertaining that this unit has reached 'interruption of transmission'. When all second-tier sub-national units in one first-level tier unit have reached 'interruption of transmission', the first-level sub-national unit is "automatically" declared as having reached interruption of transmission. When all first-level tiers have reached this benchmark, then interruption of transmission is declared country-wide.

Similarly, when the criteria for elimination of disease have been achieved in all second-level sub-national jurisdictions within a first-level jurisdiction, the first-level jurisdiction is considered as having reached disease elimination. When all first-level jurisdictions have reached elimination of disease,

the country is considered as having reached disease elimination. This situation still allows for sporadic cases to occur after disease elimination has been reached at second- or first-level tier, hence the need for maintaining post-elimination surveillance for at least ten years. An international team would be constituted to verify disease elimination at national level.

8. Dossier template for interruption of transmission and elimination of leprosy disease

8.1. Country Dossier: contents, inputs from other health programmes

Dr V R R Pemmaraju, presented a dossier structure or contents taking inputs from other health programmes.

A Country Dossier is prepared by the country. It contains all evidence to claim achievement of elimination of leprosy at national level (following achievement at all subnational levels). It is submitted to WHO with a request to have the claim verified. The supporting evidence includes epidemiological evidence, programmatic criteria and programmatic achievements.

8.2. Background information

A Country Dossier typically provides general information about the country – geographic information and population details with reference to recent census or population statistics reports of the country. The population details also include mid-year population used for calculation of epidemiological indicators in health programmes. Description of recent health surveys can be presented to give information to international team about monitoring of health programmes. Details of surveillance mechanisms used for detecting cases in other disease control programmes would help the external evaluation team.

Social determinants of health including social and development factors, economic condition of people, literacy levels in different population groups, information about access to services by women and poverty need to be included in the dossier. This background information can be brief, but all the statements need to be substantiated with the indicators drawn from national statistics (e.g. literacy level can be described with mean years of schooling).

Information about the health system, defining how it is organized, the details of human resources (different segments of health staff) needs to be presented. Capacity building initiatives, facilities for training of health staff would help in understanding the ways of sustaining skills of health staff in the country. Monitoring and reporting mechanisms, frequency of reporting and information about data management systems need to be included under general health information. This also helps in understanding the supervision of health programmes. Budget allocations and expenditures over a period of ten years would indicate the health system functioning and indirectly political commitment for health.

A detailed organogram is usually included in a dossier giving details of health facilities at different levels: primary, secondary and tertiary levels. Detailed information about apex centres (if present) at national level needs to be included. Any other information about health systems would help understand the effectiveness of health systems. Reference to recent evaluation reports of disease control programmes would help the external evaluation team about other health interventions.

8.3. Mandatory information about leprosy control

While the background information is optional, mandatory information in the dossier include information about leprosy control activities. History of leprosy programme, with details of evolution of MDT programme, other interventions in the programme such as case detection, treatment and epidemiological data. The contents of a proposed Country Dossier are presented below:

1. **History of leprosy control**
    a. Trends of leprosy in the country
    b. Evolution of leprosy programme
    c. Standard operating procedures (basis for verification)
    d. Achievements
2. **Sub-national units assessed**
    a. Sub-national jurisdictions (hierarchy)
    c. Number of units
3. **Classification of sub-national units**
    a. Endemicity level
    b. Baseline for analyzing trends (availability of data)
    c. Epidemiological indicator(s) for assessment
4. **Planning**
    a. National strategic plans
    b. Standard operating procedures
    c. Resources: allocation and use
    d. Inclusion of partners and persons affected by leprosy
5. **Programme implementation (period to be assessed)**
    a. Interventions or actions taken
    b. Case detection
    c. Case management

6. **Indicators monitored**
    a. Input, process and output indicators
    b. Outcomes/results
    c. Data to be reviewed
7. **LTAS exercises carried out at sub-national units**
    a. Summary of reports (spread sheets on LTAS)
    b. Protocols
    c. Sampling procedure
    d. Detailed reports from selected units
8. **Final list of criteria for verification**
    a. Criteria/considerations (described in the matrix) to be verified
    b. Data collection formats for verification
    c. Verifiable indicators as per the Matrix for each of the activity
    d. Reporting format

Support will be provided to countries for preparing a dossier to claim elimination of leprosy. The Country Dossier will form the basis for verification of elimination of leprosy disease by an external team. The external team may visit the country and ascertain the report contents through desk review and field visits to select health facilities.

In countries where no case of leprosy was detected for more than ten years and a dedicated leprosy programme is not operational, preparing a dossier and verification by an external team might not be realistic. Alternate innovative ways of verification, e.g. zero reports for the past ten years to be considered equivalent to dossier and announcement to be made on presence of an effective surveillance or disease notification systems.

9. Conclusions and recommendations

Conclusions and recommendations from group work, discussions during the presentations and consultations with TFCEL members are compiled under five components: (i) concepts; (ii) definitions and indicators; (iii) matrix for defining phases of elimination of leprosy; (iv) application of cut-off levels and analysis of sub-national level data; and (v) LTAS and Country Dossier preparation.

1. Concepts and definitions used in discussions about elimination of leprosy were agreed
    - Autochthonous case
    - Population at risk
2. Indicators to be used for monitoring interruption of transmission and elimination of disease were discussed and listed for use in verification exercise;

3. Four phases in the elimination pathway were defined:
    - Phase 1: till elimination as a public health problem
        - most countries have achieved this at national level;
        - progress towards elimination to be monitored and supported at country level
    - Phase 2: till interruption of transmission
    - Phase 3: till elimination of disease
    - Phase 4: post-elimination surveillance
4. Cut-off levels for each phase agreed
    - Elimination as a public health problem: prevalence of less than 1 case per 10 000 population
    - Interruption of transmission: zero autochthonous child case for five consecutive years
    - Elimination of disease: zero autochthonous cases for at least three years (can be up to five years so that it does not occur before interruption of transmission)
    - Post elimination surveillance: ten years, in order to pick up sporadic cases that may occur during this phase. Active surveillance (with zero reporting) can be discontinued after ten years but case reporting should continue as new cases can occur – rarely – even after ten years after elimination was declared.
5. Criteria/considerations, facilities/interventions and indicators:
    - 14 criteria/considerations were suggested for verification
    - Facilities/interventions to be implemented as part of
    - Outcome indicators and targets identified for reviewing and verification process
    - Separate criteria for stigma/discrimination to be included depending on country situation
6. Countries need to develop country-owned national strategic plans
    - Standard operating procedures (to be made available for the verification)
    - Capacity building plan to sustain clinical and programmatic expertise to be available (including care after cure)
7. Sero-prevalence for anti-*M. leprae* PGL-I IgM antibodies among children to be considered as a potential test for assessing transmission in a community.
    - Number of children (optimal age group to be determined) in a given sample who test positive for anti-*M. leprae* PGL-I IgM antibodies;
    - Prevalence (percentage) of the total number of children who test positive for anti-*M. leprae* PGL-I IgM antibodies in a sample would be used to monitor trends;

- Further research in using PGL-l test is recommended for inclusion as test for assessing interruption of transmission in programmatic condition.

8. Surveillance and data management systems should be available
    - Surveillance of disease control programmes/ system for notification of cases
    - Web-based reporting systems
    - Mandatory notification of sporadic cases
9. Surveillance indicators for leprosy programme needs to be developed
    - e.g. surveillance of poliomyelitis is based on the number of cases with acute flaccid paralysis registered in health services
10. Application of data sets to real time data of four countries pretty well confirmed the assumptions in defining the cut-offs
    - Data sets from Maldives and Morocco were reviewed:
        - Reversal to pre-elimination may occur in case of a cluster of cases (defined as two cases in one year or cases in two consecutive years in one second-level subnational jurisdiction). However, if such cases can be assessed as truly unrelated to each other, then they can be considered as 'sporadic' (and not as 'cluster') without reversal.
        - sporadic cases (even sporadic child cases) may occur after disease elimination has been declared, but these do not seem to lead to a resurgence. A critical incident investigation should be carried out for each such case.
    - Sporadic autochthonous cases can even occur after completion of post-elimination phase of 10 years
    - There may be a need for sustaining systems for treatment of cases as well as care after cure, even after the post-elimination surveillance phase is completed (e.g. in case of sporadic autochthonous cases, foreign-born (imported) cases. or as long as persons with leprosy-related disabilities are still alive).
11. Countries are expected to carry out an assessment at sub-national level
    - Reports of sub-national level assessments (by internal teams) need to be included in the dossier at national level.
12. LTAS is recommended for countries:
    - to assess interruption of transmission (by internal teams) for all second-tier sub-national units
    - to assess elimination of disease (by internal teams) for all second-tier sub-national units
    - to verify elimination of disease (by WHO with external team) at the national level.

13. Detailed technical guidance will be provided to countries on the following topics

    - LTAS protocols and reporting
    - Developing a Country Dossier to claim elimination of disease by an external team
    - Critical incident investigation for sporadic cases

14. Other factors

    - Zoonotic transmission: a protocol to investigate possible transmission of *M. leprae* from the nine-banded armadillos (in the Americas region) has been developed;
    - Leprosy caused by *M. lepromatosis*, an organism similar to *M. leprae*, should also be considered.

Annex 1: Programme

Wednesday 24 March 2021		
IST		**Face-to-face meeting sessions**
09:00-09:30 am		**Opening Session** Welcome – Dr Erwin Cooreman Objectives and expected outcomes – Dr V R R Pemmaraju Inaugural address – Ms Rekha Shukla Introduction of participants Group photo
09:30-10:00 am		Informal Consultation on defining criteria to declare elimination of leprosy: Conclusions and recommendations; Mexico City, Mexico, 10-12 February 2020 – Dr Md. Jamsheed Ahmed
10:00-10:30 am		Task force on definitions, criteria and indicators for transmission and elimination of leprosy (TFCEL): Overview and processes – Dr Erwin Cooreman
10:30-11:00 am		***Tea/Coffee***
11:00-11:30 am		Migration in leprosy – discussions – Mr John Kurian George
11:30 am-12:00 noon		Framework of control, elimination and eradication of NTDs and other factors in transmission of leprosy (e.g. role of armadillos, *M. lepromatosis*)
12:00 noon-12:30 pm		Concepts, definitions and indicators for interruption of transmission and elimination of disease (presentation) – Dr Vivek Lal
12:30-1:30 pm		Definitions, concepts and indicators for interruption of transmission (discussion) – Dr Vivek Lal; Dr VK Pannikar
01:30-2:30 pm		***Lunch***
2:30-3:30 pm		Concepts definitions, and indicators for interruption of transmission and elimination of diseases (discussion) – Dr Vivek Lal; Dr VK Pannikar [contd]
IST	**CET**	**Virtual meeting sessions**
06:00-06:30 pm	01:30-02:00 pm	Summary of discussions from face-to-face meetings – Dr Vineet Chadha
06:30-07:00 pm	02:00-02:30 pm	Discussion to finalize phases toward interruption of transmission – Dr Wim van Brakel
07:00-07:30 pm	02:30-03:00 pm	Discussion to finalize definitions of concepts: Interruption of transmission – Dr Wim van Brakel
07:30-07:45 pm	03:00-03:15 pm	***Break***
07:45-08:15 pm	03:15-03:45 pm	Discussion to finalize indicators: interruption of transmission – Dr Wim van Brakel
08:15-08:45 pm	03:45-04:15 pm	Analysis of data from Brazil by municipality – Dr Mauricio L Nobre
08:45-09:15 pm	04:15-04:45 pm	Conclusions on the phases, concepts and indicators for interruption of transmission – Dr Wim van Brakel
Thursday 25 March 2021		
IST		**Face-to-face meeting sessions**
09:00-09:30 am		Conclusions on the phases, concepts and indicators – Dr Jerry Joshua
09:30-10:00 am		Draft criteria/considerations (epidemiological, programmatic and laboratory investigations) – Dr V R R Pemmaraju
10:00 -10:30 am		Application of data from Brazil – Dr Mauricio L Nobre
10:15-11:00 am		Application of indicators on a low-endemic setting – Maldives data – Dr Sana Saleem
11:00-11:30 am		***Tea/Coffee***

11:30-12:00 noon		Application of data on two low endemic districts – Tamil Nadu or other states	
12:00 noon-12:30 pm		Surveillance indicators for tuberculosis-free status – Dr M Murhekar	
12:30-01:30 pm		**Group work 1**: Epidemiological indicators, programmatic criteria for interruption of transmission in leprosy	**Group work 2**: Leprosy Elimination Assessment Survey (LEAS) – concept, terminology and components and feasibility
01:30-02:30 pm		***Lunch***	
02:30-03:30 pm		Presentations and discussions from group work	
IST	**CET**	**Virtual meeting sessions**	
06:00-06:30 pm	01:30-02:00 pm	Summary of discussions from face-to-face meetings – Mr John Kurian George	
06:30-07:15 pm	02:00-02:45 pm	Discussion to finalize epidemiological indicators and programmatic criteria for interruption of transmission and elimination of disease – Dr Wim van Brakel	
07:15-07:30 pm	02:45-03:00 pm	***Break***	
07:30-08:15 pm	03:00-03:45 pm	Discussions to finalize concept, terminology and components of LEAS – Dr Wim van Brakel	
08:15-09:00 pm	03:45-04:30 pm	Conclusions on programmatic criteria, epidemiological indicators and LEAS – Dr Wim van Brakel	
Friday 26 March 2021			
IST		**Face-to-face meeting sessions**	
09:00-09:30 am		Conclusions on programmatic criteria, epidemiological indicators and LEAS – Dr Vineet Chadha	
09:30-10:00 am		Guidance to national programmes on verification of elimination of diseases – Dr Zaw Lin	
10:00-10:30 am		Dossier – contents inputs from different health programmes – Dr V R R Pemmaraju	
11:00-11:30 am		***Tea/Coffee***	
11:30 am-01:00 pm		**Group work 3**: Data management and documentation of interruption of transmission and elimination of the disease (sub-national level)	**Group work 4**: Development of dossier template for interruption of transmission and elimination of leprosy disease (contents for national programmes)
01:00-01:30 pm		Presentations and discussions	
01:30-02:30 pm		***Lunch***	
02:30-03:30 pm		Presentations and discussions [Contd]	
IST	**CET**	**Virtual meeting sessions**	
06:00-06:30 pm	01:30-02:00 pm	Summary of discussions from face-to-face meeting – Dr Vivek Lal	
06:30-07:15 pm	02:00-02:45 pm	Discussion on surveillance and response for achieving interruption of transmission – Dr Wim van Brakel	
07:15-07:30 pm	02:45-03:00 pm	***Break***	
07:30-08:15 pm	03:00-03:45 pm	Discussion to finalize – Template of dossier – Dr Wim van Brakel	
08:15-09:00 pm	03:45-04:30 pm	Conclusions: Dr Wim van Brakel Surveillance and response systems: reaching interruption of transmission, elimination of leprosy disease and post-elimination surveillance Template and contents of dossier	
09:00-09:30 pm	04:30-05:00 pm	Closing remarks – Ms Rekha Shukla Conclusion of meeting and next steps: Dr Erwin Cooreman	

Annex 2: List of participants

Government representatives

In person:

Ms Rekha Shukla
Joint Director (Health, Leprosy and NTDs)
Ministry of Health and family Welfare
India

Dr Sunil Gitte
Assistant Deputy Director General (Leprosy)
Ministry of Health and Family Welfare
India

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Director Public Health and Preventive Medicine
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Tamil Nadu, India

Dr V Dharmalingam
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Dr P Yamuna
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Dr P Manickam
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Remotely connected:

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Health Protection Agency
Ministry of Health
Maldives

Dr Benedict Quao
National Leprosy Programme manager
Ministry of Health
Ghana

Dr Raisa C Rumbaut Castillo
Ministry of Public Health
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Partner agencies

In person:

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Mr John Kurian George
Chief Executive Officer
Fairmed India
Gurugram, Haryana, India

Dr Vivek Lal
Chief Executive Officer
Sasakawa India Leprosy Foundation
New Delhi, India

Remotely connected:

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Medical Director
Until No Leprosy Remains
Amsterdam, The Netherlands

Ms Mondie Tharp
Project Manager
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Basel, Switzerland

Professor Takahiro Nanri
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Sasakawa Health Foundation
Tokyo, Japan

Ms Aya Tobiki
Chief Program Officer, Hansen's Disease Program
Sasakawa Health Foundation
Tokyo, Japan

Ms Kiyomi Takahashi
Program Director, Hansen's Disease Program
Sasakawa Health Foundation
Tokyo, Japan

Mr Geoff Warne
Chief Executive Officer
International Federation of Anti-Leprosy Associations
Cointrin, Switzerland

Others

In person:

Dr Vijay Kumar Pannikar
Hosuru, Karnataka, India

Dr Rajan Babu
Karigiri, Tamil Nadu, India

Remotely connected:

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Ms Christine Fenenga
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Amsterdam, The Netherlands

World Health Organization

In person:

Dr Erwin Cooreman
Team Leader, Global Leprosy Programme
WHO Regional Office for South-East Asia

Dr V R R Pemmaraju
Technical OFficer, Global Leprosy Programme
WHO Regional Office for South-East Asia

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WHO Regional Office for South-East Asia

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WHO Country Office for India

Remotely connected

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Mr Subhash Chand
Executive Assistant, Global Leprosy Programme
WHO Regional Office for South-East Asia

Annex 3: TFCEL members

Chairperson

Dr Wim van Brakel
Medical Director
Until No Leprosy Remains
Amsterdam, The Netherlands

Members (including former members)

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(former) Director
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Chengalpattu, Tamil Nadu, India

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Health Protection Agency
Ministry of Health
Male', Maldives

Dr Raisa C Rumbaut Castillo
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Dr Tiara Prakasi
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Dr Epco Hasker
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Dr Abraham Aseffa
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WHO Secretariat

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WHO Regional Office for South-East Asia

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Hosuru, Karnataka, India

Mr John Kurian George
Chief Executive Officer, Fairmed India
Gurugram, Haryana, India

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Global Business Director, Leprosy Flagship
Global Health & Corporate Responsibility
Novartis AG
Basel, Switzerland

Dr Peter Steinmann
Swiss Tropical and Public Health Institute
Basel, Switzerland

Professor Takahiro Nanri
Executive Director
Sasakawa Health Foundation
Tokyo, Japan

Dr Nuzha Mohamed
President
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Professor Annemieke Geluk
Leiden University
Leiden, The Netherlands

Annex 4: Maldives leprosy data

Five years no children (till end of Phase 2)
Interruption of transmission
1 Sporadic child after interruption of transmission
Three consecutive years of zero leprosy
Till end of phase 3
10-year post-elimination surveillance period
1 Sporadic case during surveillance period
Post-elimination surveillance period completed
1 Sporadic case after 10 years of post-elimination

Island / City / Atoll	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		2020	
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Gaafu Alif Atoll		**1**				**1**	**3**	**5**								**2**							**1**					**1**										**1**		
Madaveli		1		1																																			
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Faresmaathodaa																														1						2		1		
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Gaafu Dhaalu Atoll		**1**		**1**				**1**						**1**						**1**		**1**								**1**				**1**		**2**		**1**		
Male' City		**3**		**1**		**1**		**1**		**3**				**1**								**2**		**4**		**1**						**1**		**1**						
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Maradhoo-Feydhoo																																								
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Hirimaradhoo						1																																		
Nolhivaranfaru																				1						1				3		1		1	1	1				2		
Nellaidhoo																																								
Nolhivaramu																		1																						
Kuribi																																								
Kulhudhuffushi				2		2																																		
Kumundhoo																																								
Neykurendhoo																																								
Vaikaradhoo	1	2		1		1																														1				1
Makunudhoo																																								
Haa Dhaalu City	**2**	**4**	**1**	**5**		**4**								**1**		**1**		**1**		**1**						**1**				**3**		**1**		**1**	**1**	**1**		**1**		**2**		**1**

Atoll	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		2020	
	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages
Haa Alif Atoll			1	2	1	1				1	1	3		2		2		1						1																
Shaviyani Atoll		1				1												1						1																
Noonu Atoll			1	2			1	3				1												1						1										
Raa Atoll		1	1					1				1		1		1							1	1						1				1						
Baa Atoll	2	3																		1																				
Lhaviyani Atoll	1	2		1	6	7	1	1			2	3		1		1		1		1				1																
Kaafu Atoll		3		2	4	4	1	2		2	1	1				1				2		1				2	1	1		1	1	1				1				
Alif Alif Atoll																																				1				
Alif Dhaal Atoll	2	3		1				1				1																1												
Vaavu Atoll		1	1	1		1		2																1																
Meemu Atoll						1																																		
Faafu Atoll			2	2			1	2								1				2								1						1						2
Dhaalu Atoll																						1		1																
Thaa Atoll												2		1																										
Laamu Atoll		2	1	4	2	5				1		2				2		1		1								1												
Gaafu Alif Atoll		1				1	3	5								2								1				1												1		
Gaafu Dhaalu Atoll		1		1				1						1						1		1								1				1		2		1		
Male' City		3		1		1		1		3				1								2		4		1						1		1						
Gnaviyani City																																									
Seenu/Addu City	1	2		2	2	3		1		1	1	1						1		2				1		2								1				1		
Haa Dhaalu City	2	4	1	5		4								1		1		1		1						1				3		1		1	1	1		1		2		1
Maldives	8	27	8	24	15	29	7	20		8	5	15		8		11		6		11		5	1	12		6	1	2		9	1	3		3	1	5		7		5		3

Annex 5: Morocco leprosy data

Five years no children (till end of Phase 2)
Interruption of transmission
1 Sporadic child after interruption of transmission
Three consecutive years of zero leprosy
Till end of phase 3
10-year post-elimination surveillance period
1 Sporadic case during surveillance period
Post-elimination surveillance period completed
1 Sporadic case after 10 years of post-elimination

Prefecture / Province / Region	2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		2020	
	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages
M'diq-Fnideq																1		3		2				2		1				1						
Tangier-Assilah		1		1		2				2		1		1		3				3		1								2		2				
Al Hoceima						1	2	2								1				1				1								1		1		
Chefchaouen		4		1		1	1	1		4		3		5		5						7		7				1				2		1		1
Fahs-Anjra																															1	1				
Larache		7		1		10	1	2		4				4		3		7	1	7		8		3		5		3		2		2	1	5		1		
Ouezzane		1	1	3	1	7		2		3		2		6	1	4		2		3		1				1				1						
Tétouan		2		3		1						3		2		3		6		2		3				2										1
Tanger-Tétouan-Al-Hoceima		**15**	**1**	**9**	**1**	**22**	**4**	**7**		**13**		**9**		**18**	**1**	**20**		**18**	**1**	**18**		**20**		**13**		**9**		**4**		**4**		**4**	**2**	**11**		**3**		**2**
Oujda-Angad		1																				1						1		1						
Berkane		1																				1						1								
Driouch	1	1						2		2										1												1				
Figuig				1		1								3								2		1												1
Guercif		2	2	5				1		1		1																		2		1				
Jerada																																				
Nador		1			2	3		1				1		2		2		1				1								2				1		
Taourirt						2		2		1				1				1						2		1		4								
Région orientale	**1**	**6**	**2**	**6**	**2**	**6**		**6**		**4**		**2**		**6**		**2**		**2**		**1**		**5**		**3**		**1**		**6**		**1**		**4**		**2**		**1**		**1**
Fès		2		1		1				4														2		1										
Meknès				1		4	1	1						1						4		1		1				1		3				1		
Boulemane		6		6		3		5		3		3		7		2		1	2	12		2		3		1		2		6		2				1	
El Hajeb				2		2								1																1						
Ifrane		1						1		1						1				1				1				1								
Sefrou																								1										1		

Prefecture / Province / Region	2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		2020	
	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages
Taounate		2		1		2		3		5		3		6		4		2	1	2		2		3		1		2		4				2		2		
Taza		2		1		2		2		1		3		2				1										5				3				3		
Moulay Yacoub																														1								
Fès-Meknès		**13**		**12**		**14**	**1**	**12**		**14**		**9**		**17**		**7**		**4**	**3**	**19**		**5**		**11**		**3**		**10**		**15**		**5**		**2**		**8**		
Rabat		2								1		1				1				1				1								1						
Salé		1		2				2		1								3				1		1		2		1										
Skhirat-Temara								1														1																
Kénitra	1	2				3	1	3	1	5		2				3		2		1		1		2	1	2				1				1		1		
Khémisset																				1		1				1		1										
Sidi Kacem		6		4		4		4		2	1	3		2		1	1	3			1	2	1				1	3		1		2		1		1		1
Sidi Slimane										1		2				2								2				1										
Rabat-Salé-Kénitra	**1**	**11**		**6**		**7**	**1**	**10**	**1**	**10**	**1**	**8**		**2**		**7**	**1**	**8**		**3**	**1**	**6**	**1**	**6**	**1**	**5**	**1**	**6**		**2**		**3**		**2**		**2**		**1**
Azilal		1				1				6								1				1								1								
Béni-Mellal		1		1						1						1																		1				
Fquih Ben Salah	1	2		1						2		1		2								1																
Khénifra										1						1																						
Khouribga																																		1				
Béni Mellai-Khénifra	**1**	**4**		**2**		**1**				**10**		**1**		**2**		**2**		**1**				**2**								**1**				**2**				
Casablanca		3		4		4		1	1	1				4				2		2				1		2		1		1								
Mohammedia										1				2																								
Ben Slimana				1												1		1								2												
Berrechid						2		1																														
El Jadida								1		1		1						2		1										1								
Médiouna								3										1								2												
Nouaceur																								1	1	1												
Settat		1	1	2				2											1	1		1																
Sidi Bennour		1		3					1	2		4		1				1		5				1								1		1		2		1
Casablanca-Settat		**5**	**1**	**10**		**6**		**8**	**2**	**5**		**5**		**7**		**1**		**7**	**1**	**9**		**1**		**3**	**1**	**7**		**1**		**2**		**1**		**1**		**2**		**1**
Marrakech					1	1				1								1										1				1						
Al Haouz																1				1																		
Chicahoua																								1														

Prefecture / Province / Region	2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		2020	
	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages
El Kelâat Es Sraghna						2																				1		1				3				1
Essaouira				4		2						2																								
Rehamna										1														1												
Safi	1	1										1								1				1				1								
Youssoufia				1		1		1												1		2														1
Marrakech-Safi	**1**	**1**		**5**	**1**	**6**		**1**		**2**		**3**				**1**		**1**		**3**		**2**		**2**		**1**		**3**		**1**		**1**		**3**		**2**
Errachidia																		1																		
Midelt												1																								
Ouarzazate																																				
Tinghir	1	4														1																				1
Zagora																																				
Drâaa-Tafilalet	**1**	**4**										**1**				**1**		**1**										**1**								**1**
Agadir-Ida Ou Tanane														1		1						1														
Inezgane-Aït Melloul										2														1								1				
Chtouka Aït Baha														1										1		2										
Taroudant														1				2								1		1								
Tata																																				
Tiznit																																				
Souss-Massa										**2**				**3**		**1**		**2**				**1**		**2**		**3**		**1**				**1**				
Assa-Zag																																		1		
Sidi Ifni						1						1		1						1		1						1								
Guelmin																																				
Tan-Tan												1																								
Guelmin-Oued Noun						**1**						**2**		**1**						**1**		**1**						**1**						**1**		
Boujdour																																				
Es Semara																																				
Laâyoune		1																																		
Tarfaya											1	1																								
Laâyoune-Sakia El Hamra		**1**									**1**	**1**																								

Prefecture / Province / Region	2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		2020	
	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages
Aousserd																						1														
Oued Ed-Dahab																		2				1														
Dakhla-Oued Ed-Dahab																		**2**				**2**														

Region	2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		2020	
	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages
Tanger-Tétouan-Al-Hoceima		15	1	9	1	22	4	7		13		9		18	1	20		18	1	18		20		13		9		4		4		4	2	11		3		2
Région orientale	1	6	2	6	2	6		6		4		2		6		2		2		1		5		3		1		6		1		4		2		1		1
Fès-Meknès		13		12		14	1	12		14		9		17		7		4	3	19		5		11		3		10		15		5		2		8		
Rabat-Salé-Kénitra	1	11		6		7	1	10	1	10	1	8		2		7	1	8		3	1	6	1	6	1	5	1	6		2		3		2		2		1
Béni Mellai-Khénifra	1	4	0	2		1				10		1		2		2		1				2								1						2		
Casablanca-Settat		5	1	10		6		8	2	5		5		7		1		7	1	9		1		3	1	7		1		2		1		1		2		1
Marrakech-Safi	1	1		5	1	6	0	1		2		3				1		1		3		2		2		1		3		1		1		3				2
Drâaa-Tafilalet	1	4										1				1		1												1								1
Souss-Massa										2				3		1		2				1		2		3		1						1				
Guelmin-Oued Noun						1						2		1						1		1						1								1		
Laâyoune-Sakia El Hamra		1									1	1																										
Dakhla-Oued Ed-Dahab																		2				2																
Morocco	5	60	4	50	4	63	6	44	3	60	2	41		56	1	42	1	46	5	54	1	45	1	40	2	29	1	32		27		18	2	22		19		8

Annex 6: Thailand leprosy data

Five years no children (till end of Phase 2)
Interruption of transmission
1 Sporadic child after interruption of transmission
Three consecutive years of zero leprosy
Till end of phase 3
10-year post-elimination surveillance period
1 Sporadic case during surveillance period
Post-elimination surveillance period completed
1 Sporadic case after 10 years of post-elimination

Province / Region	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		2020	
	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages
Chiang Mai	8	67		47		26		20	1	26		21	1	27		16	2	23		18	1	15	1	22		26		15		31		11	1	17		14		25		10		12
Lamphun		1		1		2		2				4		1		3		3		1		2		2		3		3		2		1				2				1		1
Lampang		14		14	1	3		7		3		4		5				4		2		2		3		2		1		4		6		1						4		3
Uttaradit		6		5		4		3		1		2		2		14		7		3						3		2		4				1						1		
Phrae		1		1						1												1		2								2				1				1		1
Nan		4				1		1				2		1		1		2		2		2		1				1												5		
Phayao		1		4		1		1		2		1		1						1		1						2														
Chiang Rai		16	1	8		12	1	18		19		11		11		11		13		6		14		15		7	1	11		3		11		14		6		7		5		7
Mae Hon Son	2	18	2	18	1	7		21		10	2	14		11		7		13	1	3	1	10	1	5		9		6		2		10		6		8		4	1	3		2
Nakhon Sawan		25	1	16		13		6	1	10	1	19		17		14		112	1	9		14		4		4		8		3		7		4		5		5		3		1
Uthai Thani	1	2		6		3		1		2		5		2		3		2		1		1		3		1		1												2		
Khampaeng Pet		31		16	2	21		13	1	9	1	15		5		8		7		7	1	5		8		8	2	2		57		58		2		1				1		2
Tak	1	12		1		2		5		2		1		3		2		3		2		3	1	4		2	1	6	2	8		8		9		3	2	11		2		5
Sukhothai	2	19	1	13		13		4		7	1	10		7		12	1	7		9	1	7		1		3		4		5						2				1
Phitsanolok	1	10	1	8		7		6		4		2		3				1		1	1	4		4		2		3		2		6		2		3		1				
Phichit		7		6		8		6	1	5		4		2		3		1		4	1	4		2		2		1		1						3				2		
Phetchabun		18		16	1	17		11		8		6		7	2	16		9		12		7		5		4		3		6		3		6				1		1		6
Northern Region	**15**	**252**	**6**	**180**	**5**	**140**	**1**	**125**	**4**	**109**	**5**	**121**	**1**	**105**	**2**	**110**	**3**	**207**	**2**	**81**	**6**	**92**	**3**	**81**		**76**	**4**	**69**	**2**	**128**		**123**	**1**	**62**		**46**	**2**	**56**	**1**	**41**		**41**
Bueng Kan		1		2		4		2		7		6		4	1	4		4		2		1		1		1		2		3		1				2		1				1
Nong Khai	1	2		2	1	6		2		2		6		4		4		9		3		2		2												2						3
Loei		2		1		5		2		1		1		1		1						4		3						1		2		1		1				3		3
Nong Bua Lamphu		14		16	1	21	1	15		6	1	7		5		4		4		2		7		5		1				2		2		2		7						5
Udon Thani	1	18		10		28	1	29		24	1	16	1	9	3	12	1	9		8		21	1	4		8		11		9		3		1		8		1				3
Sakhon Nakhon		16		8	1	16		3		2		2		3		18		6		5		2		2		1		1		1		3		1		16						3
Nakhon Phanom	1	11		10		3		3		2		6		6		2		6		5				2				2		1						5						

Province / Region	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		2020	
	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages
Mukdahan	1	5	1	7		2		1				3		3		2		2		2						1		1				1								5
Kalasin		7		12		26		18	1	13		7		10	1	11		17		4	1	9		2		9		6		3		3			1	3		1				2
Chaiyaphun		35		26	1	44	1	27		35		37	2	28		18		18		11	1	37	1	23	1	24		12		3	1	9		11		8	1	5		6		4
Khon Kaen	3	47		45	2	48		25	2	49	3	32	2	30	1	50	1	45		11	1	41	1	11	1	34		16		16	1	11		6		10		14		5		8
Maha Sarakham		36		24		34	1	25	2	3	1	15		18		9		16		5		17	2	8		8		12		5		8		5		11	1	4		1		7
Roi Et	4	39		22	1	43	2	21		16	1	37		18	1	10		16		17	1	7		17		9		8		6		5		1		4		2		1		1
Yasothon		10		8		10		3		3		2	1	4		4		1		9		1	1	2				4				1		3		2		4				
Amnat Charoen		4	1	1		7		3				1		4		1		4				3	1	1						2		1				1				
Ubon Ratchathani	1	33		38	1	41		21	1	21		30		15	1	15		23		15		5		4		1		1				26		11	2	7		6	1	1		5
Sisaket	4	69	3	37	7	81	1	27	2	43	1	21		25		19		41		26		19		5				25		4	1	23	1	7		15		5		4		8
Surin	1	10		18	5	49	1	22		14	1	22		15		17		13		23	2	24		19		15		19		14		15		13	1	14		9		7		7
Buriram	5	89	1	72	5	86	2	51	2	66		45	2	31		31		31	2	36	2	30	1	21	2	37	1	17		17		11		14		12		4	1	8		13
Nakhon Ratchasima	3	71	4	74	2	60	2	47	1	7	1	12		28		17	2	16		33	3	25		14		26		13		12		17		7		17		5		7		18
Northeastern (Isan)	**25**	**519**	**10**	**433**	**27**	**614**	**12**	**347**	**11**	**314**	**10**	**308**	**8**	**261**	**8**	**249**	**4**	**281**	**2**	**217**	**11**	**255**	**8**	**146**	**4**	**174**	**1**	**150**		**98**	**3**	**142**	**1**	**85**	**4**	**144**	**2**	**62**	**2**	**43**		**96**
Ratchaburi	1	14	1	5		9		3		4		4	1	7		8		4		1						3						1		2						2		5
Prachua Khiri Kan		9		3		5		1		1		1		1		1		2		1						2																
Phetchaburi		2		1		3		5		2		5		5		7		7			1			2		5						1		4				1				1
Samut Songkran		2						1				1		1				1						1		1								1				1				
Kanchanaburi		12		12	1	12		8		6		7		5		2		16				3				2						1		8		4		1				6
Suphan Buri		5		7		12		1	1	4	1	8		1		6		5		3		1		1				1				1		1		1		2				3
Western Region	**1**	**44**	**1**	**28**	**1**	**41**		**19**	**1**	**17**	**1**	**26**	**1**	**20**		**24**					**1**			**4**		**13**		**1**				**4**		**16**		**5**		**7**		**2**		**15**
Bangkok		56		52	2	49	1	46	1	38		46	1	30	1	27		42		33		27		18		6		11	1	5		58		59		60		61		62		63
Nakhon Pathom		8		8	1	6		11		4		4		1		4		2		1		1		1		1						1				1		1		4
Nonthaburi		9	1	9		4		5	1	10	1	3		9		1		5		3	1	5		3		5				1		4		1		1		1				1
Pathum Thani		7		8		7		5		12	1	8		3		5	1	4		7		8		5		3		2		4		1		3		1		4				1
Samut Prakhan	3	26		17	2	21		19	1	28		15		6		10		15		3		14	1	5		4		11		2		7		1	1	12		2		4		6
Ang Thong		2		1		3		1		2	1	4		2				4						1												2		1				
Ayutthaya		7		5		2		5		5		3		3		1		3		2		2						1						1				1				1
Chainat		1		4		3		1				1		1		2		1		3		1		3		1								2				1				
Lopburi		10	1	9		5		3		7		2		6		4		7		7		1		3		1				4		3		1		3		3		1		1
Nakhon Nayok		3		1	1	6	1	5		6						3				1				1						3				1				1				
Saraburi	1	17		6		7		3	1	44		5			3	5		9		4				3				1		1		1										

Province / Region	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		2020	
	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages
Sing Buri		1		2		1		1		1				1																										
Central Region	**4**	**147**	**2**	**122**	**6**	**114**	**2**	**105**	**4**	**157**	**3**	**91**	**1**	**62**	**4**	**62**	**1**				**1**		**1**	**43**		**21**		**26**	**1**	**20**		**74**		**69**	**1**	**80**		**75**		**69**		**77**
Chonburi		17		14	1	13		7		6		1		2		1		1		1		2								1				1	1	2		1		1		
Rayong		10		4		4		1	1	6		4		6		1		4				1									2									3
Chanthaburi	2	13	2	6		9		10		10		8	1	1				6													3					1			2
Trat	1	5		1		1		1				3																												
Chachoengsao		8		10		2		1				2		4		3		4		2		1		1																3
Prachunburi		4		6		11	2	11		2				2		1		1				2	1	3			1	2				2		1		4				1
Sa Kaeo	1	10		3	1	5	1	2		5		9		1		3		4				1						5		1		8		1		1				1
Eastern Region	**4**	**67**	**2**	**44**	**2**	**45**	**3**	**33**	**1**	**29**		**27**	**1**	**16**		**9**							**1**	**4**			**1**	**7**		**1**	**1**	**15**		**3**	**1**	**7**		**2**		**1**		**10**
Chumphon		1		2		2		2		2		3		5		3		5				2																		4
Nakhon Sri Thammarat		11		13	1	20	2	8	1	9	1	6		5	1	7		6		5		6		4				5	1	2		3		2		5		3		1		1
Narathiwat	2	17	2	31	8	28	10	46	4	20	5	31	5	30	1	18	3	23	2	41	4	27	2	19	4	35	1	23	2	13		20	4	20	2	20	1	16		12	1	23
Pattani		6		7	1	16	2	16	6	22	3	15		20	3	11	3	14		21	3	27	3	10		11	1	14		6	1	7	3	9	2	20	1	24	1	9		12
Phattalung				3		2		1		4		5		1		2		2		2		2																		2
Songkhla		14	1			6		6		4	3	14		10		7		9		5		4		7		4		5		3		2		4		11		5		1		1
Surat Thani	1	14		17	1	11		9		4	1	13		12		10		14	3	10		14		10		1		5		2		3		2		4				4
Yala		4	1	4		5		7		2		6		7		6		6		5		5		2		10	1	2	2	2	1	5		6		9		4		1		3
Krabi	2	3		3		1		1		4		2	1	5		5		4			1	4						3		1		5		1				1			
Phang Nga		1	1	5		2		3						2		1				2		1	1	3			1	3	1			1				1				1		1
Phuket		10		6		3		2		3		7	1	10		4		8		6		5						1				9								4
Ranong		1		3		1		1		1		1				1						1												1								
Satun		2	1			1		2	1	1	1	7		2		1				6	1	5				4		1		1		5		2		2		2				
Trang		4		2		3		6	1	3		2		4		5		4		3		1		1		2		2				1					1	1		1		1
Southern Region	**5**	**88**	**6**	**96**	**11**	**101**	**14**	**110**	**13**	**79**	**14**	**112**	**7**	**113**	**5**	**81**	**6**	**95**	**5**	**106**	**9**	**104**	**6**	**56**	**4**	**67**	**4**	**64**	**6**	**30**	**2**	**61**	**7**	**47**	**4**	**72**	**3**	**57**	**1**	**26**	**1**	**56**

Region	2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		2020	
	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages
Northern Region	15	252	6	180	5	140	1	125	4	109	5	121	1	105	2	110	3	207	2	81	6	92	3	81		76	4	69	2	128		123	1	62		46	2	56
Northeastern (Isan)	25	519	10	433	27	614	12	347	11	314	10	308	8	261	8	249	4	281	2	217	11	255	8	146	4	174	1	150		98	3	142	1	85	4	144	2	62
Western Region	1	44	1	28	1	41		19	1	17	1	26	1	20		24					1			4		13		1				4		16		5		7
Central Region	4	147	2	122	6	114	2	105	4	157	3	91	1	62	4	62	1				1		1	43		21		26	1	20		74		69	1	80		75
Eastern Region	4	67	2	44	2	45	3	33	1	29		27	1	16		9							1	4			1	7		1	1	15		3	1	7		2
Southern Region	5	88	6	96	11	101	14	110	13	79	14	112	7	113	5	81	6	95	5	106	9	104	6	56	4	67	4	64	6	30	2	61	7	47	4	72	3	57
Thailand	54	1117	27	903	52	1055	32	739	34	705	33	685	19	577	19	535	14	583	9	404	28	451	19	334	8	351	10	317	9	277	6	419	9	282	10	354	7	259

Annex 7: Viet Nam leprosy data

Five years no children (till end of Phase 2)
Interruption of transmission
1 Sporadic child after interruption of transmission
Three consecutive years of zero leprosy
Till end of phase 3
10-year post-elimination surveillance period
1 Sporadic case during surveillance period
Post-elimination surveillance period completed
1 Sporadic case after 10 years of post-elimination

Province / Region	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		2020	
	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages
Bắc Giang		30				2		2		2		3		1		1		1		1		1		2								3										
Bắc Kạn/Dong Bac		1	1	1		1		3		2				2				2		1				1												1				
Cao Bằng	1	7	1	5		4						1								2		1		1						1	1	3						1		2
Hà Giang		1		7				4	1	2		3		2		1		2		1		2		2		1				2		2		1				2		
Lạng Sơn		3		2					1	2		1												2				1						1		1				1
Phú Thọ		2				3		3		2		1		2				1				1		1		1		1												
Quảng Ninh		1						1																						1		1								
Thái Nguyên		5		4		3		1		2		3		1				1						3						1		1								
Tuyên Quang				1		5	1	5	1	4		1	1	6		3		4		4	1	3		5			2	4				2		0				2			
Northeastern	**1**	**50**	**2**	**20**		**18**	**1**	**19**	**3**	**16**		**13**	**1**	**14**		**5**		**11**		**9**	**1**	**8**		**17**		**2**	**2**	**6**		**3**		**6**	**1**	**10**		**1**		**4**		**3**		**3**
Điện Biên										4		4	1	2		8				3	1	3		1		2		2		1				2		5		3				1
Hòa Bình		2		2	1	1						1				1		1		2		1	1	1																	
Lai Châu	2	6		5		7	1	8		4		5		1		3		1		3		4		2	1	4	1	5				1		1		2		3		3		4
Sơn La		3		5		4		9		5		10	1	5	1	6		2		1		3		9		3		3		5										1		
Lào Cai		1		1		1				2												2				2		1		1		1		1						
Yên Bái		4		2		2		4		1		1		3		2		1		2		1		2		4	1	4	1	3		2		2				1		
Northwest	**2**	**16**		**15**	**1**	**15**	**1**	**21**		**16**		**21**	**2**	**11**	**1**	**20**		**5**		**11**	**1**	**14**	**1**	**15**	**1**	**15**	**2**	**15**	**1**	**10**		**3**		**6**		**8**		**6**		**5**		**5**
Bắc Ninh		3		2		2				2		1				2								1						3		2									
Hà Nam				1		1				1				1						1																				
Hải Dương		5		3		1		2		1								2		2				7								2								
Hưng Yên				1			1	2										1		1								1												
Nam Định		3		4		2		1		1				1		3				1		2				1		1				1								1
Ninh Bình		1		3		3		3	2	3				4		1		1				1		1		1		2		1		1								
Thái Bình		4		1		1		2			1			2										1		2										1					
Vĩnh Phúc		1				2		3		5	5			5		1		1		7		1		3						3											

Province / Region	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		2020	
	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages
Hanoi		1						1		2	2							4				1		5		4		3		1		1		1		2				1
Haiphong		1		1				1		3						2										2				1				1						
Hong River Delta		**19**		**16**		**12**	**1**	**15**	**2**	**18**	**8**	**1**				**9**		**9**		**12**		**5**		**18**		**10**		**7**		**8**		**4**		**5**		**2**		**2**		**2**
Hà Tĩnh	1	3		5	2	8	1	4	2	6		1		3				2		1		1	1	1		1				1		1								
Nghệ An		8		9	1	9		4		4		2		7	1	8		1		3		3		5		3		3		2		1				2		1		
Quảng Bình		4				2		4		1		2		3		4		2		1				4		4				1		1								
Quảng Trị		6		3		3		2		1		3				1		1					1	3								1								
Thanh Hóa		7		9		6		7	1	7		3		2		2		4		4		3		5		3		3		1		1		1		1		2		
Thừa Thiên–Huế	1	24	2	24		16		13	2	14	1	3		6		11		6		6		2		3		3		5		3		1		5		3		2		1		2
North Central Coast	**2**	**52**	**2**	**50**	**3**	**44**	**1**	**34**	**5**	**33**	**1**	**14**		**21**	**1**	**26**		**16**		**15**		**9**	**2**	**21**		**14**		**11**		**8**		**4**		**7**		**4**		**5**		**4**		**2**
Bình Định	6	64	1	50	2	65	2	35	4	26	1	21	1	22		12		7		8		18	1	7		2		9		6	1	2		2		3		2				1
Bình Thuận	17	134	17	148	7	113	12	117	3	71	1	51	2	45	2	39	2	49	2	26		26		16	1	18	1	14		7	1	12		8		4		4		4		3
Khánh Hòa	1	65	1	55	4	39	4	38	2	32	2	18		19	1	14		23		10		8		10	1	8	1	8	2	6		6		2		1		1				4
Ninh Thuận	13	79	4	48	4	53	3	45	3	41	2	21	5	36	2	14	1	30		16		14		5	1	12	1	12		3	2	5		5		4		3		2		
Phú Yên		15	1	20		12		10		7		9	1	7		7	1	5		5		3		2		3		3		1		1	1	3		3					
Quảng Nam	1	9		16		12		13		16	1	7		3		4		6		4		2		3				2		1		2				2		1		2
Quảng Ngãi	4	23	1	23	2	26	1	17	1	14	2	18		5		8		9		6		4		5		9	2	4		2		1		2				4		1		1
Đà Nẵng	1	25		11	1	14	2	13	2	7		4		5		5		7	1	4		4		5		5		2		3				1								2
South Central Coast	**43**	**414**	**25**	**371**	**20**	**334**	**24**	**288**	**15**	**214**	**9**	**149**	**9**	**142**	**5**	**103**	**4**	**136**	**3**	**79**		**79**	**1**	**53**	**3**	**57**	**5**	**54**	**2**	**29**	**4**	**29**	**1**	**23**		**17**		**15**		**9**		**13**
Đắk Lắk	2	14		13	1	23		10	1	8		5		5		4		2		6		3				6		4		3		3		4				4				
Đắk Nông										4	1	4		6		5		1		2		2		2				1		1		2		2		2		1				1
Gia Lai	5	73	6	60	11	78	7	59	6	95	7	75	1	48	2	46	3	31	3	26	6	35	2	28	2	23	3	26	1	11		13	1	11	1	8		13		12		12
Kon Tum	4	25	2	17	4	16	2	16	1	23	10	39	8	30	6	25	5	18	2	19	2	11	1	14	1	12	1	11		4		4		8		1		4		4		2
Lâm Đồng	2	15	1	16	1	10		7		11	1	6		7		2		4		5		3		2		1		1		8		2		1				1		4		1
Central Highlands	**13**	**127**	**9**	**106**	**17**	**127**	**9**	**92**	**8**	**141**	**19**	**129**	**9**	**96**	**8**	**82**	**8**	**56**	**5**	**58**	**8**	**54**	**3**	**46**	**3**		**4**	**43**	**1**	**27**		**24**	**1**	**26**	**1**	**11**		**23**		**20**		**16**
Bà Rịa–Vũng Tàu	2	27		35	2	33		16		18	1	17		16	3	6		6	1	11				6		1		3		1		4		2		2		4		3		1
Bình Dương	3	28	2	18		14		8		11		9		4		11		6		8		7	2	8		10		5		5	1	7		1		5		2		2		1
Bình Phước	4	40	5	40	1	20		20	5	19	2	17	2	9		10	1	17		6		4	1	10		4		6		4		3		2		2		2		1		
Đồng Nai	8	78	4	69	1	27	1	31	2	21	4	27	1	28		21		24		20	2	19		16		12		12		6		7		6		8		1		4		4

Province / Region	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		2020	
	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages
Tây Ninh	11	113	6	108	5	70	5	63	2	48		35	1	35		33		33		25		24		15	1	12		9		7		9		8		4		3		2		1
Ho Chi Minh City	5	165	6	157	4	141	2	98	1	87	1	71	3	70	2	69	1	57	1	32		38		29	1	25		15	1	11		15	1	7	1	7		8		4		6
South-East	**33**	**451**	**23**	**427**	**13**	**305**	**8**	**236**	**10**	**204**	**8**	**176**	**7**	**162**	**5**	**150**	**2**	**143**	**2**	**102**	**2**	**92**	**3**	**84**	**2**	**64**		**50**	**1**	**34**	**1**	**45**	**1**	**26**	**1**	**28**		**20**		**16**		**13**
An Giang	1	34	2	40		34		17		19	2	21		31		11		16		18		16		15		17		8		16		7		5		7		1		1		1
Bạc Liêu		25	2	16	1	19		16		12		15		5		6	1	6		4		2		5		5				1		3		3		2				1		
Bến Tre		12	1	10		5		10		4		7	1	4		7		2		1		4				2		1				1				2		2		4		
Cà Mau	1	41	2	37	3	38		26	2	34	2	36		21	3	23		23		15		11		10		12		6		6		7		4		6		3		5		1
Đồng Tháp	1	26	3	27		28	1	19		17		21	1	24		8		12		7		5		11		6		6	1	5		8		2		5		2		1		4
Hậu Giang										13		15		9		12		12		9		8		13		5	1	13		10		1		3		3		4				1
Kiên Giang		79	1	73	3	51	3	47		29	1	37		31	1	33	1	26		20		17		25		10		14		4		14		6		7		3		9		4
Long An	1	31	2	30		35	1	23		23	1	24		15		13		11		6		10		5	1	5		5		3		3		5		1		1		3		1
Sóc Trăng	2	23	1	14		11	1	16		15		7	1	9	1	9	1	8		7		3		6		3		2		4		5		4		2		1				
Tiền Giang	1	32		19		27		15		15		15	3	14		15		14	1	16	1	6		7		7		6	1	7		4		2		1						1
Trà Vinh		8	1	5	2	10		10	1	13		11	1	8		7		10		8		2		4		4		3		3		3				1		1				1
Vĩnh Long	1	20		17	1	15		15		11	2	13		19		8		7	1	11		10		9		5		6		1		2				1		1		3
Cần Thơ	3	39		38	1	28	1	27	1	11	2	16	2	14		3		7		3		4				5		4		3		5		1		1		2		1		2
Mekong River	**11**	**370**	**15**	**326**	**11**	**301**	**7**	**241**	**4**	**216**	**10**	**238**	**9**	**204**	**5**	**155**	**3**	**154**	**2**	**125**	**1**	**98**		**110**	**1**	**86**	**1**	**74**	**2**	**63**		**63**		**35**		**38**		**21**		**26**		**2**

Region	2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		2020	
	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages	Child <15 yrs	All ages
Northeastern Region	1	50	2	20		18	1	19	3	16		13	1	14		5		11		9	1	8		17		2	2	6		3		6	1	10		1		4
Northwest	2	16		15	1	15	1	21		16		21	2	11	1	20		5		11	1	14	1	15	1	15	2	15	1	10		3		6		8		6
Hong River Delta		19		16		12	1	15	2	18	8	1		0		9		9		12		5		18		10		7		8		4		5		2		2
North Central Coast	2	52	2	50	3	44	1	34	5	33	1	14		21	1	26		16		15		9	2	21		14		11		8		4		7		4		5
South Central Coast	43	414	25	371	20	334	24	288	15	214	9	149	9	142	5	103	4	136	3	79		79	1	53	3	57	5	54	2	29	4	29	1	23		17		15
Central Highlands	13	127	9	106	17	127	9	92	8	141	19	129	9	96	8	82	8	56	5	58	8	54	3	46	3	0	4	43	1	27		24	1	26	1	11		23
South-East	33	451	23	427	13	305	8	236	10	204	8	176	7	162	5	150	2	143	2	102	2	92	3	84	2	64		50	1	34	1	45	1	26	1	28		20
Mekong River	11	370	15	326	11	301	7	241	4	216	10	238	9	204	5	155	3	154	2	125	1	98		110	1	86	1	74	2	63		63		35		38		21
Viet Nam	105	1499	76	1331	65	1156	52	946	47	858	55	741	37	650	25	550	17	530	12	411	13	359	10	364	10	248	14	260	7	182	5	178	4	138	2	109		96


C.L.T&R.I