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COMMUNICABLE DISEASES
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Contents

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List of Abbreviations

AFB	Acid fast bacilli
AFRO	WHO African Regional Office
AMRO	WHO American Regional Office
CDR	Case detection rate (i.e. smear-positive case detection rate, whole country)
DDR	DOTS detection rate (i.e. smear-positive case detection rate under DOTS)
DOT	Directly observed treatment
DOTS	WHO TB control strategy
EMRO	WHO Eastern Mediterranean Regional Office
EURO	WHO European Regional Office
IEDC	Infectious and Endemic Disease Control Project (China)
IUATLD	International Union Against Tuberculosis and Lung Disease
NGO	Non-government organization
NTP	National Tuberculosis Control Programme
SCC	Standardized short-course chemotherapy
SEARO	WHO South-East Asia Regional Office
TB	Tuberculosis
TB80	The league of high-burden countries accounting for 80% of all new cases each year
TS	Treatment success (cured + completed) under DOTS
WPRO	Western Pacific Regional Office

Summary

Background and aims

This is the fifth annual report on global TB control, based on case notifications and treatment outcome data supplied by national control programmes to WHO. Six consecutive years of data were used to assess worldwide progress in TB control, focusing on 23 high-incidence countries that account for 80% of all new cases (the TB80 group). The main aim was to assess progress towards 2005 targets for case detection (70%) and treatment success (85%), and to begin to evaluate the epidemiological impact of diagnosing and curing larger numbers of patients. Analysis of progress from 1995 to 1999 included a revision of incidence estimates for all countries in these years, together with projections to 2005.

Methods

During 2000, a standard data collection form was sent to 211 countries via WHO Regional Offices. The form has three sections which request information about: policy and practice in TB control; the number and types of TB cases notified in 1999; and the outcomes of treatment and retreatment (DOTS areas only) for smear-positive or culture-positive (mainly Europe) cases registered in 1998.

Results

The main findings were:

1. There were an estimated 8.4 million new tuberculosis cases in 1999, up from 8.0 million in 1997; the rise is due largely to a 20% increase in incidence in African countries most affected by the epidemic of HIV/AIDS. If present trends continue, 10.2 million new cases are expected in 2005, and Africa will have more cases than any other WHO Region.
2. Following a decade of successful control, and the consequent reduction in incidence, Peru fell to bottom place in the league of high-burden countries in 1999. It was eliminated from TB80 during 2000.
3. The number of countries implementing the DOTS strategy (at least in part) increased by 8 during 1999, bringing the total to 127 (out of 211).
4. The fraction of the world's population that had access, in principle, to DOTS increased slightly from 43% in 1998 to 45% in 1999.
5. Roughly one quarter (23%) of estimated new smear-positive cases were reported to DOTS programmes in 1999, as compared with 22% in 1998; this is consistent with the average increment of about 120 000 cases in each year since 1994.
6. If this trend is maintained, the target of 70% case detection under DOTS will not be reached until 2013; to get to the target by 2005, DOTS programmes must collectively recruit at least 300 000 additional smear-positive cases each year.
7. There was an insignificant increase between 1998 and 1999 in the total number of smear-positive cases reported to WHO; about 1.4 million cases were reported in both years (41% of the estimated total).
8. Almost all (92%) of the progress in DOTS expansion, as judged by smear-positive case notifications, was made in just 5 countries; 65% of these additional cases were found in 2 countries, India and South Africa.

9. Treatment success of new smear-positive patients has remained high under DOTS, and exceeded 80% in the most recent cohort (1998).
10. Against expectation, the cure rate measured by sputum smear conversion in 12 European countries was not consistently higher than the cure rate measured by culture conversion; in order to explain this result, treatment outcomes must be examined for patients individually, rather than in aggregate.
11. In 1999, Peru and Viet Nam were still the only high-burden countries to have exceeded both WHO targets of 70% case detection and 85% treatment success. However, several other TB80 countries are within reach: they include Brazil, Cambodia, Kenya, the Philippines, South Africa and Tanzania.
12. A number of smaller countries appear to have declining TB incidence rates that are linked to high rates of case detection and cure; these include Cuba, Lebanon, the Maldives, Nicaragua, Oman and Uruguay.
13. During the preparation of this report, China announced preliminary results of a nationwide survey suggesting a comparatively large reduction in TB prevalence in 13 provinces that have participated in the IEDC TB control project since 1990.

Conclusion

Progress in global TB control has remained steady, but slow. Despite large numbers of patients recruited in India and South Africa during 1999, DOTS implementation overall was no faster than in previous years. DOTS programmes worldwide will have to increase the number of additional patients enrolled annually by a factor of 2.5 in order to meet 2005 targets. Following the impact of short-course chemotherapy in Peru (reduced incidence) and China (reduced prevalence), detailed epidemiological analyses are needed to find out whether other control programmes with high rates of case detection and cure have also succeeded in reducing TB burden.

Introduction

The goal of this report is to chart progress in TB control and, in particular, progress in implementing the WHO DOTS strategy.[1] The targets for global TB control ratified by the World Health Assembly are: (1) to treat successfully 85% of detected smear-positive TB cases, and (2) to detect 70% of all such cases. Since these targets were not reached by the end of year 2000 as originally planned, the target year has been re-set to 2005.[2]

Monitoring and evaluation are carried out through WHO's Global TB Monitoring and Surveillance Project, established in 1995. Last year we reported[3] that:

- 45% of all estimated tuberculosis cases, and 40% of smear-positive cases, were notified to WHO for 1998.
- By the end of 1998, 119 countries had adopted, and reported on, the WHO DOTS strategy for TB control; they included all high-burden countries (numbering 22 last year).
- 43% of the global population had access to DOTS.
- 22% of estimated smear-positive cases were reported under DOTS in 1998.
- Compared with 1997, an additional 220 000 smear-positive cases were reported by DOTS programmes in 1998.
- The average treatment success rate was 78% under DOTS programmes in 1997, and 82% in high-burden countries.
- The biggest improvements in case detection were made in China, South Africa, India, Bangladesh and the Philippines.
- Countries failing to make significant progress included Indonesia, Pakistan, Russia and Uganda.
- Peru and Viet Nam were the only two high-burden countries to have met the WHO targets for case detection and cure.

We concluded that progress in global tuberculosis control accelerated slightly between 1997 and 1998; DOTS programmes recruited more cases than in any previous year, whilst maintaining high treatment success rates. However, progress was slow with respect to global targets: the data suggested that DOTS programmes would have to enrol an additional 250 000 patients each year in order to meet targets by 2005. This was more than twice the average yearly increment between 1994 and 1998.

The present report is number five in the series. It presents data available at 22 January 2001 on case notifications for 1999, treatment results for patients registered in 1998, and the status of DOTS implementation by the end of 1999. This information is supplemented, where possible, with the latest data on progress made by countries during 2000. We compared the new figures with those in previous reports (data from 1994 onwards), paying special attention to progress in countries with the largest numbers of TB cases. The results imply that much more effort will be needed if DOTS programmes, collectively, are to reach global targets by 2005.

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[1] World Health Organization. *WHO Tuberculosis Programme: Framework for Effective Tuberculosis Control*. Geneva, Switzerland: World Health Organization 1994. WHO/TB/94.179.

[2] World Health Organization. Fifty-third World Health Assembly. Stop Tuberculosis Initiative, Report by the Director General. A53/5, 5 May 2000.

[3] World Health Organization. *Global Tuberculosis Control. WHO Report 2000*. WHO/CDS/TB/2000.275. See http://www.who.int/gtb/publications/globrep00/index.html.

The analysis in this year's report also includes new estimates of TB incidence in each country. The reasons for revising TB incidence rates are that case numbers have been rising sharply in African countries with the spread of HIV, and in Eastern Europe following the break-up of the former Soviet Union. There have also been some successes in TB control, which have probably reduced incidence, notably in Peru and China. The revised estimates change the denominators of case detection rates, and therefore influence our view of progress towards the 70% target. The technique we have used to estimate incidence for 1999 (the year to which all notifications in this report apply) also allows projections to 2005, assuming present trends continue. These forecasts include some sobering statistics for Africa.

Methods

WHO member states and other countries and territories voluntarily report communicable disease surveillance data to WHO. One distinctive feature of TB surveillance is the collection of data on treatment outcomes as well as disease incidence. Another is the stratification of data by type of control strategy (DOTS or non-DOTS). Together, these data are important in monitoring progress towards targets (85% treatment success, 70% case detection), and in assessing the epidemiological impact of DOTS.

Before setting out the details of methods used to collect the most recent set of data, we make four general remarks about the process. First, the questions posed on the WHO form for data collection assume that countries are able to provide precisely the information requested. We recognize, however, that some countries have slightly different definitions and procedures, and we encourage respondents to note such differences in their reports.

Second, WHO deals with national health authorities, some of whom supervise only public systems of TB control. In a number of countries, TB treatment is unregulated, case reporting by private practitioners to the local health authority is not mandatory, and legislation is not enforced, or not dictated by clear criteria and definitions. Under these circumstsances, the data collected by the national health authority, and reported in turn to WHO, will be incomplete and perhaps inaccurate.

Third, this report presents data with a significant time delay. Published in 2001, it contains data that were compiled mostly during 2000. The new data available are case notifications for 1999 (the most recent year of complete information), and treatment outcomes for patients registered in 1998. Treatment results always lag notifications by one year because the most important evaluations are made at the end of treatment, which usually lasts 6–9 months. (WHO recommends that data are compiled and analysed more often than once per year within countries, e.g. quarterly, but this is unnecessary for monitoring at the global level.)

Fourth, late reports or revisions of data for previous years are incorporated into WHO's databases, so that trend data presented in this report, and on the WHO Geneva web-site, can be as up-to-date as possible (Annex 8 contains the updated global profile for 1997/8). Except for countries in the European region, there has been no systematic attempt to revise earlier data. Because some countries update their information without notifying WHO, the numbers published in this report may not agree with other publications on TB surveillance.

Accepting only the inevitable imperfections, our goal is to present the best possible appraisal of global TB control as of January 2001.

Data collection

In August 2000, we asked the national health authorities in 211 countries and territories to complete a standard TB data collection form (Annex 1). The form has detailed instructions and definitions that follow WHO/IUATLD guidelines on TB recording and reporting. The form asks for:

- programme information in 1999, i.e. national policy and typical practice, population coverage of DOTS and other, non-DOTS strategies, and completeness of reporting;
- TB cases reported during 1999, divided into various types, and including a stratification of laboratory-confirmed pulmonary cases by age and sex;
- treatment outcomes for laboratory-confirmed pulmonary cases registered during 1998, plus outcomes for all re-treatment cases in DOTS areas.

The information about policy and practice concerns the country as a whole, whereas the

other sections ask for data from DOTS and non-DOTS areas separately. Treatment and retreatment outcomes are not expected from non-DOTS programmes, but the form allows respondents to supply the former if they can do so.

Distribution of the forms for data collection was via CD-ROM, and/or fax, airmail and electronic mail, depending on regional procedures and country preferences. A utility on the CD-ROM version allows respondents to enter data directly and return an electronic file to WHO; the data in this file can be uploaded automatically to a Microsoft Access database. Otherwise, manually completed forms were faxed or delivered to the WHO local or Regional Office. Regardless of the format or mode of data transfer, reporting to WHO requires each NTP manager to assemble data as per WHO instructions, from various sub-national (district, provincial) periodic reports (quarterly, semi-annually), or directly from individual case reports, using whatever technology is available. The WHO form, and the means provided for its transmission, are not intended to be tools for surveillance and monitoring within countries.[4]

Completed forms were first reviewed in the relevant WHO country and Regional Office, and then by the Communicable Diseases programme in Geneva. Inconsistencies in the data were followed up with NTP managers, or with other responsible persons in countries. Data were entered in computer files at WHO headquarters and regional levels, and analysed principally with Microsoft Access and Excel 97.

Surveillance in the European Region

In the WHO European Region, tuberculosis monitoring and surveillance are carried out jointly with EuroTB (Institut de Veille Sanitaire, Paris), the WHO Collaborating Centre for the surveillance of tuberculosis in Europe, with financial support from the European Commission. This year, for the first time, a joint WHO/EuroTB data collection form was sent to countries, designed to meet the overlapping objectives of both organizations, and to minimize double reporting by NTP managers. In addition to the information requested on the global form, the WHO/EuroTB form asks for definitions used and reporting requirements in each country, notifications by nationality, citizenship, age and sex, and notifications and treatment outcomes by sputum culture and smear examination (Annex 1).

In the European Region only, national respondents were invited to report to WHO directly via the regional web-site (http://cisid.who.dk/tb). This system provides messages to help check data on entry, and immediate feedback on the TB situation in neighbouring countries, using a menu for custom queries of the regional database.

The WHO/EuroTB collaboration brings several mutual benefits. First, data can be cross-checked more carefully by a larger number of staff. Second, EuroTB continues to compile and refine data throughout the year; this information is used to update the Geneva database, and can then be further disseminated via both EuroTB and WHO networks. Third, the extra information on the European form allows a fuller analysis of TB epidemiology in the region. For example, the present report contains a preliminary comparison of treatment outcomes by smear and culture conversion.

Categorization of countries

From the responses as a whole (but particularly the section on policy), we accepted or revised each country's own determination of its DOTS status. Countries were then further categorized qualitatively (or semi-quantitatively), as shown in Figure 1, using definitions in Table 1. A country was considered as implementing the DOTS strategy if by 31 December 1999 it had a national TB control policy based on WHO recommendations, complied with all technical elements of the DOTS strategy[5] (Table 2), and reported on notifications and treatment outcomes from DOTS areas.

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[4] WHO offers reference material about national recording and reporting systems, and prototype software designed for national or provincial TB managers to assemble, clean, and analyse their TB data. For further information, contact local or Regional WHO offices, or bleedd@who.int.

[5] WHO/IUATLD/KNCV. *Revised international definitions in tuberculosis control.* Geneva, Switzerland: World Health Organization 2000. Unpublished document.

Table 1. Categorization of countries

Category	Definition
0	Countries not reporting to WHO.
1	Countries **not** implementing the DOTS strategy and having an estimated incidence rate of 10 **or more** cases per 100 000 population.
2	Countries implementing the DOTS strategy in less than 10% of the total population (**pilot phase**).
3	Countries implementing the DOTS strategy in 10 to 90% of the total population (**expansion phase**).
4	Countries implementing the DOTS strategy in over 90% of the total population (**routine implementation**).
5	Countries **not** implementing the DOTS strategy but having an estimated incidence rate of **less** than 10 cases per 100 000 population (**low incidence**).

Table 2. Technical elements of the WHO TB control strategy (DOTS)

Microscopy	Case detection among symptomatic patients self-reporting to health services, using sputum smear microscopy*.
SCC/DOT	Standardized short-course chemotherapy using regimens of 6–8 months for at least all confirmed smear-positive cases. Good case management includes directly observed therapy (DOT) during the intensive phase for all new sputum positive cases, during the continuation phase of regimens containing rifampicin, and during the entirety of a retreatment regimen**.
Drug Supply	Establishment and maintenance of a system to supply all essential anti-tuberculosis drugs, and to ensure no interruption in their availability.
Recording and Reporting	Establishment and maintenance of a standardized recording and reporting system, allowing assessment of treatment results (see Table 5).

* Sputum culture can be used for diagnosis, but direct sputum smear microscopy should still be performed for all suspected cases.

** In countries that have consistently documented high treatment success rates, Directly Observed Therapy may be reserved for a subset of patients, as long as cohort analysis of treatment results is provided to document the outcome of all cases.

If DOTS was implemented only in some districts (or equivalent administrative units) on the initiative of local authorities, but endorsed by national authorities, the country was classified as DOTS. If a country reported that DOTS was newly implemented during 1999, so that the results of cohort analysis were not yet available, it was also classified as DOTS, provided 1999 case notifications from DOTS areas were available.

This system of categorization provides a first impression of each country's progress in TB control. However, WHO targets are expressed more stringently in terms of treatment success and the case detection rate. TB control should ensure high treatment success before expanding case finding. The reason is that a proportion of patients given less than a fully-curative course of treatment remain chronically infectious, and continue to spread TB. Thus DOTS programmes must be shown to achieve high cure rates in pilot projects before attempting country-wide coverage. Case detection and treatment success rates are defined and measured as follows.

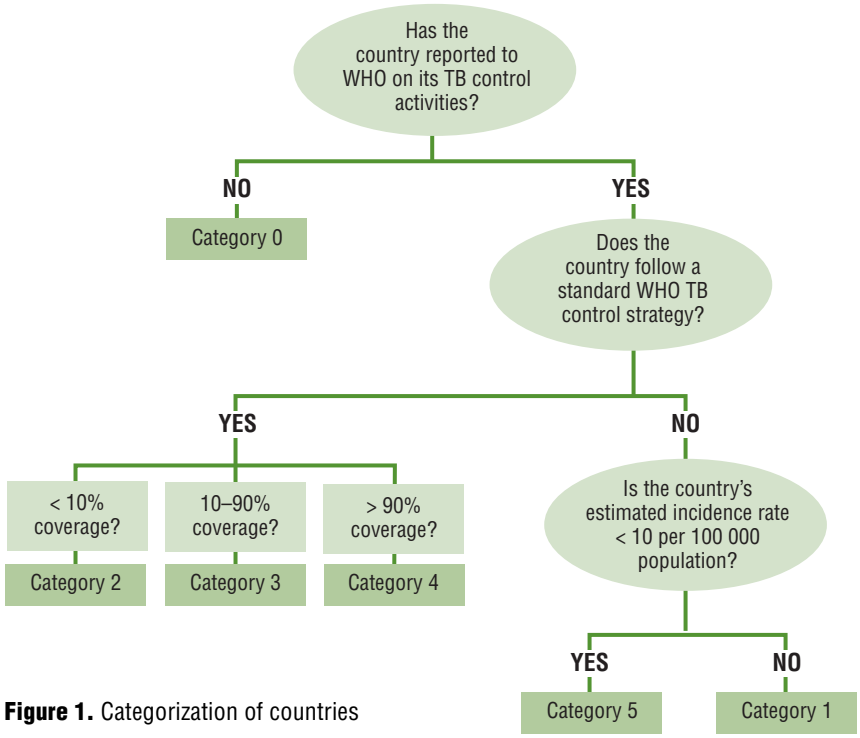


Figure 1. Categorization of countries

Case detection

We made separate assessments of TB control programmes in DOTS and non-DOTS areas. Case notifications distinguished between all types of TB and sputum smear-positive cases (or culture-positive cases, in some countries). Table 3 contains standard case definitions, including minor

Table 3. Definitions of tuberculosis cases

Case of tuberculosis	A patient in whom tuberculosis has been bacteriologically confirmed, or has been diagnosed by a clinician. Note: any person given treatment for tuberculosis should be recorded.
Definite case	Patient with positive culture for the *Mycobacterium tuberculosis* complex. In countries where culture is not routinely available a patient with 2 sputum smears positive for acid fast bacilli (AFB+) is also considered a definite case.
Smear-positive pulmonary case	At least two initial sputum smear examinations (direct smear microscopy) AFB+; or one sputum examination AFB+ and radiographic abnormalities consistent with active pulmonary tuberculosis as determined by the treating medical officer; or one sputum specimen AFB+ and culture positive for *M. tuberculosis*.
Smear-negative pulmonary case	Pulmonary tuberculosis not meeting the above criteria for smear-positive disease. Diagnostic criteria should include: at least 3 sputum smear examinations negative for AFB; and radiographic abnormalities consistent with active pulmonary TB; and no response to a course of broad-spectrum antibiotics; and decision by a clinician to treat the patient with a full course of anti-tuberculosis therapy; or positive culture but negative AFB sputum examinations.
Extrapulmonary case	Patient with tuberculosis of organs other than the lungs e.g. pleura, lymph nodes, abdomen, genito-urinary tract, skin, joints and bones, meninges. Diagnosis should be based on one culture-positive specimen, or histological or strong clinical evidence consistent with active extrapulmonary disease, followed by a decision by a clinician to treat with a full course of anti-tuberculosis chemotherapy. Note: a patient diagnosed with both pulmonary and extrapulmonary tuberculosis should be classified as a case of pulmonary tuberculosis.
New case	Patient who has never had treatment for tuberculosis, or who has taken anti-tuberculosis drugs for less than 1 month.
Relapse case	Patient previously declared cured but with a new episode of bacteriologically positive (sputum smear or culture) tuberculosis.
Retreatment case	Patient previously treated for tuberculosis whose treatment failed, who defaulted (treatment interrupted, see Table 5, 'Definitions of treatment outcomes'), or who relapsed.
Chronic case	Patient who is sputum positive at the end of a retreatment regimen.

revisions made during 2000.[6] As an indicator of each NTP's ability to detect and identify smear-positive cases we calculated the proportion of new sputum smear-positive cases out of all new pulmonary cases (expected value 55–70% in areas with low prevalence of HIV infection).

Case notifications represent only a fraction of the true number of cases arising in a country because of incomplete coverage by health services, inaccurate diagnosis, or deficient recording and reporting. The estimated smear-positive case detection rate is defined as:

$$\text{case detection rate (\%)} = \frac{\text{annual new smear-positive notifications (country)}}{\text{estimated annual new smear-positive incidence (country)}}$$

A stricter measure of case finding is the fraction of all incident smear-positive cases which are detected (and potentially treated) by DOTS programmes:

$$\text{DOTS detection rate (\%)} = \frac{\text{annual new smear-positive notifications (under DOTS)}}{\text{estimated annual new smear-positive incidence (country)}}$$

Case detection rate (CDR) and DOTS detection rate (DDR) are identical when a country reports only from DOTS areas. This should happen only when DOTS coverage is 100%.

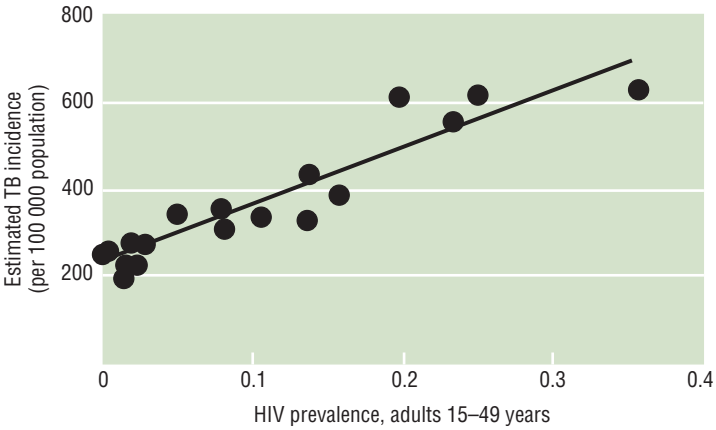
[6] WHO/IUATLD/KNCV. *Revised international definitions in tuberculosis control (2000)*. Unpublished document available from WHO Geneva.

Estimated TB incidence, 1995–2005

The denominators for 1999 case detection rates are 1999 estimates of the smear-positive incidence rate, obtained from a revision of published 1997 estimates.[7] The methods used to make the 1999 revision, and the results, will be described in full elsewhere. In brief:

1. For each of 19 African countries that report TB cases consistently and with clear trends, estimated incidence rates for 1997 have been adjusted according trends in the notification rate. This assumes that there has been no significant change in the proportion of cases detected. The resulting estimates for 1999 are closely correlated with the estimated prevalence of HIV in adults 15–49 years old (r^2 = 87%, Figure 2). The corresponding linear regression has been used as a calibration curve to estimate the TB incidence rate for 41 countries in the WHO African Region (including the original 19 countries, but excluding 5 groups of islands). This new method replaces the previous, less satisfactory approach of dividing case notification rates by the supposed proportion of cases detected, where the latter was typically based on few data for countries other than those represented in Figure 2.

Figure 2. Relationship between estimated incidence of TB (all forms) and HIV prevalence in adults for 18 African countries in 1999 (HIV data supplied by UNAIDS)



2. 113 countries outside the WHO African Region have also provided notification data with interpretable trends, and with no other evidence (e.g. from NTP activities) for any significant change in the case detection rate. We therefore assumed, as for the 19 African countries above, that trends in the notification rate represent trends in the incidence rate, and adjusted the estimated 1997 incidence rates accordingly. Some of these adjustments produced very small increases or decreases in the incidence rate but, for consistency, we applied the same technique to all countries that have decipherable trend data.
3. China carried out a country-wide disease prevalence survey during 2000, and the preliminary results (as of 22 January 2001) have been used to re-evaluate incidence for 1999.
4. For the remaining 56 countries, case notifications could not be used to assess trends in incidence, either because they were too inconsistent, or because independent information suggested that the case detection rate has changed through time (for better or worse). For these countries we applied the trend for one of eight groups of epidemiologically similar countries. The trend was the weighted case notification rate for the countries and groups shown in Figure 9 and Table 9. For example, the Philippines was aligned with non-industrialized Western Pacific countries (defined as Wpr B & D in World Health Report 2000[8]).
5. The information on trends obtained from the series of case notifications, both in and out of Africa, was used to back-calculate incidence to 1995, and to project forward to 2005. We computed incidence rates over this 10-year period for all countries, using the country trends for 133, and the regional trends for the other 78.
6. Finally, the numbers of new cases arising in all countries were calculated by multiplying estimated incidence rates by estimated population sizes.[9]

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[7] Dye C, Scheele S, Dolin P, Pathania V, Raviglione MC. Global burden of tuberculosis: estimated incidence, prevalence and mortality by country. *JAMA* 1999; 282: 677–686.

[8] World Health Organization. *Word Health Report 2000. Health Systems: Improving Performance*. Geneva: World Health Organization.

[9] UN Population Division, World Population Prospects, 1998 revision.

Treatment success and cure rate

To assess the quality of treatment programmes for new infectious cases, we first compared the number of new cases registered for treatment in 1998 (reported in 1999) with the number of cases notified as smear-positive in 1998 (reported in 1998). These numbers should be the same. Differences may arise because NTPs do not compile data at the end of each calendar year, because diagnoses are incorrect, because patients are lost between diagnosis and the start of treatment, or because records are lost. Second, we determined what fraction of registered cases was evaluated for outcome. All registered cases should be evaluated. Third, we compiled data on the six standard, mutually exclusive outcomes of treatment (Table 4). Treatment success is defined as the proportion of patients who were cured plus the proportion who completed treatment. These figures are reported as percentages of all registered cases, so that the six possible outcomes plus the fraction of cases not evaluated sum to 100%. Sometimes, countries state the number of patients registered for treatment, but give no outcomes. When this happens, we report no result, rather than zero treatment success (Table 14). In other instances, the number of registered cases is less than the sum of the six outcomes (i.e. the number evaluated), or is missing. In such instances we take the denominator for treatment success to be the number evaluated or the number of smear-positive cases notified in the previous year, whichever is greater. Although treatment outcomes are expressed as percentages, they are usually referred to as 'rates'.

Table 4. Definitions of treatment outcomes

Cured	Initially smear-positive patient who has a negative sputum smear in the last month of treatment, and on at least one previous occasion*.
Completed treatment	Patient who has completed treatment but does not meet the criteria for cure or failure.
Died	Patient who died during treatment, irrespective of cause.
Failed	Smear-positive patient who remained smear-positive, or became smear-positive again, at least 5 months after the start of treatment.
Interrupted treatment (defaulted)	Patient who did not collect drugs for 2 months or more at any time after registration.
Transferred out	Patient who was transferred to another reporting unit and for whom treatment results are not known.
Successfully treated	The sum of cases who were cured and who completed treatment (expressed as a percentage of the number registered in the cohort**).

* Some European countries define cure in terms of culture conversion, rather than sputum smear conversion[10]

** A cohort is a group of patients diagnosed and registered for treatment during a given time period, usually one quarter of a year.

Data describing the outcome of retreatment were collected only from DOTS areas because the definitions of failure and relapse require data on bacteriological conversion (Tables 3 and 4). We have not attempted to assess how many cases should have been registered on retreatment regimens, to compare with the number that were actually registered.

In addition, 1998 cohort data from a selection of European countries were used to compare cure (and treatment failure) judged by sputum smear or culture conversion. Cure by smear conversion from positive to negative was for all patients initially diagnosed with positive smears, including those that with positive cultures. Reciprocally, culture conversion was measured for all patients initially diagnosed with positive cultures, including those with positive smears. We looked for systematic differences in cure and failure rates measured by the two methods. Because data were not available for individual patients, we compared treatment results for groups of patients, across all countries.

[10] Veen J, Raviglione MC, Rieder HL, Migilori GB, Graf P, Grzemska M, Zalesky R. Standardized tuberculosis treatment outcome monitoring in Europe. *Eur Respir J* 1998; 12: 505–510.

Results

Global and regional progress in TB control

Countries reporting to WHO

By 22 January 2001, 171 (81%) of 211 countries reported case notifications for 1999 and/or treatment outcomes for patients registered in 1998, 18 fewer than last year. We received reports from all high-burden countries except Mozambique, all countries with more than 30 million people except Canada, and all other countries with more than 10 million people except Yemen, Madagascar and Niger (Tables 5a and 5b).

Table 5a. List of countries implementing DOTS, 1999

Category 2 (9 countries)

Brazil
Democratic People's Republic of Korea (the)
Lithuania
Pakistan
Papua New Guinea
Romania
Russian Federation (the)
Tajikistan
Uzbekistan

Category 3 (47 countries)

Afghanistan
Angola
Argentina
Armenia
Australia
Azerbaijan
Bangladesh
Cameroon
China
China, Hong Kong SAR
Colombia
Cook Islands
Costa Rica
Côte d'Ivoire
Democratic Republic of the Congo (the)
Dominican Republic (the)
Ecuador
Egypt
El Salvador
Eritrea
Ethiopia
Ghana
Guatemala
Haiti
Honduras
India
Indonesia
Iraq
Italy
Mali
Marshall Islands (the)
Mauritania
Mexico
Myanmar
Nepal
Nigeria
Panama
Philippines (the)
Poland
Saudi Arabia
Somalia
South Africa
Sudan (the)
Syrian Arab Republic (the)
Thailand
Vanuatu
Zimbabwe

Category 4 (71 countries)

American Samoa
Andorra
Bahamas (the)
Bahrain
Barbados
Benin
Bhutan
Bolivia
Bosnia and Herzegovina
Botswana
Burkina Faso
Burundi
Cambodia
Chad
Chile
Cuba
Cyprus
Czech Republic (the)
Djibouti
Fiji
French Polynesia
Georgia
Guinea
Hungary
Iran (Islamic Republic of)
Israel
Jamaica
Jordan
Kazakhstan
Kenya
Kiribati
Kyrgyzstan
Latvia
Lebanon
Libyan Arab Jamahiriya (the)
Malawi
Maldives
Malta
Mauritius
Monaco
Mongolia
Morocco
Namibia
Netherlands (the)
Nicaragua
Norway
Oman
Peru
Portugal
Puerto Rico
Qatar
Rwanda
Saint Kitts and Nevis
Saint Lucia
Samoa
San Marino
Senegal
Slovakia
Slovenia
Solomon Islands
Sri Lanka
Tonga
Trinidad and Tobago
Tunisia
Turks and Caicos Islands
Uganda
United Republic of Tanzania (the)
United States of America (the)
Uruguay
Venezuela
Viet Nam

Bold: countries which adopted DOTS in 1999

Italics: countries which moved one or more categories down since 1998 due to decrease in coverage

Underline: countries which moved one or more categories up since 1998

Table 5b. List of countries not implementing DOTS or not reporting to WHO, 1999

Category 0 (40 countries)

Anguilla
Belize
Bermuda
British Virgin Islands
Brunei Darussalam
Canada
Cape Verde
China, Macao SAR
Comoros (the)
Dominica
Equatorial Guinea
Gambia (the)
Grenada
Guam
Guinea-Bissau
Guyana
Kuwait
Lao People's Democratic Republic (the)
Lesotho
Liberia
Madagascar
Micronesia (Federated States of)
Mozambique
Nauru
Netherlands Antilles
New Caledonia
Niger (the)
Saint Vincent and the Grenadines
Seychelles
Sierra Leone
St. Helena
Swaziland
Togo
Tuvalu
United Arab Emirates (the)
United States Virgin Islands
Wallis and Futuna Islands
West Bank and Gaza
Yemen
Zambia

Category 1 (38 countries)

Albania
Algeria
Austria
Belarus
Belgium
Bulgaria
Central African Republic (the)
Croatia
Congo (the)
Denmark
Estonia
Finland
France
Gabon
Germany
Greece
Ireland
Japan
Luxembourg
Malaysia
Montserrat
Niue
Northern Mariana Islands (Commonwealth of)
Palau
Paraguay
Republic of Korea (the)
Republic of Moldova (the)
Sao Tome and Principe
Singapore
Spain
Suriname
The former Yugoslav Republic of Macedonia
Tokelau
Turkey
Turkmenistan
Ukraine
United Kingdom of Great Britain and Northern Ireland (the)
Yugoslavia

Category 5 (6 countries)

Antigua and Barbuda
Cayman Islands
Iceland
New Zealand
Sweden
Switzerland

Bold: countries which reported in 1998 and were classified as DOTS, but did not report in 1999

Italic: countries which reported in 1998 and were classified as non-DOTS, but which didn't report in 1999

Underline: countries which reported in 1999, and were classified as DOTS in 1998 but not in 1999

A growing number of European countries are submitting data via the CISID web-site, using either in English or Russian versions. Fourteen used CISID to provide data for this report: Estonia, Finland, Georgia, Germany, Iceland, Latvia, Macedonia, Netherlands, Norway, Portugal, Slovakia, Slovenia, Sweden and Turkmenistan. Fourteen countries in other regions used the CD-ROM to supply data electronically to WHO. A further nine countries used the CD-ROM for data entry, but supplied a printout of the form to WHO.

Categorization of countries, 1995–99

The number of countries implementing a strategy consistent with DOTS has continued to increase, reaching 127 (60%) in 1999, 8 more than in 1998 (Figure 3, Table 5a). Sixteen countries classified as DOTS based on 1998 data did not report 1999 data. Of the 211 countries and territories, 71 had implemented DOTS in over 90% of the country (category 4; Figures 4 and 5). Nine countries were in the DOTS pilot phase (category 2), and 47 were in the expansion phase (category 3). Since 1995, countries have been moving out of category 1 and into categories 2 to 4 (Figure 4).

By the end of 1999, 82% of the world's population was living in countries that had adopted DOTS (categories 2–4). Reported DOTS population coverage was greatest in the American (62%), Western Pacific (57%) and African Regions (55%) (Figure 6). Table 6 tabulates DOTS coverage for each high-burden country, and for the whole world, from 1995 to 1999.

Seventeen countries implemented DOTS for the first time in 1999 (Table 5a). Three had achieved limited coverage (< 10%, Category 2), DPR Korea, Lithuania and Tajikistan. Five achieved moderate coverage (10–90%, Category

Figure 3. Number of countries implementing DOTS, 1990–99

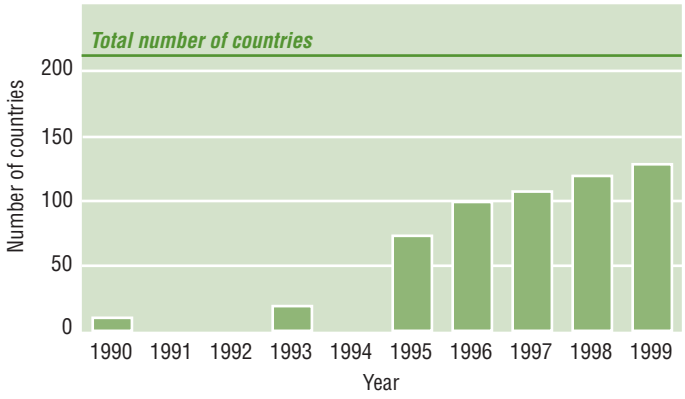


Figure 4. Changes in the categorization of countries, 1995–99, according to the scheme in Figure 1

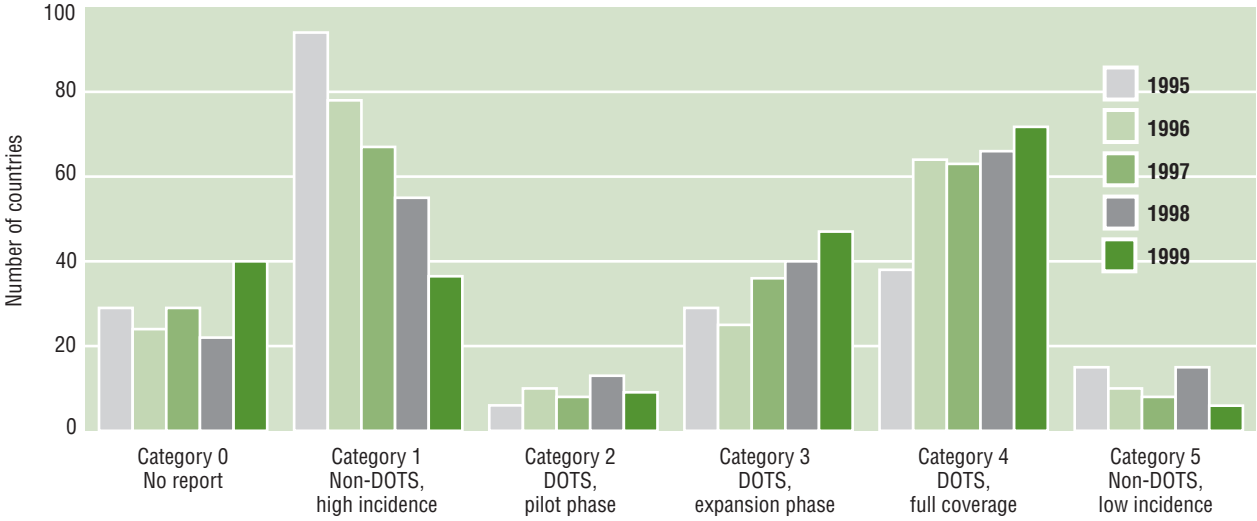


Figure 5. Proportions of countries with different levels of DOTS coverage, 1999

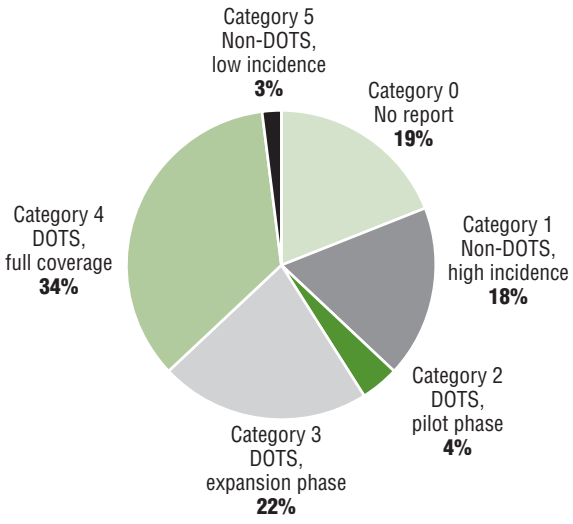


Figure 6. DOTS population coverage by WHO Region, 1999. Each bar shows the population of the region, and the shaded portion of the bar shows the population covered by DOTS. The number above each bar is the percent of the population covered. AFR: African region; EMR: Eastern Mediterranean Region; EUR: European Region; SEAR: South-East Asian Region; WPR: Western Pacific Region.

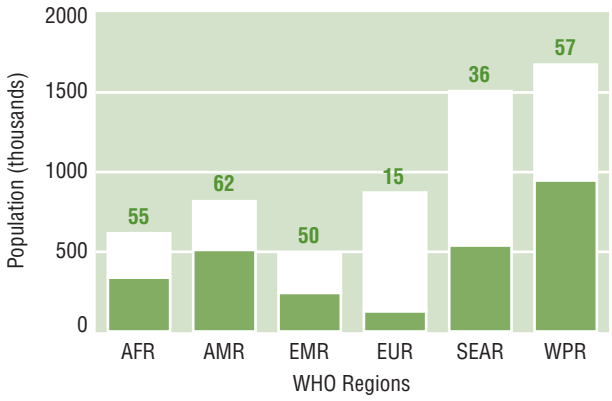


Table 6. Progress in DOTS implementation: 23 high-burden countries, 1995–99

		Percent of population covered by DOTS				
		1995	1996	1997	1998	1999
1	India	1.5	2.0	2.3	9.0	14
2	China	49	60	64	64	64
3	Indonesia	6.0	14	28	80	90
4	Nigeria	47	30	40	45	45
5	Bangladesh	41	65	80	90	90
6	Pakistan	2.0	8.0		8.0	8.0
7	Philippines	4.3	2.0	15	17	43
8	Ethiopia	39	39	48	64	63
9	South Africa			13	22	66
10	Russian Federation		2.3	2.3	5.0	5.0
11	DR Congo	47	51	60	60	62
12	Viet Nam	50	95	93	96	99
13	Kenya	15	100	100	100	100
14	Brazil		0.0	0.0	3.0	7.0
15	UR Tanzania	98	100	100	100	100
16	Thailand		1.1	4.0	32	59
17	Mozambique	97	100	84	95	
18	Myanmar		59	60	60	64
19	Uganda		0.0	100	100	100
20	Afghanistan			12	11	14
21	Zimbabwe		0.0	0.0	100	12
22	Cambodia	60	80	88	100	100
23	Peru	100	100	100	100	100
	23 high-burden countries	24	32	35	43	46
	Global	**22**	**32**	**35**	**43**	**45**

Zero indicates that a report was received, but the country had not implemented DOTS.
Blank indicates that no report was received.

3), including China Hong Kong SAR, Costa Rica, Mauritania and Saudi Arabia. The remaining nine reached high coverage (> 90%), including Libya and Tunisia. Among the four countries that moved up to category 3 in 1999 were Haiti, India and Poland. Bolivia, Iran and Kazakhstan were the biggest of six countries that reached full coverage (category 4). Sixteen countries that had implemented DOTS by 1998 failed to provide data for 1999, including Mozambique, Madagascar and Niger (Table 5b).

Case notifications, 1995–99

The 171 countries reporting to WHO notified a total of 3 689 822 cases (62 per 100 000 population), of which 1 485 783 (40%) were sputum smear-positive (Table 7). These totals are nearly the same as for 1998.

Among all cases reported for 1999, 1 679 086 (46%) originated in DOTS areas (Table 7), a 7% increase on 1998. Of the smear-positive cases, 868 374 (58%) were reported from DOTS areas, 4% higher than in 1998. The African (17%), South-East Asia (41%) and Western Pacific Regions (22%) together accounted for 80% of all notified cases and similar proportions of sputum smear-positive cases (Figure 7).

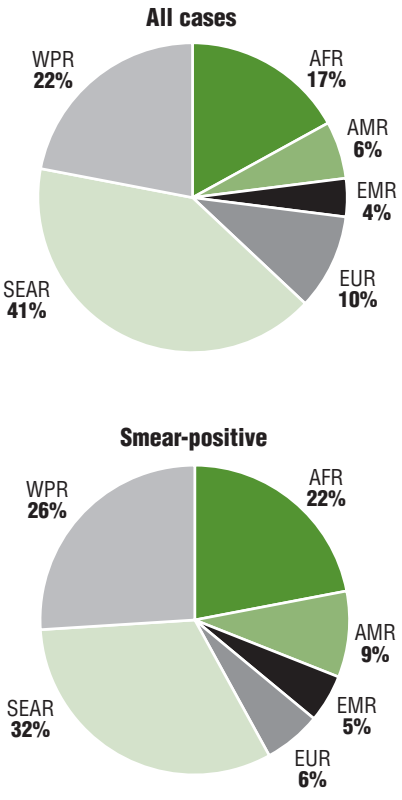


Figure 7. (left) Proportions of all notified cases, and smear-positive cases, by WHO Region, 1999. Abbreviations are as in Figure 6

Figure 8. (below) Global trend in the case notification rate, 1980–99

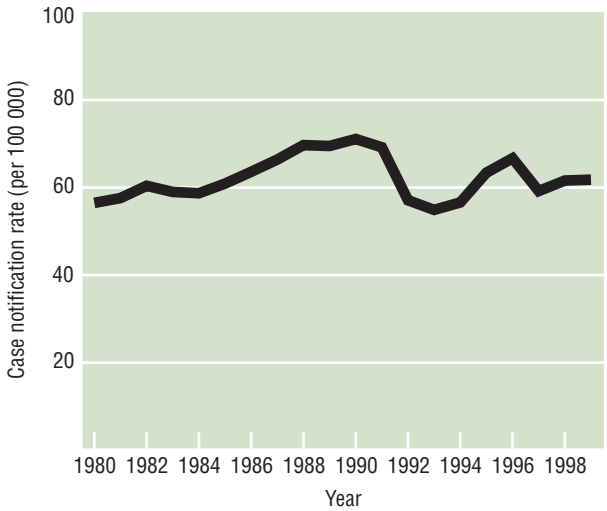


Table 7. Summary of notifications by WHO region, 1999

		% of pop*	Notifications		New ss+ notifs	% of new pulmonary
			Number	%		cases smear-positive
AFR	DOTS	55	571 158	89	278 725	63
	non-DOTS	33	73 814	11	42 535	77
	no report	12				
	Total		**644 972**		**321 260**	
AMR	DOTS	63	117 240	50	68 241	73
	non-DOTS	33	116 583	50	65 122	65
	no report	4.0				
	Total		**233 823**		**133 363**	
EMR	DOTS	50	88 881	57	43 906	74
	non-DOTS	45	67 756	43	23 229	41
	no report	4.7				
	Total		**156 637**		**67 135**	
EUR	DOTS	14	65 361	18	18 596	38
	non-DOTS	86	297 171	82	67 675	29
	no report	0.0				
	Total		**362 532**		**86 271**	
SEAR	DOTS	36	338 224	23	176 793	61
	non-DOTS	64	1 131 448	77	308 997	29
	no report	0.0				
	Total		**1 469 672**		**485 790**	
WPR	DOTS	57	498 222	61	282 113	62
	non-DOTS	43	323 955	39	109 851	38
	no report	0.4				
	Total		**822 177**		**391 964**	
Global	DOTS	45	1 679 086	46	868 374	62
	non-DOTS	52	2 010 727	54	617 409	35
	no report	2.3				
	Total		**3 689 813**		**1 485 783**	

* Percent of population: the regional DOTS population includes only that portion of the population of DOTS countries that is covered by DOTS.

Table 8. Case notifications: 23 high-burden countries, 1999

		Number notified				% of new pulmonary cases smear-positive	
		All cases		Smear-positive			
	Country (ranked by burden)	DOTS	non-DOTS	DOTS	non-DOTS	DOTS	non-DOTS
1	India	120 279	1 102 848	53 034	296 736	55	29
2	China	346 200	113 969	188 525	23 901	57	22
3	Indonesia	69 064		49 172		74	
4	Nigeria	24 143		15 903		74	
5	Bangladesh	71 343	7 996	34 047	3 774	52	100
6	Pakistan	4 671	16 265	2 269	3 979	58	25
7	Philippines	31 825	113 982	20 477	52 896	67	51
8	Ethiopia	72 095		21 457		44	
9	South Africa	90 278	38 777	54 404	23 667	82	80
10	Russian Federation	3 820	130 540	1 274	20 470	39	18
11	DR Congo	59 531		34 923		81	
12	Viet Nam	88 426	453	53 561	244	75	70
13	Kenya	57 266		27 197		57	
14	Brazil	4 060	74 400	2 108	39 326	61	63
15	UR Tanzania	52 437		24 125		59	
16	Thailand	29 413		14 934		57	
17	Mozambique						
18	Myanmar	19 626		11 458		71	
19	Uganda	34 994		18 149		59	
20	Afghanistan	3 314		1 669		70	
21	Zimbabwe	50 138		14 414		34	
22	Cambodia	19 266		15 744		96	
23	Peru	40 345		24 511		82	
	total, high-burden countries	1 292 534	1 599 230	683 355	464 993	62	32
	Global total	**1 679 086**	**2 010 736**	**868 374**	**617 409**	**62**	**35**

* Expected percentage of new pulmonary cases which is smear positive is 55–70%

In DOTS areas, 52% of all new cases were smear-positive (45–60% expected), compared with 31% in other areas. Sixty-two percent of new pulmonary cases were sputum smear-positive in DOTS areas (55–70% expected), compared with 35% elsewhere (Tables 7 and 8).

Although the case notification rate has remained approximately stable since 1980 (Figure 8), the number of cases enrolled in DOTS programmes has increased linearly. The annual increments in smear-positive cases detected by DOTS programmes in the five years 1995 to 1999 were 140 453, 80 596, 190 309 and 98 442, averaging 127 450 extra cases each year. For all forms of TB, the average increment under DOTS has been 255 858 cases each year.

Table 9. Groups of countries used to estimate regional trends in incidence, and groups of countries where incidence was estimated using regional trends

Established Market Economies	Eastern Europe	Latin America	Eastern Mediterranean	Africa–low HIV§	Africa–high HIV§	South East Asia	Western Pacific
Trend estimated from	**Trend estimated from**	**Trend estimated from**	**Trend estimated from**	**Trend estimated from**	**Trend estimated from**	**Trend estimated from**	**Trend estimated from**
Australia	Albania	Anguilla**	Cyprus	Algeria	Botswana	Bhutan	American Samoa**§
Austria	Armenia	Antigua & Barbuda**	Jordan	Benin	Cent Afr Rep	India	Cambodia
Belgium	Belarus	Argentina	Lebanon	Comoros	Côte d'Ivoire	Maldives	China, Hong Kong SAR
Canada	Croatia	Bahamas*	Morocco	Guinea	DR Congo	Sri Lanka	China, Macao SAR
Czech Rep	Estonia	Barbados*	Oman	Madagascar	Kenya	**Trend applied to**	Cook Is**§
Denmark	Kazakhstan§	Bermuda**	Qatar	Mali	Lesotho	Bangladesh§§	Fiji**§
Finland	Kyrgyzstan§	Br Virgin Is**	Syria	Mauritania	Malawi	DPR Korea	French Polynesia**§
France	Latvia	Cayman Is**	Tunisia	Mauritius	Uganda	Indonesia	Guam*
Germany	Lithuania	Chile			UR Tanzania	Myanmar	Kiribati*
Greece	Poland	Cuba	**Trend applied to**	**Trend applied to**	Zambia	Nepal	Lao PDR
Iceland	Romania	Dominica**	Afghanistan	Angola	Zimbabwe	Thailand	Malaysia
Ireland§	Russia	Dominican Rep	Bahrain	Burkina Faso			Marshall Is*
Japan	Slovakia	Ecuador	Djibouti	Cameroon	**Trend applied to**		Micronesia*
Netherlands§	Slovenia	El Salvador	Egypt	Cape Verde	Burundi		N Mariana Is*
New Zealand	Tajikistan	Grenada**	Iran	Chad	Congo (the)		Nauru**§
Norway	Turkey	Guatemala	Iraq	Equatorial Guinea	Eritrea		New Caledonia*
Portugal	Turkmenistan	Guyana	Kuwait	Gabon	Ethiopia		Niue**§
Singapore	Ukraine	Honduras	Libya	Gambia (the)	Mozambique		Palau*
Spain	Uzbekistan	Jamaica	Pakistan	Ghana	Namibia		Rep Korea
Sweden	Yugoslavia	Mexico	Saudi Arabia	Guinea-Bissau	Rwanda		Samoa**§
Switzerland		Montserrat**	Somalia	Liberia	South Africa		Solomon Is*
United Kingdom§	**Trend applied to**	Nicaragua	Sudan§	Niger (the)	Swaziland		Tokelau**§
United States	Azerbaijan	Peru	United Arab Emirates	Nigeria			Tonga**§
	Bosnia & Herzegovina	Puerto Rico	West Bank & Gaza	Sao Tome & Principe			Tuvalu**§
Trend applied to	Bulgaria	St Kitts & Nevis**	Yemen	Senegal			Vanuatu*
Andorra	Georgia	St Lucia**		Seychelles			Viet Nam
Israel	Hungary§	St Vincent & Grenadines**		Sierra Leone			Wallis & Futuna Is**§
Italy	Rep Moldova§	Trinidad & Tobago*		Togo			
Luxembourg	TFYR Macedonia	Turks & Caicos Is**					**Trend applied to**
Malta		Uruguay					Brunei Darussalam
Monaco		Venezuela					China§§
San Marino							Mongolia
		Trend applied to					Papua New Guinea
		Belize					Philippines
		Bolivia					
		Brazil					
		Colombia					
		Costa Rica					
		Haiti					
		Panama					
		Paraguay					
		Suriname					
		US Virgin Is					

*/** To estimate trends, data were aggregated for two groups of islands (marked by * and **) in each of the Latin American and Western Pacific Regions

§ Countries, and groups of countries, for which estimates were derived from new information

§§ Trends based on prevalence surveys of infection and disease

Regional groupings correspond with those in WHR 2000[7]:

Established Market Economies = AMR A + EUR A + WPR A, Eastern Europe = EUR B + EUR C, Africa – low HIV = AFR D, Africa – high HIV = AFR E, Latin America = AMR B + AMR D, SEAR = WHO South East Asia Region, WPR = WHO Western Pacific Region.

Figure 9. Trends in case notification rates for selected countries in different regions, 1980–1999. To highlight trends in notifications within regions, the rates for all countries have been expressed relative to an arbitrary standard of 100 in 1990. Error bars are 95% CL on the standardized (unweighted) rates. Countries selected in each region are those for which case notifications were judged to represent trends in incidence over the period 1980–1999, as listed in table 9.

Estimated TB incidence, 1995–2005

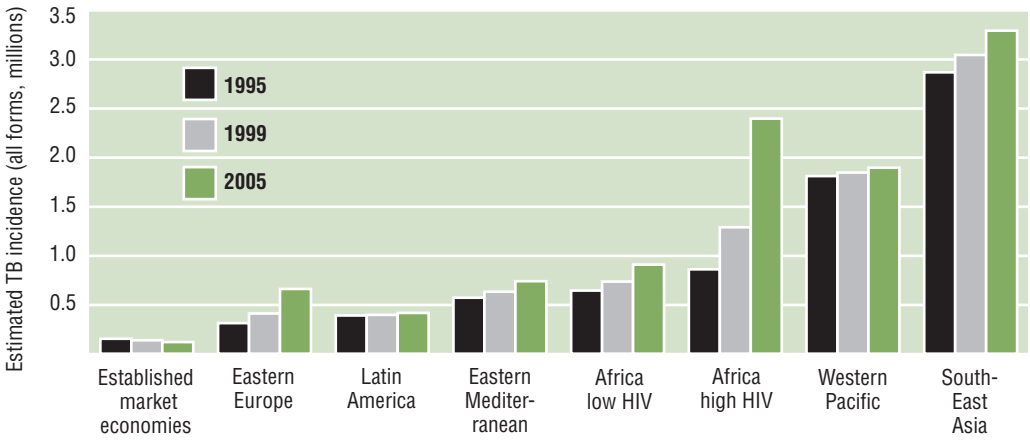
Figure 9 shows the series of case notifications that were used to judge trends in incidence, for the groups of epidemiologically similar countries listed in Table 9. Notification rates were standardized to 100 in 1990, in order to reveal trends more clearly by eliminating the absolute differences between countries in that year. Table 10 contains the estimated numbers of new cases (all forms and smear-positive) in 1999, globally and for the highest-burden countries. Twenty-three coun-

Table 10. Estimated incidence of TB: 23 high-burden countries, 1999

			Number Estimated					
			All cases		Smear-positive cases			Change
	Country (ranked by burden)	Population (1000s)	Thousands	Rate per 100 000 pop	Thousands	Rate per 100 000 pop	Cumulative incidence (%)	in rank 97 to 99*
1	India	998 056	1 847	185	827	83	22	0
2	China	1 266 838	1 300	103	584	46	37	0
3	Indonesia	209 255	590	282	265	127	44	0
4	Nigeria	108 945	327	301	142	130	48	2
5	Bangladesh	126 947	306	241	138	108	52	-1
6	Pakistan	152 331	269	177	121	79	55	-1
7	Philippines	74 454	234	314	105	141	58	0
8	Ethiopia	61 095	228	373	96	157	61	1
9	South Africa	39 900	197	495	80	201	63	-1
10	Russian Federation	147 196	181	123	81	55	65	1
11	DR Congo	50 335	151	301	65	130	67	1
12	Viet Nam	78 705	149	189	67	85	69	-2
13	Kenya	29 549	123	417	51	173	70	2
14	Brazil	167 988	118	70	53	31	72	-1
15	UR Tanzania	32 793	112	340	47	145	73	-1
16	Thailand	60 856	86	141	38	62	74	0
17	Mozambique	19 286	79	407	33	169	75	9
18	Myanmar	45 059	76	169	34	76	76	-1
19	Uganda	21 143	72	343	31	146	77	0
20	Afghanistan	21 923	71	325	32	146	77	-2
21	Zimbabwe	11 529	65	562	26	226	78	0
22	Cambodia	10 945	61	560	27	251	79	0
23	Peru	25 230	58	228	26	102	80	-3
	total, 23 high-burden countries	3 760 358	6 700	178	2 969	79	80	
	Global total	**5 975 045**	**8 417**	**141**	**3 724**	**62**	**100**	

* change in rank resulting from re-estimation of incidence. A positive value indicates that a country has moved up the table

Figure 10. Estimated numbers of TB cases in 1995 (black), 1999 (grey) and 2005 (green), by region. Regions are as defined in Figure 9



tries accounted for 80% of all new cases, henceforth referred to as TB80. The global total rose to 8.42 million in 1999, up from 7.96 million[11] in 1997 (or 7.98 million from back-calculation). Nigeria, Ethiopia, Kenya, DR Congo and Russia are now ranked higher in TB80 than in 1997. Mozambique has joined the league of high-burden countries. Peru has dropped to 23rd and final place in 1999, and was relegated from TB80 during 2000.

The total numbers of cases are predicted to increase in all regions up to 2005, except in the established market economies (decline 2–3%/year, Figure 10). The rate of increase is 3%/year on average, but much higher in those African countries most affected by HIV (10%/year), and in Eastern Europe (8%/year). If present trends continue, we expect 10.2 million new cases in 2005, and more cases in the WHO African Region (3.4 million) than in any other, including South East Asia (3.2 million).

Case detection rate, 1995–99

The 3 689 813 cases of tuberculosis (all forms) notified in 1999 represent 44% of the 8.42 million estimated cases; the total of 1 485 783 new smear-positives is 40% of 3.72 million estimated cases (Tables 6, 8, 11). Twenty percent of all estimated cases, and 23% of estimated smear-positive cases, were detected under DOTS. The detection rate of smear-positive cases within DOTS programmes has been rising faster than the overall smear-positive detection rate (Figure 11, Table 11). Case detection rates in 1999 were lowest in the Eastern Mediterranean Region and highest in Europe and the Americas (Figure 12).

Table 11. Detection of new smear-positive cases: 23 high-burden countries, 1995–99

		DOTS Programmes					Whole country				
Country (ranked by burden)		1995	1996	1997	1998	1999	1995	1996	1997	1998	1999
1	India	0.3	0.8	1.0	1.5	6.4	33	36	34	35	42
2	China	16	24	25	33	32	23	29	32	37	36
3	Indonesia	1.4	4.6	7.5	12	19	12	*	*	*	*
4	Nigeria	8.1	13	8.7	10	12	*	*	*	*	*
5	Bangladesh	6.8	15	19	24	25	15	22	24	28	28
6	Pakistan	0.9	1.6	—	3.5	1.9	2.3	*	—	13	5.2
7	Philippines	0.9	0.5	3.2	10	20	98	88	83	70	70
8	Ethiopia	0.4	19	20	22	22	*	22	*	*	*
9	South Africa	—	—	6.2	22	68	2.5	61	82	112	97
10	Russian Federation	—	0.4	0.9	0.9	1.6	62	65	60	56	27
11	DR Congo	44	50	47	57	53	47	*	*	*	*
12	Viet Nam	30	59	77	81	80	60	77	83	83	80
13	Kenya	58	58	54	57	53	*	*	*	*	*
14	Brazil	—	—	—	4.1	4.0	79	80	80	72	79
15	UR Tanzania	61	60	56	55	51	*	*	*	*	*
16	Thailand	—	0.3	5.0	21	40	55	46	35	*	*
17	Mozambique	49	44	42	41	—	*	*	*	*	—
18	Myanmar	—	26	27	30	33	26	29	29	*	*
19	Uganda	—	—	63	63	59	57	59	*	*	*
20	Afghanistan	—	—	2.0	5.8	5.2	—	—	*	*	*
21	Zimbabwe	—	—	—	60	55	45	57	64	*	*
22	Cambodia	48	40	50	53	57	*	50	*	*	*
23	Peru	99	88	95	101	95	*	*	*	*	*
	all high-burden countries	9.3	13	15	20	23	31	35	35	38	39
	Global	**11**	**14**	**16**	**21**	**23**	**35**	**38**	**38**	**40**	**40**

— not available; * no additional data beyond DOTS report

[11] WHO/IUATLD/KNCV. *Revised international definitions in tuberculosis control (2000)*. Unpublished document available from WHO Geneva.

Figure 11. Global case detection rate (grey bars) and DOTS detection rate (green bars), 1995–99

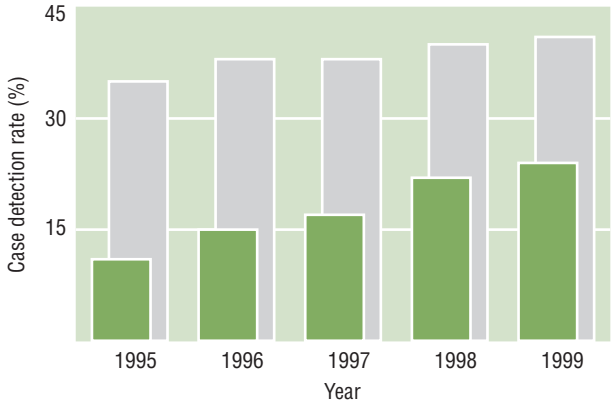
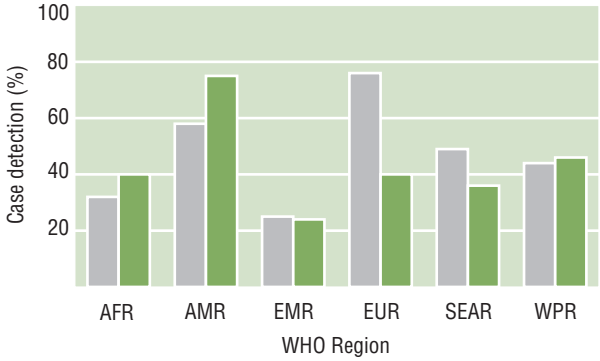


Figure 12. Detection rates of smear-positive (green bars) and all TB cases (grey bars) by WHO Region, 1999. Abbreviations are as in Figure 6.



Treatment results, 1994–98 cohorts

The number of new sputum smear-positive cases notified under DOTS in 1998 was 769 932, including late reports (Table 12a). According to 1999 reports, approximately the same number of cases (725 275) were registered for treatment in 1998 (Annex 6 lists notified and registered cases for 1998 by country). The discrepancy is due mostly to inconsistencies in reports from Brazil, Pakistan and Uganda (registered many fewer than notified), and Afghanistan and South Africa (many more registered than notified). Of the registered cases, 95% were evaluated for treatment outcome (Tables 12a and 13). Seventy-three percent of the registered cases were cured and a further 8% completed treatment (no laboratory confirmation of cure) giving, for the first time,

Table 12a. Treatment outcomes for smear-positive cases: 23 high-burden countries: DOTS strategy, 1998 cohort*

					Treatment outcomes (%)*								
	Country (ranked by burden)	Notified	Registered*	Regst'd (%)	Cured	Completed treatment*	Died	Failed	Defaulted	Trans-ferred	Not eval'd	Treatment success* (%)	%est* cases successfully treated under DOTS
1	India	12 421	12 418	100	83	1.2	4.4	2.7	7.5	1.0	0.3	84	9.3
2	China	191 290	190 016	99	97		1.2	0.8	0.6	0.3	0.5	97@	34
3	Indonesia	32 280	40 166	124	49	8.5	1.6	0.9	1.8	0.5	38	58	8.7
4	Nigeria	13 161	13 161	100	59	14	6.4	2.6	14	2.8	1.7	73	6.8
5	Bangladesh	33 220	33 506	101	76	4.3	5.1	0.9	9.1	3.0	1.9	80	21
6	Pakistan	4 145	1 918	46	53	13	4.5	0.9	25	3.2	0.0	66	5.6
7	Philippines	10 292	8 976	87	78	6.6	2.9	2.6	6.9	3.2	0.0	84	14
8	Ethiopia	18 864	14 836	79	54	20	6.3	1.0	13	4.3	1.2	74	11
9	South Africa	16 246	34 432	212	68	6.6	5.6	1.7	6.8	12	0	74	33
10	Russian Federation	683	745	109	61	6.4	7.9	8.3	6.7	3.6	5.7	68	0.6
11	DR Congo	33 419	33 442	100	58	12	5.3	1.0	9.4	8.4	6	70	36
12	Viet Nam	53 147	52 799	99	90	2.7	2.8	1.2	1.9	1.5	0.0	93@	75
13	Kenya	24 029	21 885	91	63	14	5.3	0.4	11	6.7	0.0	77	33
14	Brazil	2 221	82	3.7	78	13	2.4			6.1	0.0	91@	23
15	UR Tanzania	23 726	23 726	100	70	5.9					24	76	40
16	Thailand	7 962	7 962	100	61	6.2	7.6	1.5	9.5	2.4	11	68	14
17	Mozambique	12 116											
18	Myanmar	10 089	10 313	102	74	8.5	4.7	1.0	10	1.9	0.0	82	25
19	Uganda	18 222	13 236	73	31	31	8.1	0.4	19	4.7	5	62	27
20	Afghanistan	1 833	2 913	159	27	6.8	1.7	0.8	5.8	1.4	57	33	3.0
21	Zimbabwe	14 492	12 748	88	50	19	10	0.3	8.3	12	0	70	34
22	Cambodia	13 865	13 290	96	92	3.0	2.3	0.4	2.2	0.5	0.0	95@	46
23	Peru	27 707	26 137	159	92		2.2	1.4	3.2	0.7	0.0	92@	94
	all high-burden countries	575 430	568 707	99	78	5.5	3.2	1.0	4.6	2.7	4.9	84	16
	Global (DOTS)	**769 932**	**725 275**	**94**	**73**	**7.6**	**3.8**	**1.2**	**6.0**	**3.2**	**4.9**	**81**	**16**

* Cohort: cases diagnosed during 1998 and treated/followed-up through 1999. See table 4 and accompanying text for definitions of treatment outcomes.
@=treatment success > 85%.

an overall treatment success rate over 80% in DOTS areas. Eighty-five percent of evaluated cases, and 16% of all estimated smear-positive cases, were treated successfully under DOTS.

As usual, the discrepancy between cases notified and registered is bigger in non-DOTS areas (Table 12b). The most striking examples are Russia and the Philippines. The deviation for South Africa could be explained in terms of DOTS/non-DOTS misclassification (see above). In the non-DOTS areas that presented results, treatment success was low (37%), and the cure rate very low (15%). This poor performance is explained primarily by the low evaluation rate (50%), and

Table 12b. Treatment outcomes for smear-positive cases: 23 high-burden countries: non-DOTS strategy, 1998 cohort*

Country (ranked by burden)	Notified	Registered	Regst'd (%)	Treatment outcomes (%)*							Treatment success* (%)
				Cured	Completed treatment*	Died	Failed	Defaulted	Trans-ferred	Not eval'd	
1 India	271 645	271 645	100	1.9	22	0.1	0.1	2	0.2	73	24
2 China	23 172	20 080	87	85		1.8	6.5	4.5	1.7	1.0	85@
3 Indonesia											
4 Nigeria											
5 Bangladesh	4 517	4 523	100	50	7.3	0.5	0.3	28	8.4	5.8	57
6 Pakistan	10 829	27 470	254	20		0.3		56	0.6	24	20
7 Philippines	61 371	11 707	19	38	23	1.3	0.8	3.4	1.9	32	60
8 Ethiopia											
9 South Africa	66 047	2 657	4	30	17	5.1	0.9	13	34	0.0	47
10 Russian Federation	41 536										
11 DR Congo											
12 Viet Nam	1 726	1 752	102	75	10	3.9	2.3	6.4	2.2	0.0	85@
13 Kenya											
14 Brazil	36 588	29 996	82	10	30	2.4	0.3	6.3	3.7	48	40
15 UR Tanzania		1 450		66	6	11	1.5	7.3	5.9	1.9	73
16 Thailand											
17 Mozambique											
18 Myanmar											
19 Uganda											
20 Afghanistan											
21 Zimbabwe											
22 Cambodia											
23 Peru											
all high-burden countries	517 431	371 280	72	11	20	0.5	0.5	6.9	1.0	60	31
Global (non-DOTS)	**670 235**	**461 299**	**69**	**16**	**22**	**1.1**	**1.7**	**7.7**	**1.7**	**50**	**37**

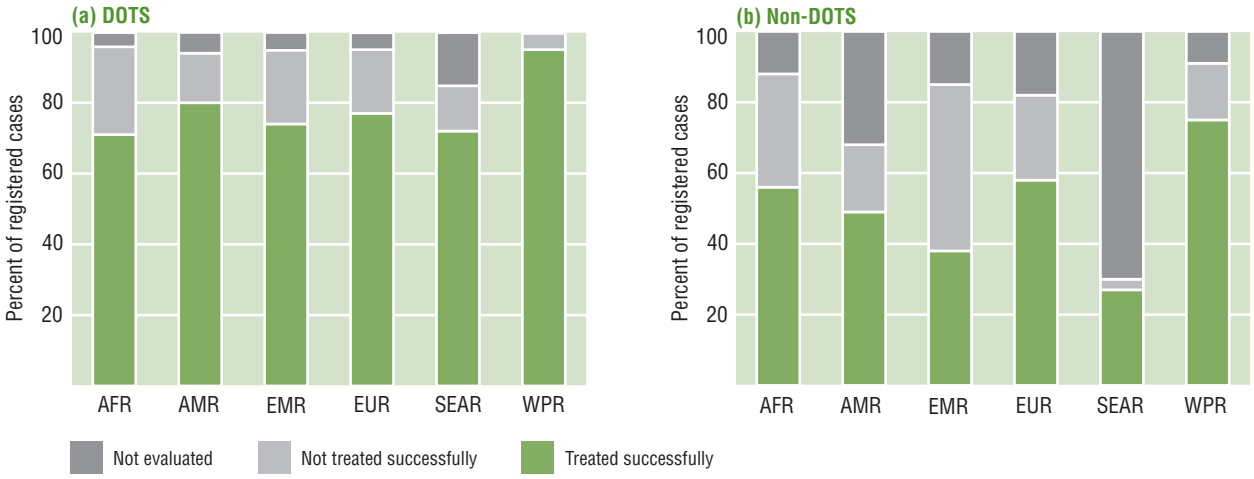
* see notes for table 12a

Table 13. Treatment outcomes for smear-positive cases, by WHO Region and strategy, 1998 cohort*

WHO region/strategy	Notified	Registered	Regst'd (%)	Treatment outcomes (%)*							Treatment success* (%)	% est* cases successfully treated under DOTS
				Cured	Completed treatment*	Died	Failed	Defaulted	Trans-ferred	Not eval'd		
AFR DOTS	253 162	227 207	90	57	13	6.0	1.1	11	6.9	5.1	70	18
non-DOTS	86 181	8 401	10	48	8.1	5.2	2.6	10	14	13	56	
AMR DOTS	70 271	63 173	90	66	15	4.4	1.0	6.0	2.6	5.6	80	28
non-DOTS	65 007	46 979	72	25	24	3.3	0.5	11	4.2	33	49	
EMR DOTS	41 298	39 311	95	64	10	3.5	2.1	10	5.2	4.9	74	10
non-DOTS	33 584	44 009	131	32	5.6	1.1	2.0	41	2.6	15	38	
EUR DOTS	18 957	12 487	66	62	15	5.8	4.5	4.9	3.2	4.4	77	4.5
non-DOTS	92 414	34 730	38	12	46	2.7	12	6.0	4.0	17	58	
SEAR DOTS	103 498	114 355	110	66	6.0	3.9	1.2	6.4	1.7	15	72	6.1
non-DOTS	284 450	284 667	100	4.6	22	0.2	0.2	2.6	0.4	70	27	
WPR DOTS	282 746	268 742	95	94	1.1	1.6	0.9	1.2	0.7	0.4	95@	30
non-DOTS	108 599	42 513	39	58	17	3.0	4.9	5.1	2.6	9.4	75	
Global DOTS	769 932	722 275	94	73	7.6	3.8	1.2	6.0	3.2	4.5	81	16
non-DOTS	670 235	461 299	69	16	22	1.1	1.7	7.7	1.7	50	37	

* see notes for table 12a. Est: estimated cases (as opposed to notified or registered)

Figure 13. Treatment success in (a) DOTS and (b) non-DOTS areas, by WHO Region, 1998 cohort. Abbreviations are as in Figure 6.



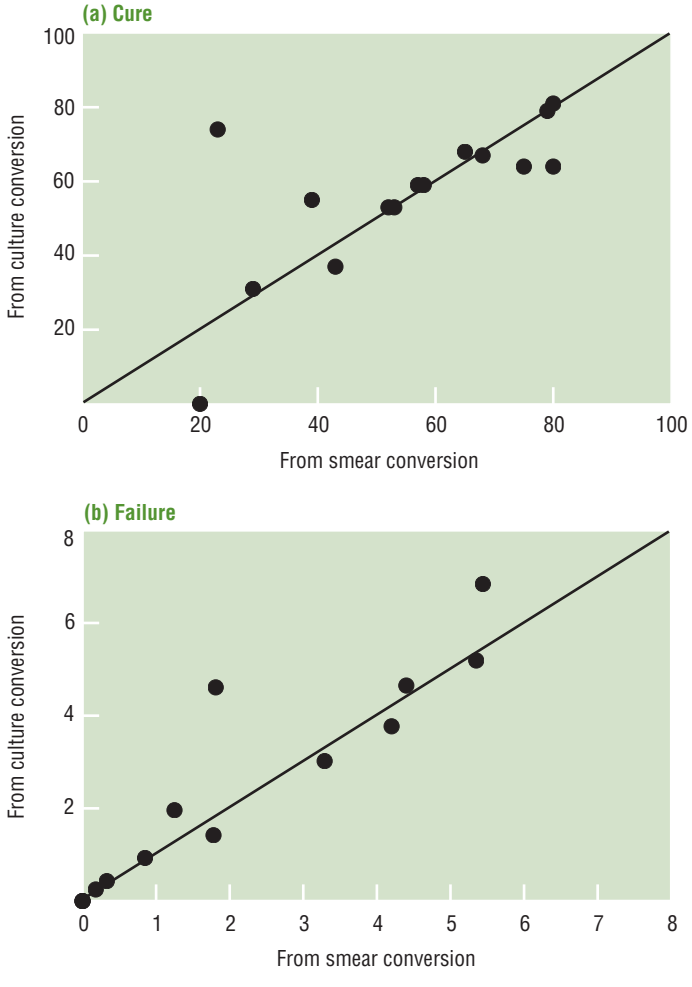
secondarily by treatment interruption (8%). Looking at evaluated patients only, 74% were successfully treated outside DOTS programmes.

By WHO region, the documented treatment success rates under DOTS varied from 70% in Africa to 95% in the Western Pacific Region (Figure 13, Table 13). Fatal outcomes were most common in Africa (6%) and Europe (6%), where cases are more frequent among HIV-infected individuals and the elderly, respectively. Treatment interruption (default) was most frequent in the African (11%) and Eastern Mediterranean Regions (10%).

Comparing treatment results for four consecutive cohorts (1995–98) shows that the overall success rates have remained approximately stable at 77–81% under DOTS, and 54–64% worldwide (Table 14).

In DOTS areas, 99 775 cases were registered for retreatment in 1998, more than twice as many as in the previous year. The reason for the difference is that China reported data for 1998, but not for 1997. The latest data show that 78% of patients on retreatment regimens were cured, and 6% completed. Chinese data strongly influence the high overall retreatment success rate of 84% (Table 15, Annex 2). Cohort data from Pakistan were incomplete, leaving in doubt the reported 92% cure rate.

Figure 14. Comparisons of (a) cure and (b) failure rates, judged by sputum smear versus culture conversion, in 16 European countries



Treatment outcomes measured by smear and culture conversion

Sixteen European countries provided treatment outcomes judged both by sputum smear and culture conversion. Although culture is generally a more sensitive method for detecting bacilli (so smears can be negative while cultures are positive), cure measured by smear conversion was not consistently higher than cure measured by culture conversion (Figure 14a). Nor was failure different by the two methods (Figure 14b).

Table 14. Treatment success for smear-positive cases: 23 high-burden countries, 1994–98 cohorts

Country (ranked by burden)	DOTS programmes					Whole country				
	1994	1995	1996	1997	1998	1994	1995	1996	1997	1998
1 India	83	79	79	82	84	83	25	21	18	27
2 China	94	96	96	96	97	91	93	94	95	95
3 Indonesia	94	91	81	54	58	94	*	*	*	*
4 Nigeria	65	49	32	73	73	*	*	*	*	*
5 Bangladesh	73	71	72	78	80	73	*	63	73	77
6 Pakistan	74	70	—	67	66	69	70	—	*	23
7 Philippines	80	—	82	83	84	88	60	35	78	71
8 Ethiopia	74	61	73	72	74	*	61	71	*	*
9 South Africa	—	—	69	73	74	78	58	61	68	72
10 Russian Federation	—	65	62	67	68	—	65	57	67	68
11 DR Congo	71	80	48	64	70	72	74	48	64	*
12 Viet Nam	91	91	90	85	93	*	89	89	85	92
13 Kenya	73	75	77	65	77	*	*	*	*	*
14 Brazil	—	—	—	—	91	70	17	20	27	40
15 UR Tanzania	80	73	76	77	76	*	73	*	*	*
16 Thailand	—	—	78	62	68	58	64	78	58	*
17 Mozambique	67	39	54	67	—	*	*	55	65	—
18 Myanmar	—	66	79	82	82	77	67	79	*	*
19 Uganda	—	—	33	40	62	—	44	*	*	*
20 Afghanistan	—	—	—	45	33	—	—	—	*	*
21 Zimbabwe	—	—	—	—	70	52	53	32	69	*
22 Cambodia	84	91	94	91	95	*	*	*	*	*
23 Peru	81	83	89	90	92	*	*	*	*	*
all high burden countries	86	83	79	82	84	83	54	51	57	63
Global	**77**	**79**	**77**	**80**	**81**	**75**	**57**	**54**	**60**	**64**

* see notes for table 12a. — not available; * no additional data beyond DOTS report

Table 15. Retreatment outcomes in DOTS programmes: 23 high-burden countries, 1998 cohort*

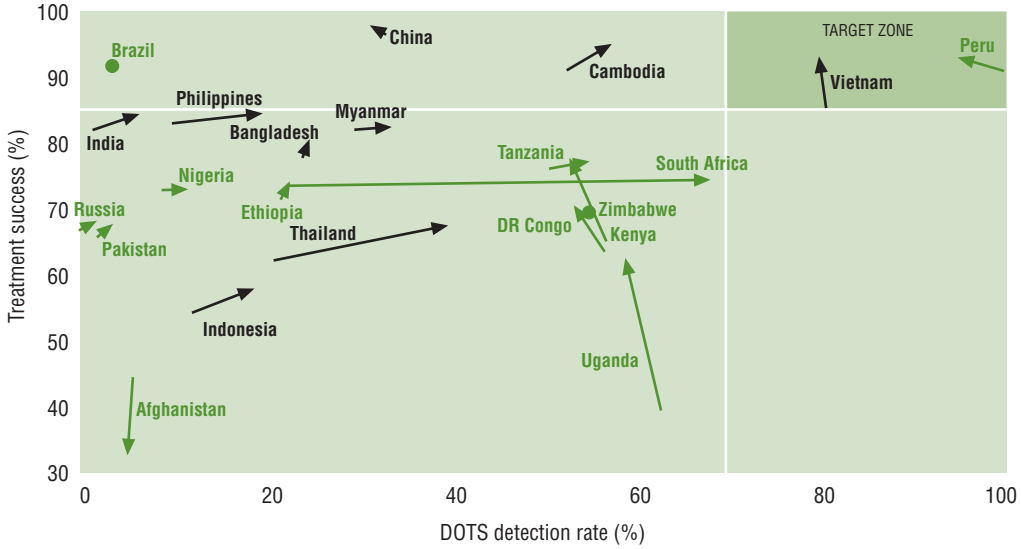
Country (ranked by burden)	Registered	Treatment outcomes (%)*							Treatment success (%)
		Cured	Completed treatment*	Died	Failed	Defaulted	Trans-ferred	Not eval'd	
1 India	5 782	59	13	6.5	5.5	14	1.7	0.1	72
2 China	49 378	95		1.7	1.7	0.8	0.2	0.3	95@
3 Indonesia	893	53	20	2.6	1.7	6	1.1	16	73
4 Nigeria									
5 Bangladesh	1 333	71	4.0	3.2	2	8.8	4.5	7	74
6 Pakistan	24	92	8.3					0.0	92@
7 Philippines	29	76	6.9	3.5	3.5	10		0.0	83
8 Ethiopia	758	46	14	8.4	2.8	7.4	3.3	18	60
9 South Africa	4 718	57	13	12	2.6	10	4.8	0.0	71
10 Russian Federation	246	38	11	17	20	7.7	4.5	1.6	49
11 DR Congo	5 820	25	6.3	8.1	3.1	8.6	11	38	31
12 Viet Nam	5 612	79	4.7	4.9	6.9	2.1	2.1	0.0	84
13 Kenya	1 541	55	9.3	6.8	0.8	10	4.2	14	64
14 Brazil									
15 UR Tanzania	1 450	66	6.3	11	1.5	7.3	5.9	2.0	73
16 Thailand	556	49	6.3	6.7	4.9	9.7	3.6	20	55
17 Mozambique									
18 Myanmar	2 052	66	10	6.2	2.7	12	3.2	0.0	76
19 Uganda	1 573	31	29	12	0.9	20	6.2	0.0	60
20 Afghanistan	40	70	7.5	7.5	7.5	5	2.5	0.0	78
21 Zimbabwe									
22 Cambodia	691	89	2.8	3.9	1.2	3.5		0.0	91@
23 Peru	5 267	83		4.2	3.7	8.5	0.8	0.0	83
all high burden countries	87 763	80	3.8	4.0	2.6	4.4	1.9	3.6	83
Global	**103 169**	**76**	**5.7**	**4.7**	**2.6**	**5.5**	**2.1**	**3.5**	**82**

* see notes for table 12a

Progress in TB control in 23 high-burden countries

Figure 15, and Tables 11 and 14, give an overview of progress towards meeting WHO targets for the countries listed in TB80 (except Mozambique which did not provide 1999 data). The immediate impression conveyed by Figure 15 is that the arrows depicting progress from 1998 to 1999 are short, with the exceptions of South Africa, Thailand and the Philippines. A more considered account of developments in these countries is given in the paragraphs that follow. These notes, which include some preliminary data for the year 2000, should be read in conjunction with the country profiles in Annex 3, and with the plans for expanding TB control in these countries.[12]

Figure 15. DOTS progress in high-burden countries, 1998–99. Treatment success refers to cohorts of patients registered in 1997 or 1998, and evaluated, respectively, by the end of 1998 or 1999. DOTS detection rate is the fraction of estimated cases notified under DOTS in 1998–99. Arrows mark progress in countries that supplied notification and cohort data for at least two years. Circles (Brazil and Zimbabwe) represent countries which have treatment outcomes are available for one year only. Countries should enter the graph at top left, and proceed rightwards to the target zone. Countries from AFR, AMR and EMR are shown in green, those from SEAR and WPR are shown in black.



1. India

India reported 41 000 additional smear-positive cases under DOTS in 1999, as compared with 1998, and an extra 66 000 smear-positive cases overall. In 1999 and 2000, population coverage increased rapidly so that by the end of the year 2000, more than 300 million people had access to DOTS. During 2000, more than 220 000 patients were treated under DOTS, including nearly 100 000 new smear positive cases, i.e. 12% of the estimated total for the country and approximately 60% of those in DOTS areas. India now has the second largest DOTS programme in the world (behind China) and is placing more than 25 000 patients on DOTS treatment every month. Coverage is expected to exceed 500 million people by the end of 2002. The programme has consistently reported treatment success around 80%. The success rate of 84% for the 1998 cohort is close to the WHO target, and would have been higher but for the 7% default rate. Although India has made much progress in the past 2–3 years, two thirds of the population still did not have access to DOTS as of late 2000.

2. China

The existing DOTS programme includes both the Infectious and Endemic Disease Control (IEDC) and Ministry of Health Projects, covering 50% and 14% of the population, respectively. More

[12] World Health Organization. *Progress Towards Global DOTS Coverage: Status of High-burden Countries*. Unpublished WHO document.

than 1 in 3 infectious TB cases are currently treated under DOTS and the reported treatment success rate has remained over 90% (though China does not separate patients known to be cured from those that merely completed treatment). The impact of this programme can be judged, in part, from the results of a national disease prevalence survey carried out during 2000. Preliminary analysis of the survey data suggests that the prevalence of smear-positive disease was 122/100 000 population, a decrease of 21% since 1990. More critically, prevalence was only 90/100 000 in the 13 provinces participating in the IEDC project. The reduction in these provinces between 1990 and 2000 was 37%, as compared with 3.2% elsewhere in China. The national death rate from TB was 9.8/100 000, a reduction of 53% since 1989. Applied to IEDC provinces, this result suggests that about 56 000 deaths were averted in the year 2000, towards the upper end of the range proposed on the basis of treatment-retreatment (capture-recapture) modelling.[13] Set against this good news is the fact that DOTS coverage has not improved since 1997; consequently, the number of cases enrolled in 1999 was about the same as in 1998. The major challenge now is to secure political commitment and financial resources to maintain and expand the DOTS programme. In this regard, there are two significant developments. First, the State Council of China held a high-level advocacy meeting with national and provincial leaders in December 2000 to push for increased commitment from all levels of government. Second, a group of international partners, including the World Bank and the Department for International Development (UK), is working to provide new funds for TB control in China.

3. Indonesia

Political commitment for TB control is strong under GERDUNAS TB—a nationwide effort to mobilize a diversity of forces against tuberculosis. The country extended DOTS to an additional 50 districts during 1999 and reported that 90% of the population now live in areas where DOTS is implemented. However, the extra 17 000 smear-positive cases reported under DOTS in 1999 brings the case detection rate up to only 19%. Case detection needs to be increased by involving all health facilities in DOTS areas. Treatment success among evaluated cases in the 1998 cohort was 92%, but the absence of reported outcomes for 38% of registered smear-positive cases leaves the overall success at just 58%. Over 40 000 cases were registered for treatment under DOTS in 1998, whereas only 32 000 were notified that year. Major efforts are said to be under way to build capacity at various levels to improve the quality of TB control services. A wide range of improvements is evidently needed because the data submitted to WHO indicate low coverage, doubtful treatment outcomes and inconsistent reporting.

4. Nigeria

DOTS population coverage did not increase between 1998 and 1999, though case detection rose from 10% to 12%. A comparison of the last two cohorts shows that treatment success did not change between 1997 and 1998 (73%). Results in 1998 would have been better, but some states recorded high rates of death (probably due to HIV) and defaulting (others have maintained high cure rates above 80%). The low level of accessibility to effective TB care is expected to improve soon because more resources are available from internal and external sources to expand DOTS coverage from 20 to all 36 states, and to the federal capital. The results, in terms of improved rates of case detection and cure, are awaited.

5. Bangladesh

In 1999, DOTS expanded in Chittagong metropolitan area, and nationwide coverage reached 90%. NGOs are responsible for 40% of DOTS coverage, including both rural and urban areas, and government is responsible for the other 60%. The two parts of the DOTS programme together detected 25% of estimated smear-positive cases. The big difference between population coverage and case detection persists because many patients continue to seek treatment from

[13] Dye C, Zhao F, Scheele S, Williams BG. Evaluating the impact of tuberculosis control: number of deaths prevented by short-course chemotherapy in China. *Int J Epidem* 2000; 29: 558–564.

non-DOTS facilities, including medical college hospitals and private practitioners. The treatment success rate of new smear-positive cases was 80% in the 1998 cohort, an increase on previous years. By contrast, treatment success outside DOTS areas was only 57%, with 28% of patients defaulting. Among cases seeking retreatment under DOTS, the percentage which were cured or completed treatment jumped from 58% in 1997 to 74% in 1998, mainly because a greater proportion of cases was evaluated. Since July 1998, the management of supplies, and recording, reporting and training have been unified following a reform of the health sector. This may have an impact on the future performance of the DOTS programme.

6. Pakistan

According to 1999 data, Pakistan still had only 8% DOTS coverage with no apparent expansion on the previous year. Case reports have fluctuated over the past three years, and so consequently has the case detection rate. Of the cases notified in 1998, only half were registered for treatment. Treatment success among cases registered has been more stable, and the 66% reported for the 1998 cohort is consistent with earlier years. The main reasons for this poor and erratic performance up to 1999 were weak leadership of the NTP, and a budget that was far too small. During 2000, Pakistan took decisive action, with the result that federal and provincial ministries now have substantially increased funds for TB control. With these extra funds they have been able to establish a team of TB experts which operates nationally and provincially, and to ensure a regular supply of anti-TB drugs. All provinces have now begun to implement DOTS and coverage was 14% at the end of 2000. Further expansion is expected to take place in 2001. Pakistan appears, finally, to have launched a credible, national TB control programme.

7. Philippines

DOTS has expanded rapidly in the Philippines, reaching 43% population coverage in 1999 compared with 17% in 1998. By the end of 1999, the WHO strategy was operational in 28 provinces. Twenty percent of all estimated smear-positive cases were notified to the DOTS programme in 1999, double the proportion in 1998. The extra 10 000 smear-positive cases reported under DOTS in 1999 were added at the expense of more than 8000 fewer cases reported from non-DOTS area. Thus, the net gain in smear-positive cases reported in 1999 was approximately 2000 cases. Treatment success in the 1998 cohort was close to the WHO target of 85%; defaulting (7%) was the main obstacle to better cure. Outside the DOTS cohort, treatment success was only 60% because a large fraction of cases was not evaluated. The burden of TB in the Philippines was accurately measured by a prevalence survey carried out in 1997; the high estimate of case detection overall (70%) is probably accurate and, with impressive outcomes of treatment, suggests that rapid progress could be made towards WHO targets.

8. Ethiopia

Only 45% of Ethiopians have access to (live within 10km of) general health services. Thus, it will be hard to provide DOTS to more than half the population if the service is confined to health facilities. Although we report here that DOTS coverage was 63% in 1999 (based on geographical Zones), a more precise analysis[14] suggests that 825 out of 2563 (32%) health facilities were using DOTS towards the end of 2000. True access appears to be closer to 32% than to 63% because less than one quarter of estimated smear-positive cases were notified to DOTS programmes in 1999. Although a growing fraction of patients is diagnosed as smear-positive, the fraction in 1999 (30%) was still lower than expected (55–70%), even allowing for a higher proportion of HIV-infected, smear-negative cases. By contrast, the proportion of patients diagnosed with extrapulmonary TB (31%) was far higher than expected. The treatment success of new smear-positive cases was 74% in the 1998 cohort, kept low by the 13% default rate (one recent study found more than a quarter of "defaulters" to be unreported deaths). To expand DOTS in a country with such

[14] Tuberculosis and Leprosy Control Programme Ethiopia. Concise Introduction and Performance in 1992 EC (July 1999–June 2000). Disease Prevention and Control Department, Ministry of Health, Ethiopia.

low access to general health services is a major challenge. Success will depend, among other things, on identifying ways to provide DOT outside health facilities, and on improving collaboration between organizations concerned with the control of TB and HIV/AIDS.

9. South Africa

DOTS coverage was extended to two thirds of the country by the end of 1999, and the proportion of smear-positive cases detected under DOTS reached 76%. The country reported 38 000 more smear-positive cases under DOTS in 1999 than in 1998, the second biggest increment after India. Although estimated incidence for 1999 (492/100 000) was higher than for 1997 (438/100 000), it may still be too low because the proportion of smear-positive cases detected nationally exceeded 100%. Treatment success has remained stable at 74%, mainly because 12% of cases were not evaluated. The number of cases registered for treatment under DOTS (reported to WHO in 1999) was twice as big as the number notified (reported in 1998), a conspicuous anomaly. The likely explanation is that half of these patients were diagnosed and began treatment in non-DOTS areas that were later re-classified as DOTS. Notwithstanding these uncertainties over case detection and treatment success, South Africa is in a position to meet WHO targets of 70% case detection and 85% treatment success within the next 1–2 years.

10. Russian Federation

By the end of 1999 DOTS coverage was still low at 5%, unchanged from 1998. Two territories implemented DOTS during 1998, Leningrad and Murmansk, but the enrolment of patients began in the third quarter of the year, so treatment results are not yet available. Approximately 2% of estimated smear-positive cases were reported from areas classified as DOTS in 1999. Outside DOTS areas, the number of smear-positive cases fell by 21 000 between 1998 and 1999, because no distinction was made in previous years between diagnoses made by culture and smear. Treatment success in the 1998 cohort was 68%, due to persistently high rates of death (8%) and defaulting (7%). During 1999 and 2000, projects began in Achangelsk, Orel, Novgorod, Karelia, Vladimir and Altaj. Negotiations with the World Bank on a loan to reinvigorate TB control nationally were advanced and the loan project should start in 2001. The loan is intended to provide a basic (DOTS-type) package of TB control measures to 55% of the civilian population and 45% of the prison population over the next 5 years. The project will address the problem of diagnosing and treating drug-resistant cases through pilot projects in selected civilian and prison populations. The Russian Ministry of Health is working closely with WHO on a revision and update of the Russian TB control strategy, to be completed by the beginning of 2002.

11. Democratic Republic of the Congo

DOTS coverage and the case detection rate have remained steady since our records began in 1995. As in 1998, coverage (62%) was reported to be about the same as the DOTS detection rate (53%). Population coverage is commonly much higher than the detection rate; little extra information was provided from DR Congo in 1999 to explain the similarity. The possibilities are that the incidence rate has been underestimated, that notification rate is exaggerated (e.g. because cases from non-DOTS areas are included), or that DOTS areas of the country suffer relatively high incidence rates. Treatment success climbed to 70%, but 9% of patients defaulted and 6% were not evaluated.

12. Viet Nam

Beginning in 1995 Viet Nam rapidly expanded the availability of DOTS, and has maintained coverage since 1996. Over 98% of the population had access to DOTS in 1999. Treatment success rates have consistently been over 85%, and reached 93% in the 1998 cohort. The estimated proportion of all incident smear-positive cases successfully treated was outstandingly high at 75%. Viet Nam has fallen two places in the league of high-burden countries, not because there is any evidence (yet) that incidence has declined, but rather because the numbers of cases have prob-

ably increased in Russia and DR Congo. In 1999, and in 1998, Vietnam was one of only two countries in TB80 to have met WHO targets of 70% case detection and 85% cure (Peru is the other).

13. Kenya

Kenya has reported 100% DOTS coverage since 1996. Although our best estimate of incidence suggests that the smear-positive detection rate is low (53%), we cannot rule out the possibility that the true incidence was lower than 157/100 000 in 1999. Treatment success has recovered to 77%, after last year's fall to 65% (due probably to aberrant reporting, rather than a lower cure rate). By solving the problem of defaulting (11%), Kenya should be able to reach 85% cure, despite high rates of HIV infection.

14. Brazil

In 1997, plans were made to start DOTS in four western states of Central West Brazil, and implementation began in 1998. In the same year the Brazilian National Health Board declared tuberculosis a priority problem. However, only 7% of the population had access to DOTS in 1999, and these areas detected 4% of smear-positive cases. Treatment success was 91% in the 1998 cohort, but only 82 patients were registered. This is far lower than the number originally notified because, during 1998, Brazil erroneously reported all patients from the Central West region as living in DOTS areas. At the national level, an improvement in the surveillance system is urgently needed so as to be able to record, for example, the number of health units using DOTS, and the number using smear microscopy for diagnosis. The most important administrative change during 1999 was the incorporation of the NTP into the Department of Basic Health Care (which includes the rapidly expanding Family Health and Community Health Workers Programmes). This is expected to facilitate access to TB diagnosis and supervised treatment. Brazil already notifies an estimated 79% of smear-positive cases in total, mostly under non-DOTS schemes. Having found the cases, there is great potential for the rapid provision of high-quality treatment and reporting under DOTS, and for meeting WHO targets by 2005 in accordance with national plans.

15. Tanzania

With regard to TB control, Tanzania closely resembles Kenya. DOTS is available country-wide, smear-positive case detection rate is stable at about 60%, and treatment success exceeds 70%. While progress in DOTS implementation remains static, the case notification rate continues to climb, though the growth rate has been slower in Tanzania (7%/year) than in Kenya (17%/year). This is consistent with the fact that HIV infection has spread more quickly in Kenya (prevalence HIV infection 14% in 15–49 year olds, 1999) than in Tanzania (prevalence 7%).

16. Thailand

Thailand continued its rapid expansion of the DOTS strategy to cover 59% of all districts by the end of 1999, up from 32% a year earlier. The 1998 cohort was the first in which treatment outcomes for a significant number of cases could be evaluated. While the success rate improved to 68% from only 62% in the previous year, these results still fall significantly short of WHO target levels. Missing outcome results for registered cases continued to be a problem, although the percentage of patients for which no results were available significantly decreased (11%, down from 19% in 1997). A higher death rate (8%) reflects the further expansion of the DOTS strategy to areas with a high HIV burden, where large numbers of fatalities among treated patients are observed. While treatment failures continue to occur only sporadically, the rise of treatment defaults to 10% is worrying. The NTP continues its intensive training and supervision efforts. Two areas getting special attention now are the quality of patient supervision, and of the reporting system. It is anticipated that outcomes will improve in existing DOTS areas after the initial phase of rapid programme expansion.

17. Mozambique

Mozambique has been added to the list of high-burden countries following revision of incidence estimates: 8% HIV prevalence among adults suggests an overall TB incidence of about 400/100 000 in 1999. In 1998, 41% of all estimated smear-positive cases were reported to WHO, DOTS coverage was estimated at 95%, and the treatment success under DOTS was 67% for the 1997 cohort. However, no further data were provided to WHO before 22 January 2001, so we can make no assessment of progress in TB control during 1999.

18. Myanmar

DOTS coverage in Myanmar increased from 64% in 1999 to 80% during 2000, and the emphasis given to training and supervision of staff has resulted in a programme of high quality. Case detection and treatment success rates show a steady increase to 33% and 82% respectively over data for 1998, with reports being received from all treatment units in the country. Of the 18% of patients not successfully treated, about half were defaulters. Continuity of funding, particularly for drugs, is vital to sustain and expand DOTS in this country.

19. Uganda

The combined TB and Leprosy programme (NTLP) achieved national coverage in 1995. Uganda officially reached 100% DOTS coverage in 1997, and has detected about 60% of estimated smear-positive cases annually since then. Treatment success for patients registered in 1998 was 62%; this significant improvement on previous years was made by increasing the proportion of cases evaluated from 65% to over 90%. However, there is a significant discrepancy between the number of cases notified in 1998 (18 222) and those registered for treatment in the 1998 cohort (13 236). This remains to be explained. Moreover, a 62% treatment success is still very low: the cohort data show that it could be increased by improving the evaluation rate still further, and by cutting the enormous default rate (19% in 1998). To these ends, the NTLP carried out, with WHO's assistance, a pilot study of community-based TB care in Kiboga district, starting in 1998. Rather than insisting that all patients be hospitalised for the intensive phase, patients were given the option of hospitalisation or ambulatory treatment (at a health centre or in the community under the observation of a volunteer). The cost per cure was reduced by 63%. Using village volunteers has improved access to treatment, lowered costs incurred by patients and providers, improved cure rates and lowered the frequency of treatment interruptions. As a result, community-based TB care has been adopted as policy by the Ministry of Health, and incorporated in the 2000–2006 Health Sector Strategic Plan.

20. Afghanistan

TB control activities have been seriously impeded by the breakdown of the government's administrative, technical and financial capacity, and by the security risk in some areas. The DOTS strategy was adopted in 1997 as national TB control policy in Afghanistan and, according to local sources, 30% of the population had access to DOTS services in 1999. WHO is assisting the MOPH with provision of DOTS to 14% of the population through 27 facilities in 6 regions. NGOs provide diagnostic and treatment services to the remainder of the population so far served. The National TB Institute provides, with the further help of NGOs, services to part of the population of Kabul only. In the absence of a coherent national TB programme, WHO supports the country by providing anti-TB drugs, training and guidelines, and assists with surveillance. During 1999, 5% of estimated smear-positive cases were reported to WHO-supported DOTS areas. The treatment success rate was only 33%, because 57% of registered cases were not evaluated. Anti-TB drugs are available in the private sector, even without prescription, threatening the development of drug resistance. At present there is no mechanism or forum for coordinating programme activities, or for planning at the national level. It is qualitatively clear that present control efforts are addressing just a small fraction of the country's TB burden, and this conclusion is reinforced by the few statistics that we have from Afghanistan.

21. Zimbabwe

Zimbabwe reported that DOTS was implemented in just 5 districts in 1998, and that plans existed to reach all districts by 2002. Implausibly, the reported DOTS coverage dropped to 12% in 1999 (from 100% in 1998) whilst 55% of all estimated smear-positives were notified under DOTS. As of 22 January 2001, no information had been provided to WHO to account for these inconsistencies. Treatment success was 70% in the 1998 cohort; this is low because of the high rates of death (10%, probably linked to HIV) and treatment interruption (8%). Zimbabwe's performance is thus mixed: capricious reporting to WHO casts doubt on the reportedly high rates of case detection under DOTS.

22. Cambodia

Reported DOTS population coverage rose from 88% in 1997 to 100% in 1998 and 1999. Fifty-seven percent of all smear-positive cases were notified under DOTS, a small increase on 1998. The measured treatment success was very high (95%). The prevalence of HIV infection is the highest in the Region (4% among 15–49 age group population, or 200 000 cases in 1999), and 20% of TB patients are expected to be HIV positive in year 2000. With some extra effort devoted to case finding (and perhaps to refining the present estimate of incidence), Cambodia should be able reach the WHO target of 70% case detection by 2005.

23. Peru

In 1999, Peru occupied the last place in TB80. If calculated trends in incidence have been obeyed, it fell to 26th place during 2000, and has been eliminated from the league of high-burden countries. Ten years of intensive control effort have been accompanied by an estimated 50% reduction in incidence. A recent analysis found that at least 3.6% of the 7.5% annual decline in the incidence rate of pulmonary TB can be attributed to the improved programme of short-course chemotherapy launched in 1990.[15] This elevated rate of decline implies that at least 16% of cases (78 000) and 70% of deaths (77 000) were averted between 1991 and 1999. As the case load falls, the distribution of TB is becoming more heterogeneous. Pockets of relatively high incidence requiring special attention exist in urban areas, especially Lima Callao. Going beyond DOTS, the NTP is now investigating, for example, the benefits of contact tracing, and of different approaches to the management of drug resistance, including studies of standardized and individualized regimens for MDR-TB.

Progress in TB control in all DOTS countries

116 DOTS countries provided data on treatment success and case detection (Figure 16); in 43 (37%), DOTS detection and treatment success rates exceeded 50% and 70%, respectively (Figure 17). These countries appear to have reached or are close to reaching WHO targets, but together accounted for only 12% of all estimated TB cases in 1999. Besides Viet Nam and Peru, the countries that appear to have met WHO targets are Cuba, the Maldives, Jamaica, Oman and Tunisia.

Of 82 countries that provided data from two consecutive cohorts, 52 (63%) showed higher treatment success rates during 1997–98; 32 (39%) improved DOTS detection by more than 1% while maintaining treatment success above 70%. Annex 7 tabulates case detection and treatment success rates by country for 1995 to 1998.

Several countries with high case detection and cure rates (that appear in Figure 17) have reported declining case notification rates in recent years. Examples of the annual rates of reduction (excluding industrialized countries) are: Cuba 8%, Lebanon 7%, the Maldives 13%, Nicaragua 4%, Oman 13%, and Uruguay 3%. Surprisingly, some other countries with high rates of case detection, including Morocco, have not reported significant reductions in incidence.

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[15] Suarez P, Watt CJ, Alarcon E, Portocarrero J, Zavala D, Canales R, Luelmo F, Espinal MA & Dye C. *The dynamics of tuberculosis in response to 10 years of intensive control effort in Peru*. Submitted for publication.

Figure 16. DOTS status in 1999. Estimated DOTS detection rate in 1999 and treatment success for the 1998 cohort in 116 countries reporting to WHO. The remaining DOTS countries have adopted the strategy too recently to provide data on treatment outcomes.

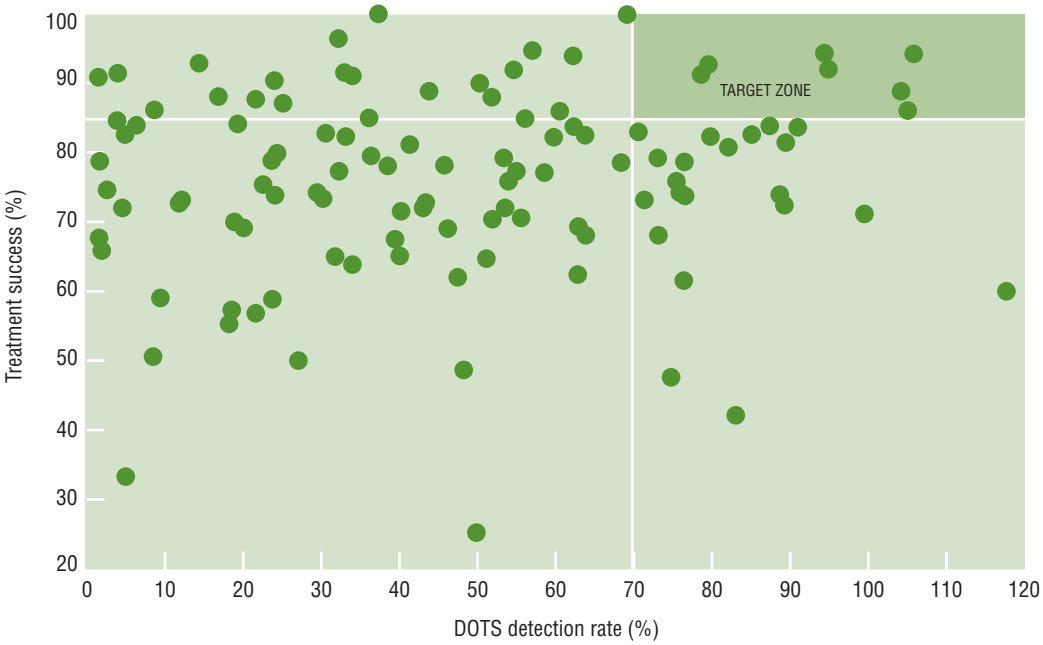
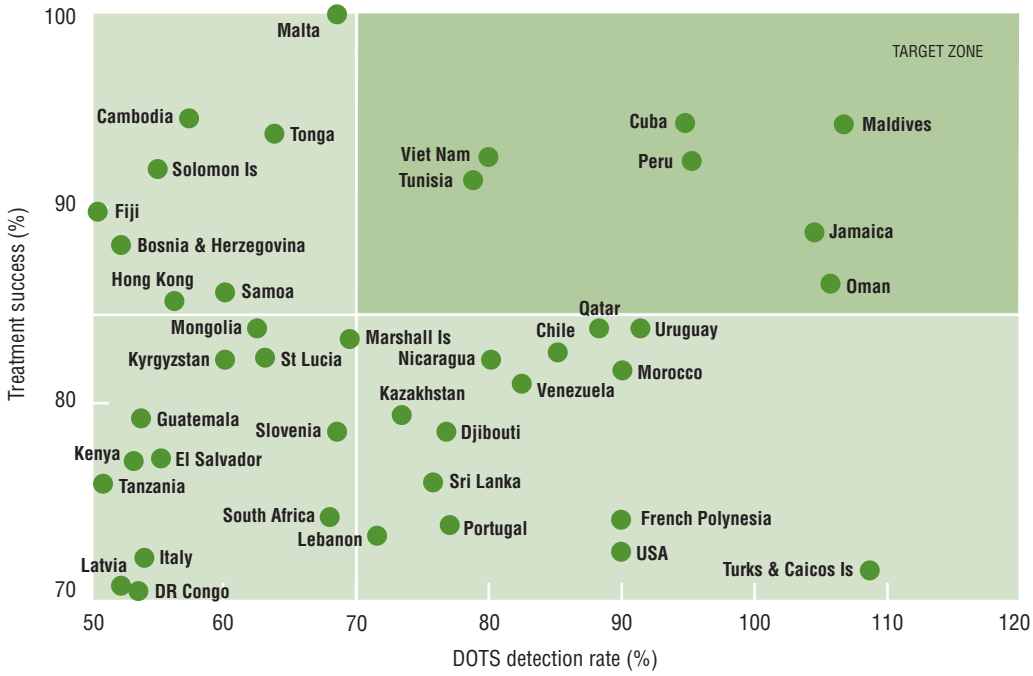


Figure 17. Magnified view of Figure 16, showing 43 countries that reported treatment success rates over 70% and estimated DOTS detection rates over 50%



Discussion

Estimated TB incidence, 1995–2005

There are at least three reasons to be cautious when using the incidence estimates and case detection rates presented in this report. First, it is crucial to remember that these estimates are subject to significant error. For high-burden countries, the difference between lower and upper estimates of incidence is typically twofold.[16] Second, the league table (TB80) based on numbers of cases is just one among several that could be constructed. For example, a ranking of incidence rates per capita might be of greater value in highlighting the impact of HIV/AIDS on TB in Africa. Third, the incidence estimates for many countries have been revised according to trends in notifications, assuming that the case detection rate has not changed. That these countries have made no progress in proportion of all TB cases detected is a premise of the analysis, not a result.

Mindful of these caveats, we estimate that there were 8.42 million new cases in 1999, of which 3.67 million were smear-positive. This is a larger total than previously forecast by mathematical modelling.[17] The revision made two important changes to TB80, the league of highest-burden countries: four African countries were ranked higher than before (Nigeria, Ethiopia, DR Congo and Kenya), and Mozambique joined TB80 ranked 17th (up 9 places). Peru fell to 23rd and last place in 1999, and was eliminated from TB80 in 2000.

From trends in notifications, we have re-estimated incidence rates from 1995–99, and projected forward to 2005. These calculations suggest that the annual rate of increase in TB incidence is 3% globally, 7% in Eastern Europe, and over 10% in the African countries that are most affected by HIV/AIDS. If these trends continue, Africa will have more cases (3.4 million) than any other WHO region by 2005. Only in industrialized countries is the number of cases expected to fall between now and 2005 (at 2–3%/year), though the rate per capita should fall slowly (< 2%/year) in the American, Eastern Mediterranean, South East Asia and Western Pacific Regions.

The projection for Africa, and probably for the world as a whole (10.2 million cases in 2005), should be viewed as the worst scenario. These forecasts assume that the present rate of increase will persist until 2005. There are two reasons to hope that this will not happen. First, HIV prevalence is falling in Uganda and, perhaps, no longer increasing exponentially in other countries such as Zambia and South Africa.[18,19] Even without any control measures, the HIV epidemic is expected to peak and decline, though the size of the peak and the timing of the decline are still matters of conjecture. Second, we can expect improvements in TB control as a result of the wider implementation of DOTS.

Global and regional progress in TB control

Between 1998 and 1999, growth in the number countries using DOTS, and in DOTS population coverage was slow. More critical indicators of progress are the numbers of smear-positive cases enrolled in, and successfully treated by, DOTS programmes. This report shows, yet again, that DOTS programmes can achieve consistently high treatment success rates (77–81% in the five

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[16] WHO/IUATLD/KNCV. *Revised international definitions in tuberculosis control (2000)*. Unpublished document available from WHO Geneva.

[17] Dye C, Garnett GP, Sleeman K, Williams BG. Prospects for worldwide tuberculosis control under the WHO DOTS strategy. *Lancet* 1998; 352: 1886–1891.

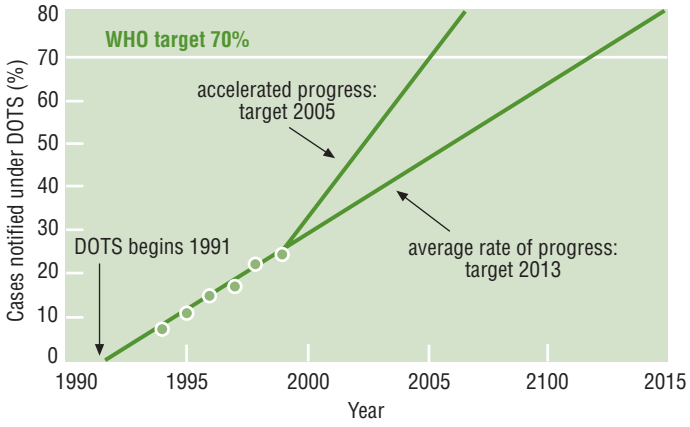
[18] UNAIDS. *Report on the Global HIV/AIDS Epidemic*, June 2000. Geneva: UNAIDS.

[19] Williams BG, Gouws E. *The epidemiology of HIV in South Africa*. Submitted for publication.

cohorts, 1994–98). Thus, the central challenge is to enrol a much larger proportion of TB patients in programmes that guarantee high-quality treatment.

The revised estimates of TB incidence 1995–99 can be used, together with case notifications under DOTS, to judge progress towards the global target of 70% case detection. During 1999, the rate of progress was about the same as in previous years: DOTS programmes continue to add approximately 120 000 new smear-positive cases each year, at which rate 70% case detection will be reached in 2013 (Figure 18). To reach the 70% target by 2005, DOTS programmes around the world must recruit at least 300 000 additional smear-positive cases each year. The number to be enrolled will obviously be greater if incidence (the denominator) continues to increase. Assuming present incidence estimates are roughly correct, new cases recruited under DOTS must include many that are not yet notified, because the overall case detection rate was only 40% in 1999.

Figure 18. Progress towards the 70% case detection target. Points mark the number of smear-positive cases notified under DOTS 1994–1999, expressed as a percentage of all estimated cases for each year. The solid line through these points indicates the current average annual increment of about 120 000 new cases, which intersects the target in year 2013; the steeper line represents a higher annual increment of approximately 300 000 cases, and reaches the 70% target by 2005.



WHO has advocated, as part of the DOTS strategy, sputum smear microscopy for diagnosis and for demonstrating cure. However many countries, notably in Europe, also use bacteriological culture. Against simple expectation, data from 14 European countries presented in this report did not show that cure rates measured by smear conversion were consistently higher than measured by culture conversion. The expected difference between the two methods might be masked if cases diagnosed as culture-positive but smear-negative have lighter bacterial loads and are easier to cure. Consistent with this is the observation that, in this set of data, the ratio % culture conversion / % smear conversion tends to be higher when the fraction smear-positive/culture-positive at diagnosis is lower. But this proposition needs to be explored further by examining the treatment outcomes for individual patients who were diagnosed as smear-positive or culture-positive.

Progress in TB control in 23 high-burden countries

Based on 1999 estimates of case detection, and treatment outcomes for the 1998 cohort, we have reclassified progress in the countries listed in TB80 (Table 16). All 23 countries have either improved (5) or maintained their positions (18). The top performing countries (treatment success ≥70%, DOTS detection rate ≥50%) included four from Africa, two from Asia, and one from Latin America.

Viet Nam and Peru are still the only high-burden countries to have exceeded WHO targets. Peru was on the point of relegation from TB80 in 1999 and, in our estimation, departed during 2000. This is reward, in part, for 10 years of intensive TB control, which has ensured consistently high rates of case detection and cure.

South Africa is one of four countries lying close to the target zone (Figure 15): significant progress was made in 1999, and the NTP as a whole (DOTS plus non-DOTS areas) apparently detected a high proportion of all new smear-posi-

Table 16. Progress in DOTS implementation: 23 high-burden countries, 1998–99

	DOTS			
		High treatment success (> 70%)		
Non-DOTS or incomplete data	Low treatment success (< 70%)	Low case detection* (< 10%)	Intermediate case detection (10-49%)	High case detection (≥ 50%)
Mozambique	Afghanistan	**Brazil**	Bangladesh	Cambodia
	Indonesia	India	China	**DR Congo**
	Pakistan		Ethiopia	**Kenya**
	Russian Federation		Myanmar	Peru
	Thailand		Nigeria	**South Africa**
	Uganda		Philippines	UR Tanzania
	Zimbabwe			Viet Nam

* DOTS detection rate: patients found and treated through DOTS programmes
Underline bold: countries which moved one or more categories up since 1998

tive cases. Cambodia, Kenya and Tanzania are near neighbours in Figure 15, but little progress was made in these countries during 1999.

Countries in the second group in Table 16 have high treatment success rates (> 70%) with intermediate rates of case detection (DDR 10–49%). The Philippines was the most progressive member of this group during 1999, doubling the number of smear-positive cases reported under DOTS. With a smear-positive case detection rate of 70% overall, and a treatment success under DOTS of 84%, the Philippines should be able to reach WHO targets well before 2005. Reports of a relatively large reduction in prevalence in the IEDC provinces of China, if confirmed, will surely provide a compelling argument for extending DOTS nationwide.

During 1999, India enrolled more than 40 000 additional smear-positive cases under DOTS, a bigger increment than any other country. The enormity of the TB control problem means that India remains in group three in Table 16, with high treatment success but low case detection nationally. During 2000, the DOTS detection rate in India is expected to climb above 10%. To reach 70% case detection, the programme will ultimately have to diagnose and report cases that are not yet notified: although India counted more smear-positives cases from both DOTS and non-DOTS areas during 1999, the combined total was still only 42% of all estimated cases.

India is accompanied in the third group by Brazil, which reported treatment outcomes for the first time. Although the number of cases detected and registered for treatment under DOTS accounts for a small fraction of all incident cases in Brazil, 79% of smear-positive cases were reported nationwide. For this reason Brazil, like the Philippines and South Africa, has the potential to advance rapidly towards WHO targets, and to provide the evidence from cohort data that it has done so.

According to the 1998 cohort data, seven of the high-burden countries had low treatment success rates (< 70%), and fall into the fourth group in Table 16. Thailand, Uganda and Zimbabwe cured 60–70% of patients. Russia has a comprehensive system of case finding, but diagnosis by smear-microscopy is not always accurate, and cure rates are routinely low. The fifth group in Table 16 is occupied by Mozambique, the only high-burden country not to have provided data for this report. Mozambique reported as a DOTS country with 95% coverage in 1998, and it remains unclear why no data were provided for 1999.

Following the success in Peru (diminished incidence), and now apparently in China (diminished prevalence), we should anticipate significant reductions (locally, at least) in TB burden in several other countries before 2005. A major challenge for TB control programmes now is to demonstrate, first, that incidence and prevalence are in decline and, second, that these declines can be attributed to specific control measures. The falling case notification rates in Cuba, Lebanon, the Maldives, Nicaragua, Oman and Uruguay probably do represent real reductions in TB incidence. Detailed epidemiological investigations in these countries may succeed in linking reduced incidence to the reportedly high case detection and cure rates. It will be equally important to explain why incidence is declining very slowly in countries like Morocco, which also find and cure a high proportion of patients. Whatever the results of such investigations, the fact that questions about TB in these countries emerge so clearly is testimony to the value of high-quality surveillance data.

The tuberculosis epidemic is growing larger and more dangerous each year. The World Health Organization's programme on Communicable Diseases monitors this epidemic, analyzing data from national control programmes and providing feedback on trends in the disease and progress in its control.

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You can also visit our website at http://www.who.int/health-topics/tb.htm