

Please see the Table of Contents for access to the entire publication.

WHO vaccine-preventable diseases: monitoring system

2010 global summary

Immunization, Vaccines and Biologicals



World Health
Organization

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**World Health
Organization**



Contents

Definitions and notes

List of acronyms	iv
Member States by WHO region.....	vi
Member States by development status	vii
Headquarters and regional offices of the World Health Organization.....	viii

Introduction	1
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1. Global and regional summaries

WHO/UNICEF estimates of national immunization coverage, 1980–2009: Methods	2
Estimating global and regional immunization coverage	6
Global and regional summary index	7
Use of selected vaccines	28

2. Reference section	32
-----------------------------------	----

Immunization profile indexes	
by WHO region and development status	R-35
by WHO Member State.....	R-49
Selected indicators of immunization system performances	R-244
Incidence index (time series).....	R-250
Coverage index (time series)	
Official country estimates	R-296
WHO/UNICEF estimates	R-349



Definitions and notes

List of acronyms

AD	auto-disable syringe
AFRO	WHO Regional Office for Africa
AFP	acute flaccid paralysis
AMRO	WHO Regional Office for the Americas
aP	acellular pertussis vaccine
BCG	bacille Calmette-Guérin; vaccine against tuberculosis
CBAW	childbearing age women
CRS	congenital rubella syndrome
CI	core indicator
d	diphtheria anatoxin with reduced content of antigen
DHS	Demographic and Health Survey
Dip	diphtheria vaccine
DT	diphtheria and tetanus toxoid vaccine
DTaP	diphtheria and tetanus toxoid with acellular pertussis vaccine
DTIPV	diphtheria and tetanus toxoid and inactivated polio vaccine
DTP	diphtheria–tetanus–pertussis vaccine
DTP3	third dose of diphtheria–tetanus–pertussis vaccine
DTPHepB	tetravalent diphtheria and tetanus toxoid with pertussis and hepatitis B vaccine
DTPHepBIPV	pentavalent diphtheria and tetanus toxoid with pertussis, hepatitis B and inactivated polio vaccine
DTPHib	tetravalent diphtheria and tetanus toxoid with pertussis and <i>Haemophilus influenzae</i> type b vaccine
DTPHibHepB	pentavalent diphtheria and tetanus toxoid with pertussis, <i>Haemophilus influenzae</i> type b and hepatitis B vaccine
DTPHibHepBIPV	hexavalent diphtheria, tetanus toxoid with pertussis, <i>Haemophilus influenzae</i> type b, hepatitis B and inactivated polio vaccine
DTPHibIPV	pentavalent diphtheria and tetanus toxoid with pertussis, <i>Haemophilus influenzae</i> type b and inactivated polio vaccine
DTPHH	diphtheria and tetanus toxoid with pertussis, hepatitis B, and <i>Haemophilus influenzae</i> type b vaccine
DTPIPV	diphtheria and tetanus toxoid with pertussis and inactivated polio vaccine
DTwP	diphtheria and tetanus toxoid with whole cell pertussis vaccine
EMRO	WHO Regional Office for the Eastern Mediterranean
EPI	Expanded Programme on Immunization
EU	European Union
EURO	WHO Regional Office for Europe
GAVI	Global Alliance for Vaccines and Immunization
GNI	gross national income
GNP	gross national product
GDP	gross domestic product
HbsAg	hepatitis B surface antigen
HBV	hepatitis B virus
HepA	hepatitis A vaccine
HepAHepB	hepatitis A and hepatitis B vaccine
HepB	hepatitis B vaccine
HepB3	third dose of hepatitis B vaccine
Hib	<i>Haemophilus influenzae</i> type b vaccine
Hib3	third dose of <i>Haemophilus influenzae</i> type b vaccine
HibHepB	<i>Haemophilus influenzae</i> type b and hepatitis B vaccine
HibMenC	<i>Haemophilus influenzae</i> type b and meningococcal C vaccine
HPV	human papillomavirus vaccine
ICC	inter-agency coordinating committee
IPV	inactivated polio vaccine



IVB	Department of Immunization, Vaccines and Biologicals (WHO)
JapEnc	japanese encephalitis vaccine
JE	japanese encephalitis
MCV	measles-containing vaccine
MCV1	first dose of measles-containing vaccine
MCV2	second dose of measles-containing vaccine
Men A	meningococcal A
Men AC	meningococcal AC
Men ACW	meningococcal ACW
Men ACWY	meningococcal ACWY
MenBC	meningococcal B and C vaccine
MenC conj	meningococcal C conjugate vaccine
MICS	Multiple Indicator Cluster Survey
MM	measles and mumps vaccine
MMR	measles, mumps, and rubella vaccine
MMRV	measles, mumps, rubella and varicella vaccine
MNT	maternal and neonatal tetanus
MR	measles and rubella vaccine
MYP	multi-year plan
NDP	national drug policy
NT	neonatal tetanus
OPV	oral polio vaccine
Pneumo_conj	pneumococcal conjugate vaccine
Pneumo_ps	pneumococcal polysaccharide vaccine
PAB	protection at birth
Pol3	third dose of polio vaccine
PPP	purchasing power parity
Pw	whole cell pertussis vaccine
SEARO	WHO Regional Office for South-East Asia
SIA	supplementary immunization activity
TBE	tick-borne encephalitis
Td	tetanus toxoid with reduced amount of diphtheria toxoid vaccine
Tdap	tetanus toxoid with reduced amount of diphtheria toxoid and acellular pertussis vaccine
TdIPV	tetanus toxoid with reduced amount of diphtheria toxoid and inactivated polio vaccine
TdPIPv	tetanus toxoid with reduced amount of diphtheria toxoid and pertussis and inactivated polio vaccine
TT	tetanus toxoid vaccine
TT2plus	second and subsequent doses of tetanus toxoid
TyphoidHepA	typhoid fever and hepatitis A vaccine
UNICEF	United Nations Children's Fund
VAD	vitamin A deficiency
VF	Vaccine Fund
VitA	vitamin A supplementation
Vitamin A1	first dose of vitamin A supplement
Vitamin A2	second dose of vitamin A supplement
VPD	vaccine-preventable diseases
WHO	World Health Organization
WPRO	WHO Regional Office for the Western Pacific
YF	yellow fever vaccine



Member States by WHO region

African Region:	Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, South Africa, Swaziland, Togo, Uganda, United Republic of Tanzania, Zambia, Zimbabwe
Region of the Americas:	Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bolivia (Plurinational State of), Brazil, Canada, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, United States of America, Uruguay, Venezuela (Bolivarian Republic of)
Eastern Mediterranean Region:	Afghanistan, Bahrain, Djibouti, Egypt, Iran (Islamic Republic of), Iraq, Jordan, Kuwait, Lebanon, Libyan Arab Jamahiriya, Morocco, Oman, Pakistan, Qatar, Saudi Arabia, Somalia, Sudan, Syrian Arab Republic, Tunisia, United Arab Emirates, Yemen
European Region:	Albania, Andorra, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Luxembourg, Malta, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Republic of Moldova, Romania, Russian Federation, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tajikistan, The former Yugoslav Republic of Macedonia, Turkey, Turkmenistan, Ukraine, United Kingdom of Great Britain and Northern Ireland, Uzbekistan
South-East Asia Region:	Bangladesh, Bhutan, Democratic People's Republic of Korea, India, Indonesia, Maldives, Myanmar, Nepal, Sri Lanka, Thailand, Timor-Leste
Western Pacific Region:	Australia, Brunei Darussalam, Cambodia, China, Cook Islands, Fiji, Japan, Kiribati, Lao People's Democratic Republic, Malaysia, Marshall Islands, Micronesia (Federated States of), Mongolia, Nauru, New Zealand, Niue, Palau, Papua New Guinea, Philippines, Republic of Korea, Samoa, Singapore, Solomon Islands, Tonga, Tuvalu, Vanuatu, Viet Nam



Member States by development status*

Developed economies:	Andorra, Australia, Austria, Belgium, Bulgaria, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, San Marino, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom of Great Britain and Northern Ireland, United States of America
Economies in transition:	Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Croatia, Georgia, Kazakhstan, Kyrgyzstan, Montenegro, Republic of Moldova, Russian Federation, Serbia, Tajikistan, The former Yugoslav Republic of Macedonia, Turkmenistan, Ukraine, Uzbekistan
Developing economies:	Algeria, Antigua and Barbuda, Argentina, Bahrain, Bahamas, Barbados, Belize, Bolivia (Plurinational State of), Botswana, Brazil, Brunei Darussalam, Cameroon, Cape Verde, Chile, China, Congo, Cook Islands, Colombia, Costa Rica, Côte d'Ivoire, Cuba, Democratic People's Republic of Korea, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Fiji, Gabon, Ghana, Grenada, Guatemala, Guyana, Honduras, India, Indonesia, Iran (Islamic Republic of), Iraq, Israel, Jamaica, Jordan, Kenya, Kuwait, Lebanon, Libyan Arab Jamahiriya, Malaysia, Mauritius, Mexico, Micronesia (Federal States of), Mongolia, Morocco, Marshall Islands, Namibia, Nauru, Nicaragua, Nigeria, Niue, Oman, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Qatar, Republic of Korea, Saudi Arabia, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Seychelles, Singapore, South Africa, Sri Lanka, Suriname, Swaziland, Syrian Arab Republic, Thailand, Tonga, Trinidad and Tobago, Tunisia, Turkey, United Arab Emirates, Uruguay, Venezuela (Bolivarian Republic of), Viet Nam, Zimbabwe
Least developed countries:**	Afghanistan, Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Haiti, Kiribati, Lao People's Democratic Republic, Lesotho, Liberia, Madagascar, Malawi, Maldives, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, Samoa, Sao Tome and Principe, Senegal, Sierra Leone, Solomon Islands, Somalia, Sudan, Timor-Leste, Togo, Tuvalu, Uganda, United Republic of Tanzania, Vanuatu, Yemen, Zambia

* Source: *World Economic and Social Survey 2010*, New York, United Nations, 2010.

** Source: UN office of the High Representative for the Least Developed countries. <http://www.un.org/special-rep/ohrls/ldc/list.htm>.



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Introduction

The data compiled in this 2010 global summary are based on data reported by WHO Member States. The global summary is updated annually and includes immunization data collected between 1980 and 2009 reported to WHO by 1st of September 2010.

In an effort to strengthen collaboration and minimize the reporting burden, WHO and UNICEF jointly collect information through a standard questionnaire (the Joint Reporting Form) which is sent to all Member States. The content of the Joint Reporting Form was developed through a consensus process by staff from UNICEF, WHO and selected ministries of health. Data collected in the Joint Reporting Form constitute the major source of information in this document, and include estimates of national immunization coverage, reported cases of vaccine-preventable diseases (VPDs), and immunization schedules, as well as indicators of immunization system performances.

The 2010 global summary is divided into two sections: (1) **global and regional summaries** of reported incidence of VPDs and immunization coverage, and (2) a **reference section** consisting of four parts.

- a) *Global and regional profiles* by WHO region and development status, pp R-34–R-47;
- b) Individual *country profiles*, including selected demographic and economic indicators, time series of VPD incidence and immunization coverage, and nationally-recommended immunization schedules, pp R-49–R-242;
- c) *Selected indicators of immunization system performances*, pp R-243–R-249 and
- d) *Time series* of reported disease incidence and reported and estimated immunization coverage for all Member States, pp R-250– R-379.

This 2010 global summary is also available on the internet at

http://www.who.int/immunization_monitoring/data/en/ in both HTML & PDF formats. Sections 2c and 2d are also available in spreadsheet format, allowing more specific analyses to the user. The list of indicators described on the internet is more comprehensive than the one described in this book, consisting of all Joint Reporting Form indicators.

The Department of Immunization, Vaccines and Biologicals is grateful to the Member States, and also WHO and UNICEF staff for their contribution to this report.



WHO/UNICEF estimates of national immunization coverage, 1980–2009

Methods:

Background

Information on immunization coverage is used for a variety of purposes: to monitor the performance of immunization services at local, national and international levels; to guide accelerated disease-control initiatives such as polio eradication, measles control, and neonatal tetanus elimination; to identify areas of weak system performance that may require extra resources and focused attention; and as a consideration when deciding whether to introduce a new vaccine. Coverage levels with diphtheria and tetanus toxoid and pertussis vaccine are considered one of the best indicators of health-system performance, and funding agencies frequently consider immunization coverage levels when reviewing applications for financial and technical support. Coverage level with measles vaccine is an indicator of progress towards Millennium Development Goals.

An accurate historical representation of immunization coverage is important to assess trends in immunization system performance, to better establish the relationship between immunization service delivery and disease occurrence, and to provide a framework for setting future goals for coverage achievement.

The WHO/UNICEF review: data, methods and process

In June 2000, WHO and UNICEF conducted a retrospective review of data available on national immunization coverage for the years 1980 to 1999, to determine the most likely true level of immunization coverage. We included data officially reported to WHO and UNICEF by Member States, in addition to data reported in the published and grey literature. Whenever possible we consulted local experts — primarily national Expanded Programme on Immunization (EPI) managers and WHO regional office staff — for additional information regarding the performance of specific local immunization services. Based on the data available, consideration of potential biases, and contributions from local experts we attempted to determine the most likely true level of immunization coverage. Estimates of national immunization coverage were made for bacille Calmette-Guérin (BCG) vaccine, the third dose of diphtheria and tetanus toxoid and pertussis vaccine (DTP3), the third dose of polio vaccine — either oral polio vaccine or inactivated polio vaccine (Pol3) — the first dose of measles vaccine (MCV) and the third dose of hepatitis B vaccine (HepB3). We also made estimates of the proportion of live births protected (PAB) through maternal immunization with at least two doses of tetanus toxoid for countries where the risk of neonatal tetanus is a significant public-health problem. In 2005 estimates of the first dose diphtheria and tetanus toxoid and pertussis vaccine (DTP1) and the third dose of *haemophilus influenzae* type b (Hib3) were added. In 2009 estimates of yellow fever vaccine, of the last dose of rotavirus vaccine and of the third dose of pneumococcal conjugate vaccine were added. The retrospective review, completed in October 2001, has been continued annually, and estimates of national immunization coverage are available from 1980 to 2009.

Data, sources and biases

For this review we relied on the following data.

1. Officially reported data by Member States to WHO.
2. The historical database maintained by UNICEF.
3. Published literature — primarily coverage survey results and methods.
4. Unpublished surveys available from ministries of health.

Immunization coverage levels are presented as a percentage of a target population that has been vaccinated. Coverage is usually calculated for each antigen and for the number of doses completed. For example, DTP3 coverage is calculated by dividing the number of children receiving their third dose of DTP by the number of children surviving to their first birthday. The target population chosen varies depending on the countries' policies, the specific vaccine, and the dose for which coverage is being calculated. In most instances the target population is the number of children surviving their first year of life. In general, estimates of immunization coverage are based on two sources of empirical data: reports of vaccinations performed by service providers (administrative data) and surveys containing items on children's vaccination history (coverage surveys). For estimates based on administrative data, service providers (e.g. district health centre, vaccination team, physician) summarize the number of vaccinations given during a time period (usually



monthly) and report these data to the local public-health authorities. The data are reviewed and, where necessary, appropriate action taken. The data are then aggregated and reported to the next administrative level. At the national level these data are aggregated, analysed, and used to determine immunization policy and focus programme activities, and to influence resource allocation.

Surveys are frequently used in conjunction with administrative data; in other instances they constitute the sole source of information on immunization coverage levels. The principle types of surveys are the Expanded Programme on Immunization (EPI) 30-cluster survey, the UNICEF Multiple Indicator Cluster Survey (MICS), and the Demographic and Health Survey (DHS). EPI 30-cluster surveys are frequently conducted by national EPI staff, are designed specifically for measuring immunization coverage, are simple to administer and easy to conduct, but have a precision plus or minus 10% points at 50% coverage. The MICS and DHS are more extensive surveys covering a variety of indicators, have a more rigorous design, and typically have a higher degree of precision, but are more expensive, logistically more complex and the questionnaire is longer and more difficult to administer.

Each of the above methods has advantages and disadvantages. The administrative method provides information on a more timely basis and makes use of routinely recorded data. In addition to giving information on coverage the administrative data can be used to detect and correct problems in service delivery (e.g. vaccine shortage, poor session attendance). Coverage estimates based on this method are sensitive to two major biases; those in the numerator (the number of doses administered), and those in the denominator (the size of the target population). The most frequent numerator bias is introduced when reports on the number of doses administered is not complete. Take the following example. Immunization coverage is being calculated for three areas. Area "A" has an estimated target population of 486 children and 310 were vaccinated. Area "B" has 300 children and 290 were vaccinated. Area "C" has 214 children and 100 were vaccinated. Immunization coverage would be estimated as 70%.

$$\frac{310 + 290 + 100}{486 + 300 + 214} = \frac{700}{1000} = .70 \text{ (or 70\% coverage)}$$

The accuracy of this calculation assumes that data from all areas are reported. However suppose data from one area are not reported. Traditionally one of two procedures has been followed. The first makes the same calculation as above but, because the data for area C are missing, the 100 vaccinations are not included in the calculation.

This gives an estimate of 60% coverage.

$$\frac{310 + 290}{486 + 300 + 214} = \frac{600}{1000} = .60 \text{ (or 60\% coverage)}$$

This procedure, in effect, assumes that there has been no vaccination in areas from which data are not available (zero doses administered), and so most likely underestimates true coverage.

The second procedure is to exclude from the denominator areas for which vaccination data have not been reported.

Applying this method to the example above we estimate a coverage of 76%.

$$\frac{310 + 290}{486 + 300} = \frac{600}{786} = .76 \text{ (or 76\% coverage)}$$

This procedure may produce a bias that leads to either over or underestimation of coverage depending on the number of children vaccinated in the area for which the data were not reported. In general, however, one would expect that areas performing well are more likely to report, resulting in an overestimation of true coverage.

The biases described above occur when intermediate sites fail to report. A similar bias can occur when the data collection/reporting system excludes part of the population. The most common example is when a significant proportion of vaccinations are performed in the private sector and are not reported to the public-health authorities. If the denominator is derived from the total population and the numerator is based only on children receiving vaccination in the public sector, this will lead to an underestimation of the actual coverage.



Biased estimates of coverage can also be the result of an inaccurate denominator — the size of the target group. An overestimate of the denominator will bias coverage low while an underestimate will inflate the estimate of coverage. This bias can most readily be seen when coverage is high and the denominator has been underestimated. In this case immunization coverage estimates can exceed 100%. Errors in estimating the denominator can result from population projections based on outdated censuses, poor population projections, or sudden shifts in population.

Estimates based on surveys also have advantages and disadvantages. The principal advantages of surveys are that an estimate of immunization coverage can be obtained if the denominator is unknown, and that vaccinations given by the private sector can be included. The principal disadvantage of surveys is that they provide information on the previous birth year's cohort (making it difficult to use for timely programme intervention). In addition, the survey methodology may provide a wider than desired confidence interval, interviewers may be poorly trained, and the implementation and supervision may be weak. In some instances the length or complexity of the questionnaire may compromise the accuracy of the responses. Finally, as with any survey, the results may be inappropriately generalized beyond the population represented in the survey.

Methods

In general we have tried to distinguish between situations where the data accurately reflect immunization system performance and those where the data are likely to be compromised and present a misleading view of immunization coverage. While the estimates with the exception of PAB are not the result of a formal modelling exercise, we have nevertheless applied a series of principles.

1. Evidence based: We have made no ad hoc adjustment to reported data; in some instances data for a country was available from a single source, usually the national reports to WHO. In these instances, in the absence of data from an alternative source, those data were used for the WHO/UNICEF estimate.
2. Country-specific: Each country was reviewed individually, and data were not "borrowed" from other countries. There was no attempt to group countries based on income, development levels, population size or geographic location. The resulting estimates are based only on data from that country.
3. Consistent patterns and trends: In cases where no data are available for a given year for a country and antigen, we have considered data from earlier and later years and interpolated to estimate coverage for the missing year. In cases where data sources are mixed and show large variation, we have attempted to identify the most likely estimate in consideration of the possible biases in the data.
4. Local knowledge incorporated: We have consulted with local experts and have attempted to put the data in the context of local events, both those occurring in the immunization system (e.g. vaccine shortage for parts of the year, donor withdrawal, etc.) and more widely occurring events (e.g. international incidences, civil unrest, heightened political commitment to immunization, etc.).
5. No averaging: In the event that multiple data points are available for a given country and antigen, we have not automatically taken an average of the data points. Rather we have considered the potential biases in each of the sources and attempted to construct a consistent pattern over time.
6. No smoothing: Immunization coverage levels vary over time, and while there are frequently general trends, we have not attempted to fit the data points to curve using smoothing techniques.
7. No 100% coverage: While it is theoretically possible to immunize 100% of the target population, especially in small countries, in reality a true immunization level of 100% is unlikely. In the review we occasionally encountered coverage levels in excess of 100%. These levels are most likely to be the result of a systematic error ascertainment of the numerator or the denominator, a mid-year change in target age groups, or inclusion of children outside the target age group in the numerator. We have chosen to represent the highest level of coverage as 99%.
8. PAB coverage has been estimated using a mathematical model. PAB is the proportion of births in a given year that can be considered as having been protected against tetanus as a result of maternal immunization. In this model, annual cohorts of women are followed from infancy through their life. A proportion receive DTP in infancy (estimated based on the WHO-UNICEF estimates of DTP3 coverage). In addition some of these women also receive TT through routine services when they are pregnant and may also receive TT during SIAs. The model also adjusts reported data, taking into account coverage patterns in other years, and/or results available through



surveys. The duration of protection is then calculated, based on WHO estimates of the duration of protection by doses ever received. A further description of the model can be found in: Griffiths U., Wolfson L., Quddus A., Younus M., Hafiz R.. Incremental cost-effectiveness of supplementary immunization activities to prevent neo-natal tetanus in Pakistan. *Bulletin of the World Health Organization* 2004; 82:643-651

Process

Update national reports: The first step was to review and update data officially reported by Member States through the WHO regional offices to ensure that WHO databases correctly reflect national data. In some cases data available to international organizations — principally WHO and UNICEF in this instance — may differ. Requests to the countries for information may be made at different times and it is possible that the national authorities have updated their estimate between the times of the requests. Alternatively, the source of data within the country may differ. The criteria for accepting data differs from agency to agency. WHO-reported data are considered official reports by WHO Member States. On some occasions UNICEF may take survey data rather than reports based on administrative data. WHO and UNICEF are working to harmonize the data collection from countries at the international level.

Search the literature: Secondly, we searched for and abstracted information on immunization coverage from a variety of additional sources. The Demographic and Health Surveys (DHS), the UNICEF Multiple Indicator Surveys (MICS) and nationally conducted coverage surveys, constitute the majority of these findings. In addition, we searched the published scientific literature and requested information on other studies from national authorities.

Where possible we consulted with national and regional experts to seek more in-depth knowledge regarding the functioning of the immunization system. These consultations have proved invaluable for a fuller understanding of the functioning of the specific national systems.

Draft estimates: Draft estimates of the most likely coverage for each year and antigen were made based on the data and methods described above. The estimates were based on an appraisal of individual data points, patterns and trends in the data, and information on local circumstances affecting service delivery. In instances where alternative data were not available, estimates were based solely on officially reported data. In general we have tried to distinguish whether the data accurately reflect immunization system performance, or whether the data are compromised and present a misleading view of coverage achievements. We did not attempt to construct a statistical or mathematical model to estimate coverage.

Review by national authorities: An essential part of this review has been the consultation and collaboration with national authorities. The draft estimates were sent to each national authority for their review, comment, and contribution. This collaboration prior to the public release of the final estimates is important not only to inform national authorities of the results of the review before its general release, but also to take advantage of local expertise and knowledge.

Revise draft estimates: The draft estimates were revised based on comments received from the national authorities.

External review: The methods and findings were reviewed by a group of external experts with broad experience in immunization systems and survey methodology. The group supported the methods and recommended a series of future activities.

Dissemination of results: The estimates and supporting data are available on

http://www.who.int/immunization_monitoring/routine/immunization_coverage/en/index4.html

and

<http://www.childinfo.org/areas/immunization/database.php>

and may be freely reproduced.

The methods described here have been published in the *Bulletin of the World Health Organization* and can be accessed on line at <http://www.who.int/bulletin/volumes/87/7/08-053819.pdf>

Burton A, Monash R, Lautenbach B, Gacic-Dobo M, Neill M, Karimov R, Wolfson L, Jones G, Birmingham M. WHO and UNICEF estimates of national infant immunization coverage: methods and processes. *Bulletin of the World Health Organization* 2009; 87:535-541.



Estimating global and regional vaccine coverage

Estimation of global and regional vaccine coverage is based on reports from WHO Member States. When coverage figures have not been reported, i.e. the vaccine is routinely scheduled but no figure was reported to WHO-HQ, a statistical method has been used to estimate the most likely coverage, and this estimate is used in the global and regional calculations. There are three types of missing data.

Type A: Missing prior to the first-ever reported coverage. In these instances, we assume that coverage is 0%.

Type B: Missing between two years where coverage was reported. In these instances the coverage estimate is a linear interpolation of the two reported coverage rates.

Type C: Missing after the last reported coverage value. If coverage has ceased to be reported, we assumed that coverage in the years following the last report will remain at the same level as was last reported.

Statistical estimates of coverage are used only when the country Ministry of Health has not reported coverage data.

Global and regional coverage is then calculated using the estimated and reported coverage figures together with estimates of the target population sized from the *World Population Prospects: the 2008 revision*. Population Division, Department of Economic and Social Affairs, United Nations, New York, 2009. The formula for aggregating coverage for a region (and globally) is:

$$\% \text{ Coverage} = \frac{\sum ((\% \text{ reported or estimated national coverage})(\text{size of target population}))}{\sum (\text{size of target population})}$$

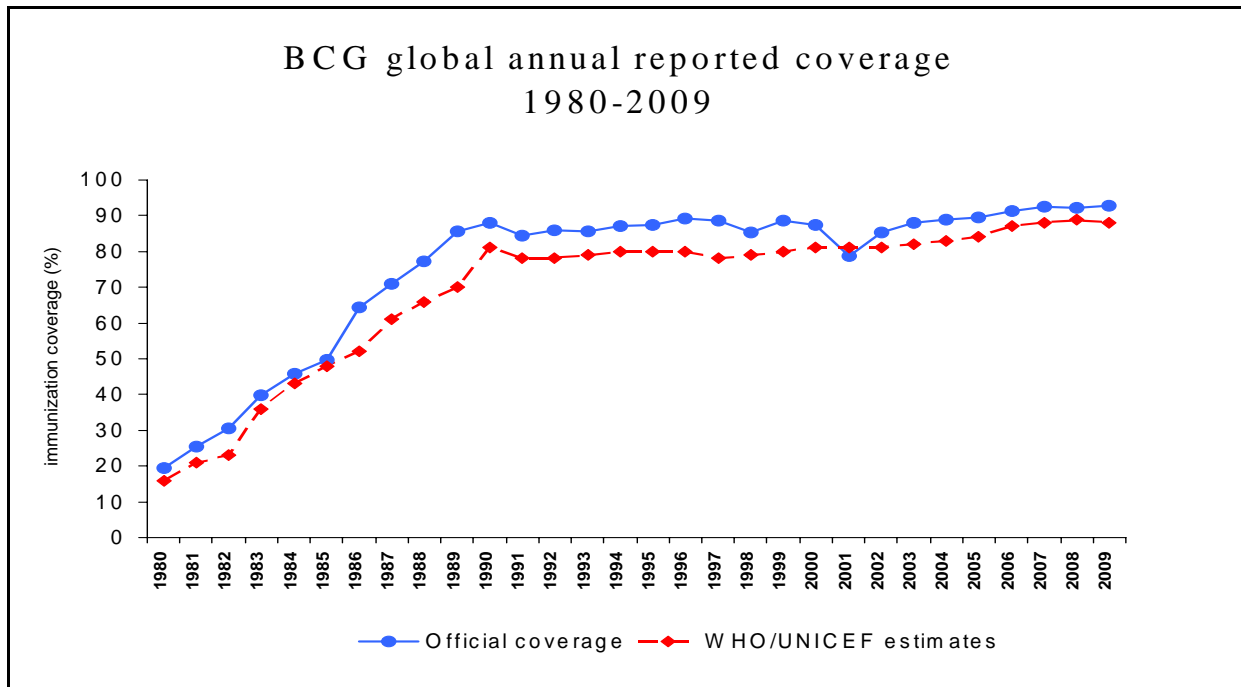
For HepB3, DTP1, DTP3, Hib3, MCV, POL3 and YF, the size of the target population is the national annual number of infants surviving their first year of life. For TT2+ the national annual number of births is used as a surrogate for the number of pregnant women. Priority countries for neonatal tetanus (NT) elimination and developing countries where tetanus is in the national immunization schedule for childbearing-age women are included in the TT2+ global and regional estimates. The size of the target population for BCG is the national annual number of births in countries that recommend BCG. For yellow fever, only those countries at risk for yellow fever are included in the yellow fever global and regional coverage summaries.



1. Global and regional summary index

BCG.....	8
Diphtheria.....	10
Hepatitis B.....	12
Haemophilus influenzae type b.....	14
Measles.....	16
Neonatal tetanus.....	18
Pertussis.....	20
Poliomyelitis.....	22
Total tetanus.....	24
Yellow fever.....	26

BCG



The data in the graph and table represent global and regional summaries using official data reported from Member States to WHO, and WHO/UNICEF estimated coverage (estimation method-description starts on page 6). In 2009, 159 Member States have BCG in their infant vaccination schedules and are expected to report. The table shows the number of Member States providing data to WHO (labelled "N° Countries") and the proportion of the world's population represented by the reporting Member States (labelled "% population"). Imputation procedures described above were used to complete missing reported Member State values. BCG coverage increased during the 1980s due to increasing numbers of Member States establishing national immunization services and increasing BCG coverage in these Member States. BCG coverage peaked in 1990 as a result of the push to achieve the goals for Universal Childhood Immunization through routine immunization services, and campaigns focusing on unreached children. Reported coverage remained high throughout the 1990s. The drop at global level observed from 2000 to 2001 was mainly the result of a change in the methodology used to produce official national estimates in two Member States, China and India which, because of the size of their infant populations, had a significant impact on the global figure. The decline was less pronounced in the WHO/UNICEF estimates and the two figures converged. The reported figures and the WHO/UNICEF estimates differ again from 2002. This is again mainly because of China and India where the official estimates are higher. In many Member States BCG is administered at or shortly after birth. For births occurring in hospital settings, the BCG is often given by hospital staff, with the dose not being reported through the regular immunization reporting. If so, this can lead to underreporting of the number of BCG doses administered, as can be demonstrated through surveys. BCG is often used to reflect the proportion of children who are protected against the severe forms of tuberculosis during the first year of life, and also as an indicator of access to health services.

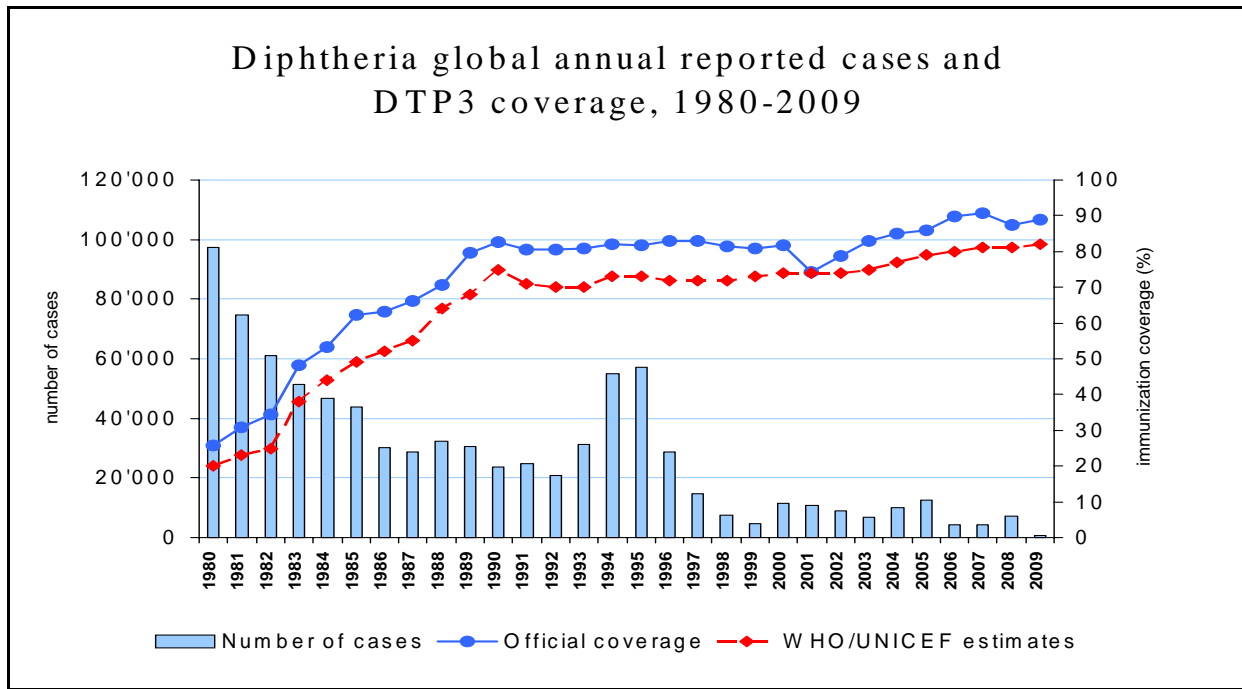


Regional and global summaries of reported, and WHO/UNICEF estimates of, vaccination coverage (%), BCG < 1 year of age: 1980, 1990, 1999-2009.

WHO regions	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
African Region	11	71	66	67	76	75	77	78	80	82	84	85 (42)
	10	75	70	69	69	71	73	75	77	79	79	79
Region of the Americas	54	80	97	96	96	97	97	97	97	100	100	97 (25)
	53	79	97	96	96	97	96	97	96	96	97	94
Eastern Mediterranean Region	24	87	87	86	82	83	84	86	88	89	89	90 (17)
	18	83	80	82	83	83	83	85	88	88	89	88
European Region	40	53	91	91	91	90	90	91	93	94	94	93 (31)
	20	81	92	92	92	92	91	91	93	93	93	92
South-East Asia Region	17	97	99	77	83	92	92	98	99	99	95	96 (10)
	12	71	78	78	79	82	83	84	89	89	89	89
Western Pacific Region	7	96	85	78	96	96	97	87	92	93	96	98 (17)
	6	96	86	86	86	86	87	87	92	93	96	96
Global	19	88	87	79	85	88	89	89	91	92	92	93
	16	81	81	81	81	82	83	84	87	88	89	88
% population	58	98	98	97	93	99	95	100	95	100	99	99
N° countries	77	126	152	146	151	149	152	155	153	157	157	156

Numbers in parenthesis (last column) indicate the number of countries reporting in 2009. The expected number of reporting countries is 46 for the WHO African Region, 27 for the WHO Region of the Americas, 18 for the WHO East Mediterranean Region, 34 for the WHO European Region, 11 for the WHO South-East Asia Region and 23 for the WHO Western Pacific Region.

Diphtheria



The data in the graph and table represent global and regional summaries using official data reported from Member States to WHO, and WHO/UNICEF estimated coverage (estimation method-description starts on page 6). In 2009, 193 Member States are expected to report. The table shows the number of Member States providing data to WHO (labelled "N° Countries" which includes Member States reporting zero cases) and the proportion of the world's population represented by the reporting Member States (labelled "% population"). Imputation procedures described above were used to complete missing reported coverage values. DTP3 coverage increased during the 1980s because increasing numbers of Member States established national immunization services and also increased coverage. It peaked in 1990 as a result of the push to achieve Universal Childhood Immunization through routine services and through campaigns. Reported coverage remained high during the 1990s. The drop at global level observed from 2000 to 2001 was mainly the result of a change in the methodology used to produce official national estimates in two Member States, China and India which, because of the size of their infant populations, had a significant impact on the global figure. The decline was less pronounced in the WHO/UNICEF estimates and the two figures converged. The reported figures and the WHO/UNICEF estimates differ again from 2002. This is mainly because of China and India where the official estimates are higher. DTP3 coverage data are used to reflect the proportion of children protected against diphtheria, pertussis and tetanus, and to indicate performance of immunization services and the health system in general. DTP3 figures are also compared with DTP1 to assess "drop-out" rates — an indicator of the quality of services and managerial capacity. The Member State profiles also show district achievements (percentage of districts achieving various levels of DTP3 coverage).

Diphtheria incidence is affected by DTP3 coverage and booster doses using DT and Td (see immunization schedules in the Member State profiles). The decline in reported diphtheria cases in the 1980s is consistent with the reported increasing DTP3 coverage. The sudden increase in incidence during the 1990s is due to an epidemic in Member States of the former Soviet Union. Since 1990, outbreaks were also reported from Algeria, Iraq, the Lao People's Republic, Mongolia, Papua New Guinea, the Sudan, and Thailand. Reported data on diphtheria incidence should be interpreted with caution due to variations in case definitions used and performance of surveillance systems. The decrease in the number of cases from 2008 is mainly due to India not reporting incidence data in 2009.

World-wide annual deaths from diphtheria (2004) were estimated by WHO at 5'000, all of them occurred among children under five.

(The Global Burden of Disease 2004 update, World Health Organization 2008)



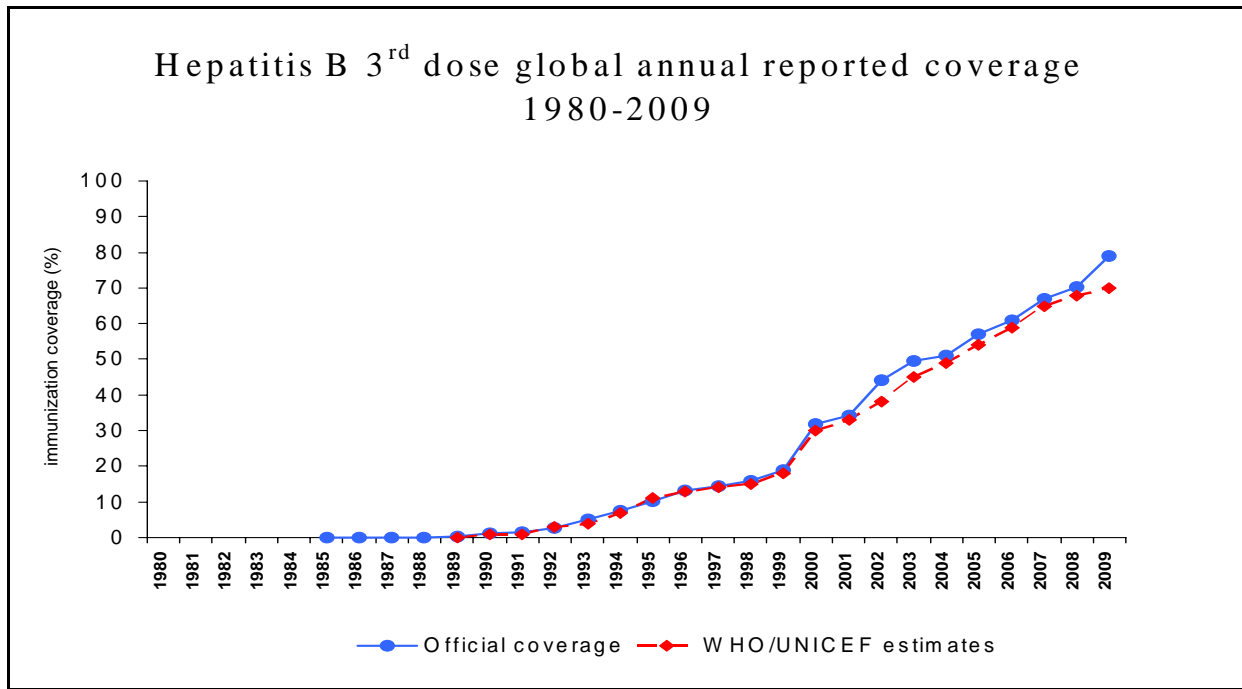
Regional and global summaries of diphtheria incidence (number of reported cases): 1980, 1990, 1999-2009.

WHO regions	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
African Region	8'771	2'588	4'038	2'587	941	216	23	54	351	17	72	10
Region of the Americas	5'570	826	113	68	128	99	181	272	285	103	102	48
Eastern Mediterranean Region	19'970	3'604	175	96	924	287	145	251	180	170	133	109
European Region	618	3'202	1'585	1'386	1'189	897	688	500	320	228	184	41
South-East Asia Region	47'354	11'582	5'470	6'045	5'583	4'596	8'874	10'908	3'016	3'675	6'502	520
Western Pacific Region	15'228	2'062	244	543	257	736	158	759	75	80	95	129
Global	97'511	23'864	11'625	10'725	9'022	6'831	10'069	12'744	4'227	4'273	7'088	857
N° countries	156	165	152	154	162	160	160	167	160	168	159	164

Regional and global summaries of reported, and WHO/UNICEF estimates of, vaccination coverage (%), DTP3 < 1 year of age: 1980, 1990, 1999-2009.

WHO regions	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
African Region	6	55	56	56	61	64	68	72	82	82	80	84
	5	57	55	55	56	59	63	65	67	70	70	71
Region of the Americas	50	71	92	92	92	93	93	94	94	95	92	90
	50	74	91	91	92	93	93	93	93	94	92	92
Eastern Mediterranean Region	23	80	81	81	77	77	79	86	87	88	85	90
	18	71	73	76	76	76	77	83	84	85	82	85
European Region	27	85	93	94	93	92	95	95	96	96	96	96
	64	78	93	94	93	91	94	95	95	96	95	96
South-East Asia Region	38	94	89	67	72	82	86	88	92	95	84	85
	7	70	66	65	64	67	70	72	71	72	72	73
Western Pacific Region	11	93	85	80	94	96	96	88	92	92	95	97
	9	94	85	86	85	87	88	88	92	92	95	95
Global	26	83	82	74	79	83	85	86	90	91	87	89
	20	75	74	74	74	75	77	79	80	81	81	82
% population	55	95	98	96	92	99	95	96	96	100	96	96
N° countries	95	155	183	170	173	181	179	180	182	184	186	186

Hepatitis B



The data in the graph and table represent global and regional summaries using official data reported from Member States to WHO and WHO/UNICEF estimated coverage (estimation method-description starts on page 6). In 2009, 177 Member States have introduced HepB vaccine in routine infant immunization, (India and the Sudan in part of the Member State only), and are expected to report. 87 Member States are reporting providing Hepatitis B vaccine at birth. The table shows the number of Member States providing data to WHO (labelled "N° Countries") and the proportion of the world's population represented by the reporting Member States (labelled "% population"). Imputation procedures described above were used to complete missing coverage values. HepB3 coverage has steadily increased since 1990 due to the increasing numbers of Member States introducing hepatitis B vaccine into their routine immunization services, as well as increasing coverage in these Member States. Since 2008, in South-East Asia Region, there was an increase in the reported national coverage estimates. This is mainly due to phased introduction of the vaccine in India.

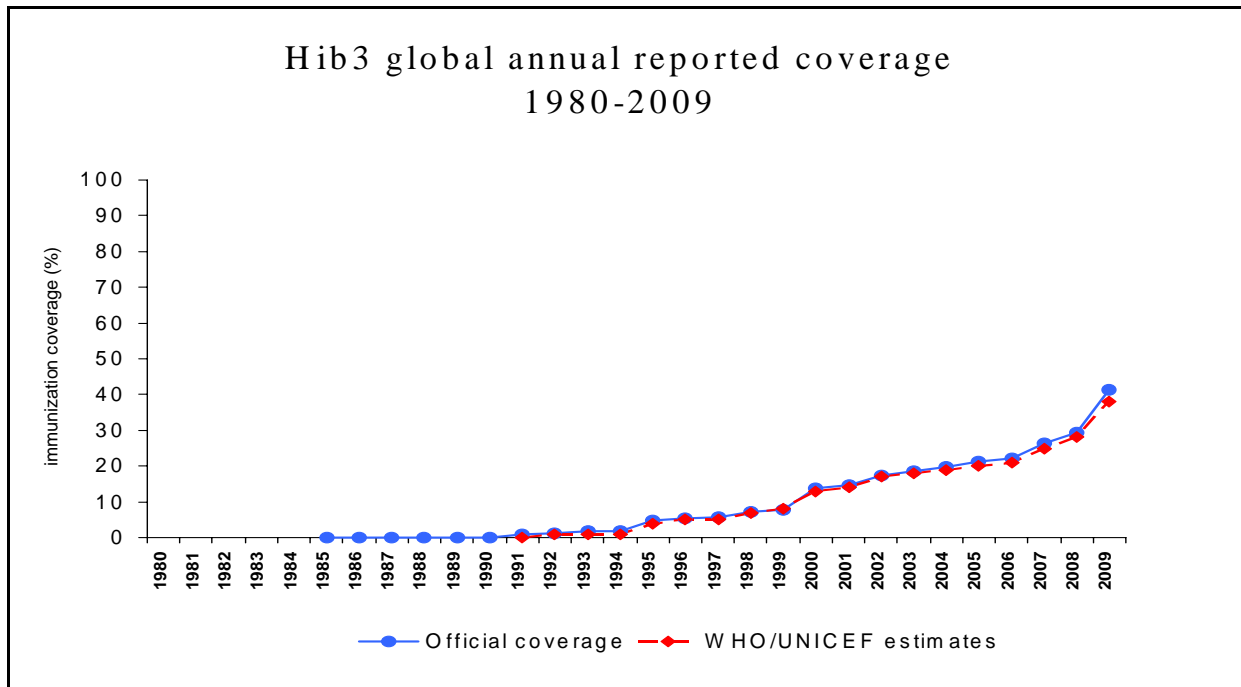
HepB3 coverage data are critical to estimate the impact of the vaccine on chronic infection with hepatitis B and its deadly sequelae (hepatoma and cirrhosis). World-wide annual deaths from hepatitis B infection (2002) were estimated by WHO at 600'000. (IVB unpublished estimates)



Regional and global summaries of reported, and WHO/UNICEF estimates of, vaccination coverage (%), HepB3 < 1 year of age: 1990, 1999-2009.

WHO regions	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
African Region	-	0	5	5	27	31	36	46	51	72	74	82
	-		5	6	23	28	33	41	45	66	66	70
Region of the Americas	-	0	72	76	79	82	84	87	90	90	85	86
	-		70	72	76	82	84	87	90	89	85	86
Eastern Mediterranean Region	-	3	39	42	44	64	66	75	79	86	84	87
	-	3	39	41	42	62	63	69	76	83	80	84
European Region	-	7	45	52	65	69	74	75	76	78	78	79
	-	4	42	49	63	67	72	73	74	77	76	77
South-East Asia Region	-	0	10	9	10	14	16	28	28	30	40	61
	-		10	10	10	11	18	24	27	29	41	41
Western Pacific Region	-	2	55	63	83	85	81	77	85	85	89	93
	-	2	49	57	60	70	73	77	85	85	89	90
Global	-	1	32	34	44	49	51	57	61	67	70	79
	-	1	30	33	38	45	49	54	59	65	68	70
% population	-	2	20	23	26	45	47	52	62	87	85	86
N° countries	-	10	62	69	80	91	102	111	131	142	152	154

Haemophilus Influenza type b



The data in the graph and table represent global and regional summaries using official data reported from Member States to WHO and WHO/UNICEF estimated coverage (estimation method-description starts on page 6). In 2009, 160 Member States have introduced Hib vaccine in routine infant immunization, of which two are in part of the Member State, and are expected to report. The table shows the number of Member States providing data to WHO (labelled "N° Countries") and the proportion of the world's population represented by the reporting Member States (labelled "% population"). Imputation procedures described above were used to complete missing coverage values. While the Hib3 coverage showed a steady increase since 1990, the last two years data show a dramatic increase due to the rallying of 45 new countries introducing Haemophilus influenzae type b vaccine into their routine immunization services.

World-wide annual deaths from Haemophilus influenzae b infection (2008) were estimated by WHO at 260'000 among HIV negative children.

(WHO/IVB provisional estimates based on Global Burden of Diseases estimates)



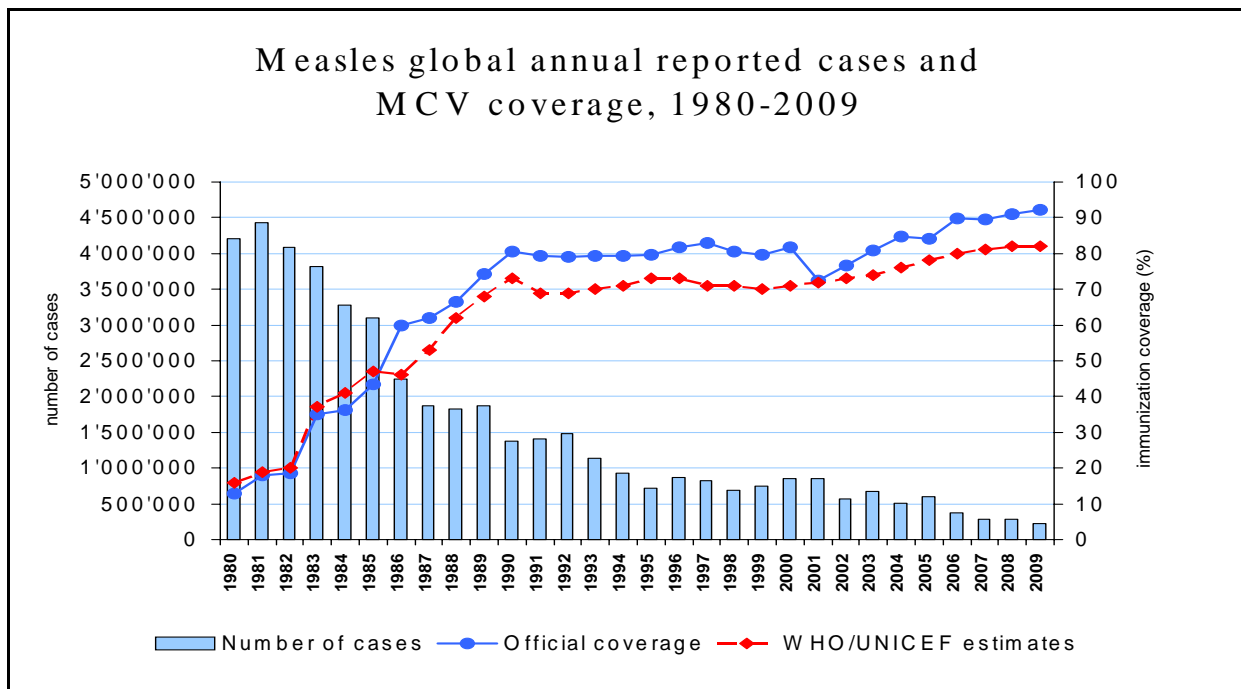
Global and regional summary



Regional and global summaries of reported, and WHO/UNICEF estimates of, vaccination coverage (%), Hib3 < 1 year of age: 1990, 1999-2009.

WHO regions	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
African Region	-	0	4	4	15	15	19	21	24	36	43	69
	-		3	3	13	13	16	18	22	33	39	62
Region of the Americas	-	0	76	78	81	86	88	92	92	93	91	88
	-		75	77	81	86	88	92	92	91	90	91
Eastern Mediterranean Region	-	0	5	9	10	11	12	14	16	20	28	61
	-		1	4	9	10	10	13	13	17	24	58
European Region	-	0	37	39	41	42	42	43	45	60	65	73
	-		38	39	41	42	42	43	45	58	65	73
South-East Asia Region	-	0	0	0	0	0	0	0	0	0	0	8
	-											
Western Pacific Region	-	0	1	1	1	1	3	3	3	3	4	4
	-		1	1	1	1	3	3	3	3	4	4
Global	-	0	14	15	18	18	20	21	22	26	29	41
	-		13	14	17	18	19	20	21	25	28	38
% population	-		5	8	8	16	17	20	21	22	20	21
N° countries	-	0	18	30	37	55	60	73	79	87	97	100

Measles



The data in the graph and table represent global and regional summaries using official data reported from Member States to WHO, and WHO/UNICEF estimated coverage (estimation method-description starts on page 6). In 2009, 193 Member States are expected to report. The table shows the number of Member States providing data to WHO (labelled "N° Countries" which includes Member States reporting zero cases) and the proportion of the world's population represented by the reporting Member States (labelled "% population"). Imputation procedures described above were used to complete missing coverage values. Measles immunization coverage is the percentage of one-year-olds who have received at least one dose of measles-containing vaccine in a given year. For Member States recommending the first dose of measles vaccine in children over 12 months of age, the indicator is calculated as the proportion of children less than 24 months of age receiving one dose of measles-containing vaccine.

Measles immunization coverage increased during the 1980s due to increasing numbers of Member States establishing national immunization services and increasing coverage in these Member States. It peaked in 1990 as a result of the push to achieve Universal Childhood Immunization through routine immunization services and campaigns focusing on unreached children. Reported measles immunization coverage remained high and steady through the 1990s. The drop at global level observed from 2000 to 2001 was mainly the result of a change in the methodology used to produce official national estimates in two Member States, China and India which, because of the size of their infant populations, had a significant impact on the global figure. The decline was not observed in the WHO/UNICEF estimates and the two figures converged. The reported figures and the WHO/UNICEF estimates differ again from 2002. This is mainly because of China and India where the official estimates are higher. Measles coverage data shown in the graph reflect only the first dose given through routine immunization services. In 2009, 136 Member States (70%) are providing a second dose of measles in their routine immunization schedule. The indicator tables in section 2 of this document show district achievements in terms of the percentage of districts achieving at least 90% measles coverage.

Reported measles incidence is affected by variations in case definitions, reporting artefacts, surveillance performance, and measles outbreaks. Generally, reported cases substantially underestimate the true measles burden. The global decrease from 2005 to 2006 is mainly due to accelerated measles control in the WHO African Region. The decrease in 2007 in the WHO European Region is mainly due to Member States not reporting.

World-wide annual deaths from measles (2008) were estimated by WHO at 164'000 with uncertainty interval of (115'000 to 222'000).
(Weekly Epidemiological Record, No 49, 2009, 84, 509-516)



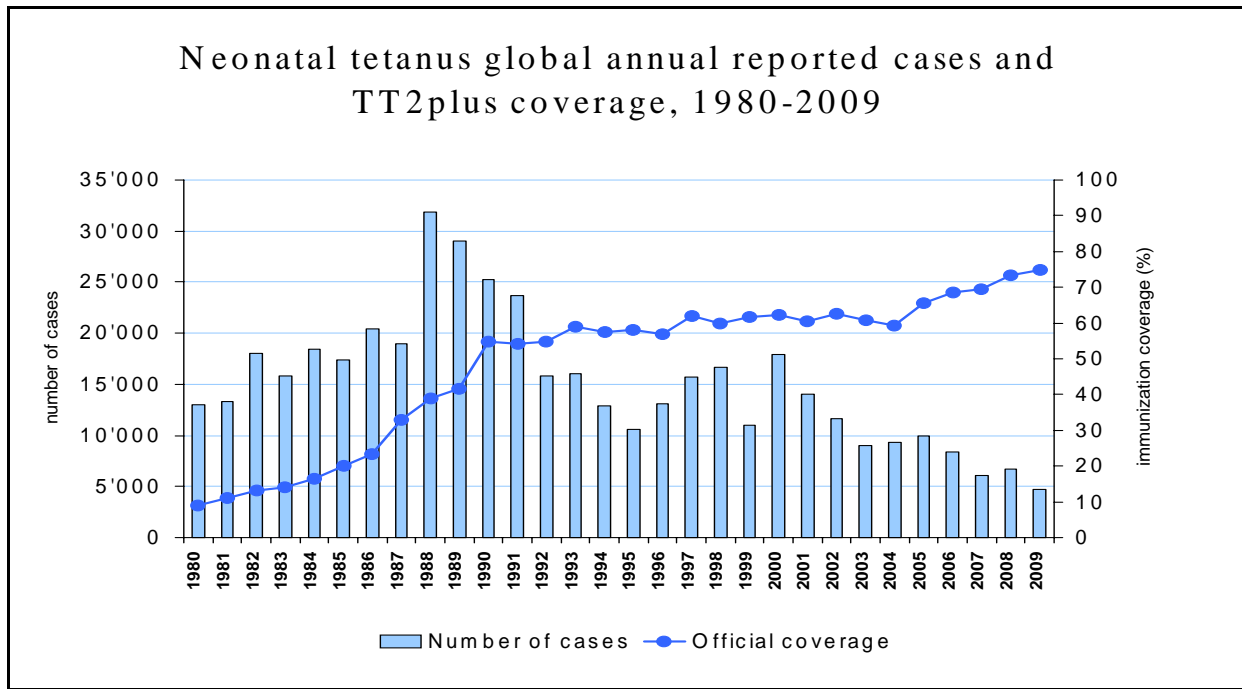
Regional and global summaries of measles incidence (number of reported cases): 1980, 1990, 1999-2009.

WHO regions	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
African Region	1'240'993	481'204	520'102	492'116	286'380	403'572	220'732	316'224	99'339	76'408	37'010	83'625
Region of the Americas	257'790	218'579	1'755	548	2'579	119	108	85	226	176	205	20
Eastern Mediterranean Region	341'624	59'058	38'592	41'103	42'616	52'110	59'804	15'069	23'303	15'670	12'120	36'605
European Region	851'849	234'827	37'421	58'364	46'714	28'199	29'503	37'332	53'344	6'949	8'879	7'499
South-East Asia Region	199'535	224'925	78'574	79'252	66'597	94'644	107'824	104'506	94'562	69'301	75'770	28'056
Western Pacific Region	1'319'640	155'490	176'493	175'382	129'285	101'810	91'763	128'016	103'156	112'280	147'986	66'603
Global	4'211'431	1'374'083	852'937	846'765	574'171	680'454	509'734	601'232	373'930	280'784	281'970	222'408
N° countries	148	169	169	175	177	182	190	182	182	186	183	185

Regional and global summaries of reported, and WHO/UNICEF estimates of, vaccination coverage (%), MCV1 < 1 year of age: 1980, 1990, 1999-2009.

WHO regions	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
African Region	6	52	54	55	60	64	66	67	87	82	79	83
	6	57	56	56	56	59	62	63	66	67	67	69
Region of the Americas	51	80	93	94	92	94	94	94	94	94	94	94
	51	80	92	93	92	93	93	93	92	92	93	93
Eastern Mediterranean Region	23	76	79	81	76	75	80	83	85	84	86	86
	15	67	73	74	74	74	77	81	82	82	83	82
European Region	22	76	91	92	91	90	92	93	95	95	95	95
	56	80	91	92	91	90	92	93	94	94	94	94
South-East Asia Region	0	88	84	61	66	77	86	88	89	92	97	98
	0	59	58	60	62	65	66	70	74	75	76	76
Western Pacific Region	5	93	95	81	95	96	96	87	93	92	95	96
	5	94	85	86	86	86	88	87	92	92	93	93
Global	13	80	82	73	77	81	85	84	90	90	91	92
	16	73	71	72	73	74	76	78	80	81	82	82
% population	31	95	98	96	92	97	95	96	96	100	96	96
N° countries	69	149	182	172	175	173	179	179	182	186	187	185

Neonatal tetanus



WHO recommends that TT2+ coverage be calculated as the proportion of pregnant women having received two or more doses of tetanus toxoid. Tetanus toxoid administered to pregnant women (and all childbearing-age women in some Member States) protects both the mother and new-born against tetanus. Global and regional summaries of TT2+ coverage include in the denominator only the 112 Member States where tetanus is in the national immunization schedule for childbearing-age women. The table shows the number of Member States providing data to WHO (labelled "N° Countries" which includes Member States reporting zero cases) and the proportion of the world's population represented by the reporting Member States (labelled "% population"). Reported TT2+ coverage has steadily increased since the early 1980s due to increasing numbers of Member States providing TT through antenatal care services and increasing coverage in these Member States. Community-based surveys have revealed the tendency to underestimate TT2+ coverage using administrative data. This occurs especially in well-performing Member States where women may already be protected, and ineligible for a TT dose during pregnancy (i.e. they are included in the pregnant women denominator, but not in the numerator).

Community-based surveys demonstrate substantial underreporting of neonatal tetanus (NT) cases through routine surveillance. The global and regional trends are influenced by surveillance performance and reporting artefacts.

World-wide annual deaths from neonatal tetanus (2008) were estimated by WHO at 59'000. (The Global Burden of Disease 2008 update, World Health Organization 2010)



Regional and global summaries of neonatal tetanus incidence (number of reported cases): 1980, 1990, 1999-2009.

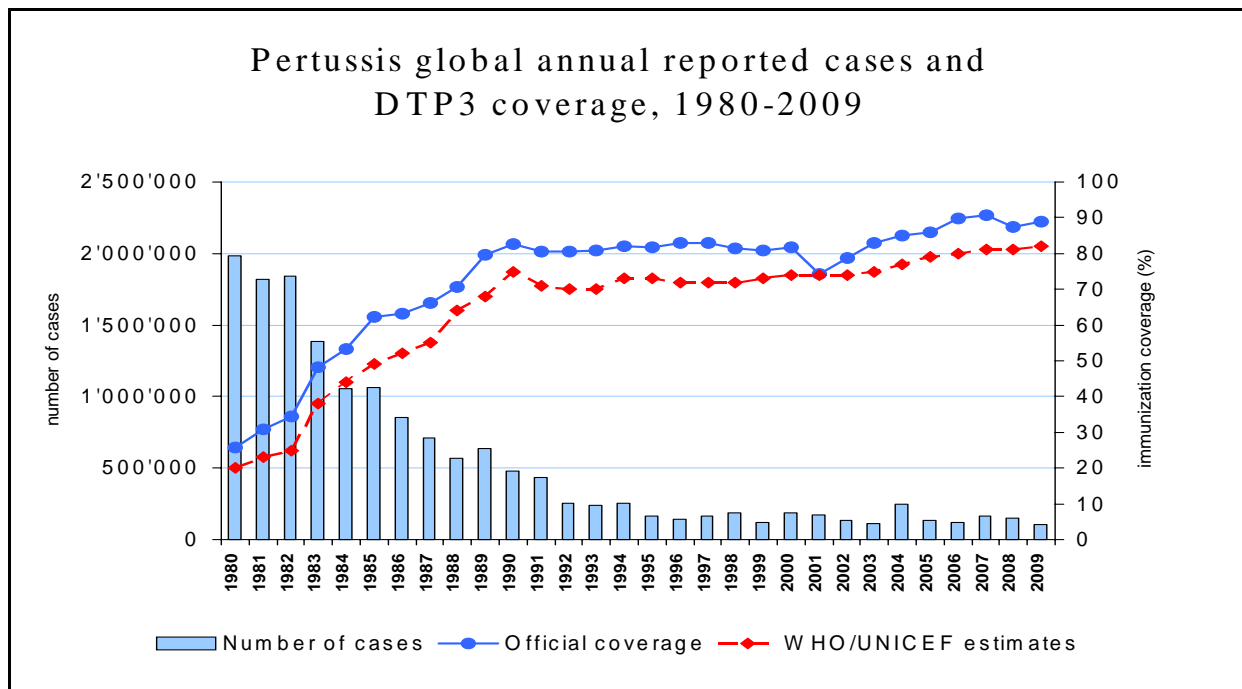
WHO regions	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
African Region	2'265	7'029	5'175	5'160	4'693	2'364	2'693	4'415	3'468	1'346	2'182	1'516
Region of the Americas	803	1'176	1'144	1'170	111	65	93	114	93	63	35	20
Eastern Mediterranean Region	5'190	4'666	3'140	1'815	1'986	1'299	910	802	886	951	1'199	1'059
European Region	26	69	27	33	32	41	15	32	18	5	7	1
South-East Asia Region	3'149	11'725	4'322	2'577	2'146	2'393	2'133	1'444	1'073	1'373	1'231	334
Western Pacific Region	1'572	628	4'127	3'261	2'656	2'881	3'474	3'111	2'854	2'348	2'004	1'782
Global	13'005	25'293	17'935	14'016	11'624	9'043	9'318	9'918	8'392	6'086	6'658	4'712
N° countries	93	152	161	169	165	167	166	172	174	178	172	174

Regional and global summaries of reported vaccination coverage (%), TT2+ among pregnant women: 1980, 1990, 1999-2009.

WHO regions	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
African Region	2	37	44	45	45	50	53	58	64	64	68	63 (40)
Region of the Americas	2	42	60	60	50	53	58	64	77	77	52	74 (17)
Eastern Mediterranean Region	1	49	48	49	51	59	50	49	51	49	51	53 (13)
European Region	0	17	38	39	38	38	42	48	53	55	57	81 (2)
South-East Asia Region	17	74	81	76	84	73	68	78	78	81	94	95 (10)
Western Pacific Region	7	38	68	69	62	55	65	65	63	59	63	62 (10)
Global	9	55	62	61	63	61	59	65	68	69	73	75
% population	56	85	84	46	76	88	89	86	85	93	96	97
N° countries	32	77	78	69	71	85	92	84	84	94	98	101

Numbers in parenthesis (last column) indicate the number of countries reporting in 2009. The expected number of reporting countries is 46 for the WHO African Region, 22 for the WHO Region of the Americas, 16 for the WHO East Mediterranean Region, 2 for the WHO European Region, 11 for the WHO South-East Asia Region and 15 for the WHO Western Pacific Region, 112 for Global.

Pertussis



Comments on DTP3 coverage may be found under the diphtheria chapter.

The data in the graph and table represent global and regional summaries using official data reported from Member States to WHO, and WHO/UNICEF estimated coverage (estimation method-description starts on page 6). In 2009, 193 Member States are expected to report. The table shows the number of Member States providing data to WHO (labelled "N° Countries" which includes Member States reporting zero cases) and the proportion of the world's population represented by the reporting Member States (labelled "% population"). Imputation procedures described above were used to complete missing reported coverage values.

Reported pertussis incidence must be interpreted with caution due to variations in case definitions and surveillance system performance among Member States. Case definitions based on clinical confirmation are used in many Member States due to limited access to laboratory services. Pertussis diagnosis in the neonate as well as older children and adults is difficult without laboratory confirmation. The global decline in reported pertussis incidence in the 1980s is consistent with the overall increases in immunization coverage. World-wide annual deaths from pertussis (2008) were estimated by WHO at 195'000. As better data become available, these estimates will be revised. The observed regional variations in reported pertussis incidence are mainly artefacts in reporting, particularly among large Member States.

Some variations in reported incidence by Member State or region are due to outbreaks (e.g. Switzerland, 1994-95) or decreased uptake of pertussis vaccine because of concerns about side-effects (e.g. Japan). According to Member State reports, acellular pertussis vaccine is used in 2009 in 53 Member States. Some Member States that have already achieved good pertussis control are experiencing a shift in pertussis epidemiology to older age groups (e.g. Canada and the United States of America).

World-wide annual deaths from pertussis (2008) were estimated by WHO at 195'000, all of them occurred among children under five.

(The Global Burden of Disease 2008 update, World Health Organization 2010)



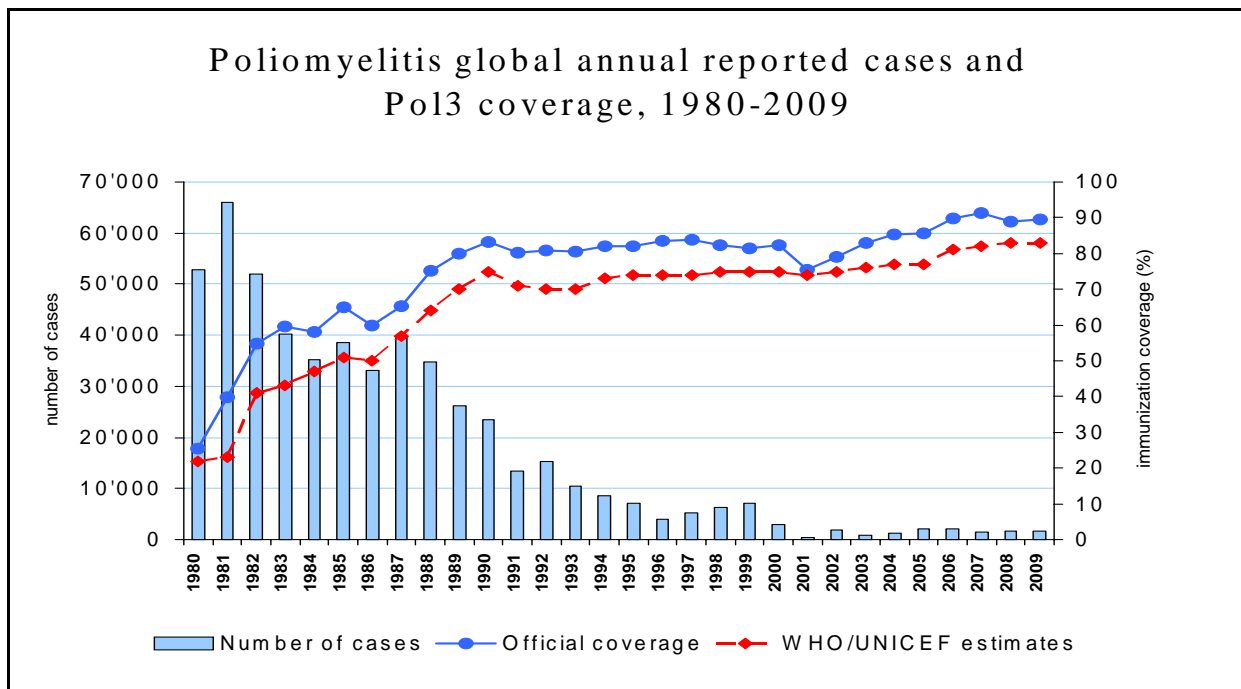
Regional and global summaries of pertussis incidence (number of reported cases): 1980, 1990, 1999-2009.

WHO regions	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
African Region	367'961	89'515	52'008	50'386	19'452	16'418	26'335	22'139	18'399	21'197	19'425	15'768
Region of the Americas	123'734	38'006	18'888	15'075	16'133	17'803	33'452	34'654	24'516	19'753	24'547	7'338
Eastern Mediterranean Region	171'631	27'437	2'112	4'257	2'650	1'161	81'987	5'164	10'060	14'213	7'849	9'790
European Region	90'546	129'735	53'675	31'084	25'176	25'530	42'220	26'425	30'168	28'798	25'270	29'229
South-East Asia Region	399'310	156'028	38'510	41'863	41'836	40'477	40'277	25'675	27'657	72'981	46'937	3'413
Western Pacific Region	829'173	35'653	25'282	32'182	30'682	11'348	21'106	21'560	9'164	6'634	25'245	40'669
Global	1'982'355	476'374	190'475	174'847	135'929	112'737	245'377	135'617	119'964	163'576	149'273	106'207
N° countries	151	164	159	162	165	160	167	162	161	164	164	169

Regional and global summaries of reported, and WHO/UNICEF estimates of, vaccination coverage (%), DTP3 <1 year of age: 1980, 1990, 1999-2009.

WHO regions	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
African Region	6	55	56	56	61	64	68	72	82	82	80	84
	5	57	55	55	56	59	63	65	67	70	70	71
Region of the Americas	50	71	92	92	92	93	93	94	94	95	92	90
	50	74	91	91	92	93	93	93	93	94	92	92
Eastern Mediterranean Region	23	80	81	81	77	77	79	86	87	88	85	90
	18	71	73	76	76	76	77	83	84	85	82	85
European Region	27	85	93	94	93	92	95	95	96	96	96	96
	64	78	93	94	93	91	94	95	95	96	95	96
South-East Asia Region	38	94	89	67	72	82	86	88	92	95	84	85
	7	70	66	65	64	67	70	72	71	72	72	73
Western Pacific Region	11	93	85	80	94	96	96	88	92	92	95	97
	9	94	85	86	85	87	88	88	92	92	95	95
Global	26	83	82	74	79	83	85	86	90	91	87	89
	20	75	74	74	74	75	77	79	80	81	81	82
% population	55	95	98	96	92	99	95	96	96	100	96	96
N° countries	95	155	183	170	173	181	179	180	182	184	186	186

Poliomyelitis



The data in the graph and table represent global and regional summaries using official data reported from Member States to WHO, and WHO/UNICEF estimated coverage (estimation method-description starts on page 6). In 2009, 193 Member States are expected to report. The table shows the number of Member States providing data to WHO (labelled "N° Countries" which includes Member States reporting zero cases) and the proportion of the world's population represented by the reporting Member States (labelled "% population"). Reported coverage increased during the 1980s due to increasing numbers of Member States establishing national immunization services and increasing coverage in these Member States. Polio immunization coverage peaked in 1990 as a result of the push to achieve Universal Childhood Immunization through routine immunization services and campaigns focusing on unreached children. Reported polio immunization coverage remained high and steady through the 1990s which reflects only those doses given through routine immunization services, and not the massive numbers of supplemental doses provided through campaigns. The drop at global level observed from 2000 to 2001 was mainly the result of a change in the methodology used to produce official national estimates in two Member States, China and India which, because of the size of their infant populations, had a significant impact on the global figure. The decline was less pronounced in the WHO/UNICEF estimates and the two figures converged in 2002. Official coverage estimates are again higher from 2002 due to China and India.

In 1988, the polio eradication initiative was launched. By the end of the year 2009 only four Member States remained endemic with the following figures for 2009: India (741 cases); Pakistan (89 cases); Afghanistan (38 cases); Nigeria (388 cases). Member States reported cases due to active transmission in 2009: Angola, Benin, Burkina Faso, Burundi, Cameroon, the Central African Republic, Chad, Côte d'Ivoire, the Democratic Republic of the Congo, Guinea, Kenya, Liberia, Mali, Mauritania, the Niger, Sierra Leone, the Sudan, Togo and Uganda.



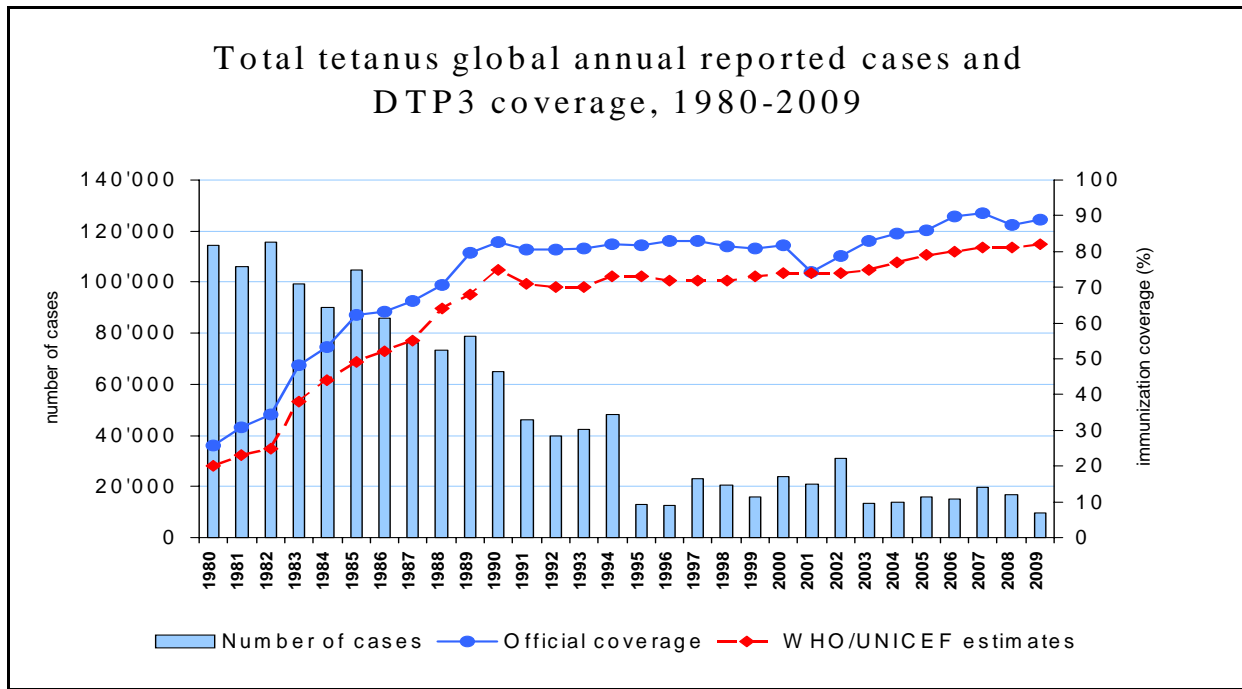
Regional and global summaries of polio incidence (number of reported cases): 1980, 1990, 1999-2009.

WHO regions	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
African Region	5'126	4'228	1'863	70	212	446	934	883	1'211	434	992	851
Region of the Americas	2'989	18	12	9	0	0	0	0	0	0	0	0
Eastern Mediterranean Region	12'622	1'498	505	143	110	113	187	729	107	58	174	176
European Region	549	370	0	4	0	0	0	0	0	0	0	0
South-East Asia Region	20'089	11'313	591	268	1'600	225	134	419	702	893	565	752
Western Pacific Region	11'420	5'963	0	3	0	0	3	1	1	0	0	0
Global	52'795	23'390	2'971	497	1'922	784	1'258	2'032	2'021	1'385	1'731	1'779
N° countries	161	161	191	191	192	192	192	188	192	193	193	161

Regional and global summaries of reported, and WHO/UNICEF estimates of, vaccination coverage (%), Polio3 < 1 year of age: 1980, 1990, 1999-2009.

WHO regions	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
African Region	8	56	55	54	60	65	67	70	80	80	77	81
	6	57	54	56	61	63	65	66	68	72	70	72
Region of the Americas	67	70	92	92	92	93	93	93	94	95	93	89
	67	75	91	91	91	92	92	92	93	93	93	91
Eastern Mediterranean Region	24	80	80	80	79	78	79	86	87	88	88	89
	20	71	75	77	77	77	77	83	84	85	85	86
European Region	31	89	95	95	94	92	95	96	96	96	96	96
	73	82	94	95	93	92	95	95	95	96	96	96
South-East Asia Region	29	94	90	73	72	82	88	89	92	98	89	89
	3	67	68	66	65	66	67	63	73	73	74	74
Western Pacific Region	7	94	89	79	95	96	96	88	93	92	97	97
	5	94	86	85	85	87	88	88	93	92	97	97
Global	25	83	82	75	79	83	85	86	90	91	89	89
	22	75	75	74	75	76	77	77	81	82	83	83
% population	54	96	99	96	92	99	95	96	96	100	96	96
N° countries	94	154	183	172	173	180	179	180	181	185	187	186

Total tetanus



Comments on DTP3 coverage may be found under the diphtheria chapter.

The data in the graph and table represent global and regional summaries using official data reported from Member States to WHO, and WHO/UNICEF estimated coverage (estimation method-description starts on page 6). In 2009, 193 Member States are expected to report. The table shows the number of Member States providing data to WHO (labelled "N° Countries" which includes Member States reporting zero cases) and the proportion of the world's population represented by the reporting Member States (labelled "% population"). Imputation procedures described above were used to complete missing reported coverage values.

Total tetanus incidence is affected not only by DTP3 coverage but also by booster doses received using diphtheria-tetanus toxoid (DT, Td) or tetanus toxoid (see immunization schedules in the Member State profiles). The decline in reported tetanus incidence in the 1980s is consistent with the reported increases in DTP3 coverage.

The global trends in tetanus are influenced by reporting artefacts, particularly from a few large Member States (India, Indonesia). The sudden decline in global incidence during 1995 and 1996 occurred because India reported no tetanus data to WHO during those years and then recommenced in 1997 (at a much lower incidence rate).

World-wide annual deaths from tetanus for children under the age of 5 (2008) were estimated by WHO at 61'000 (including neonatal tetanus).

(The Global Burden of Disease 2008 Update, World Health Organization 2010)



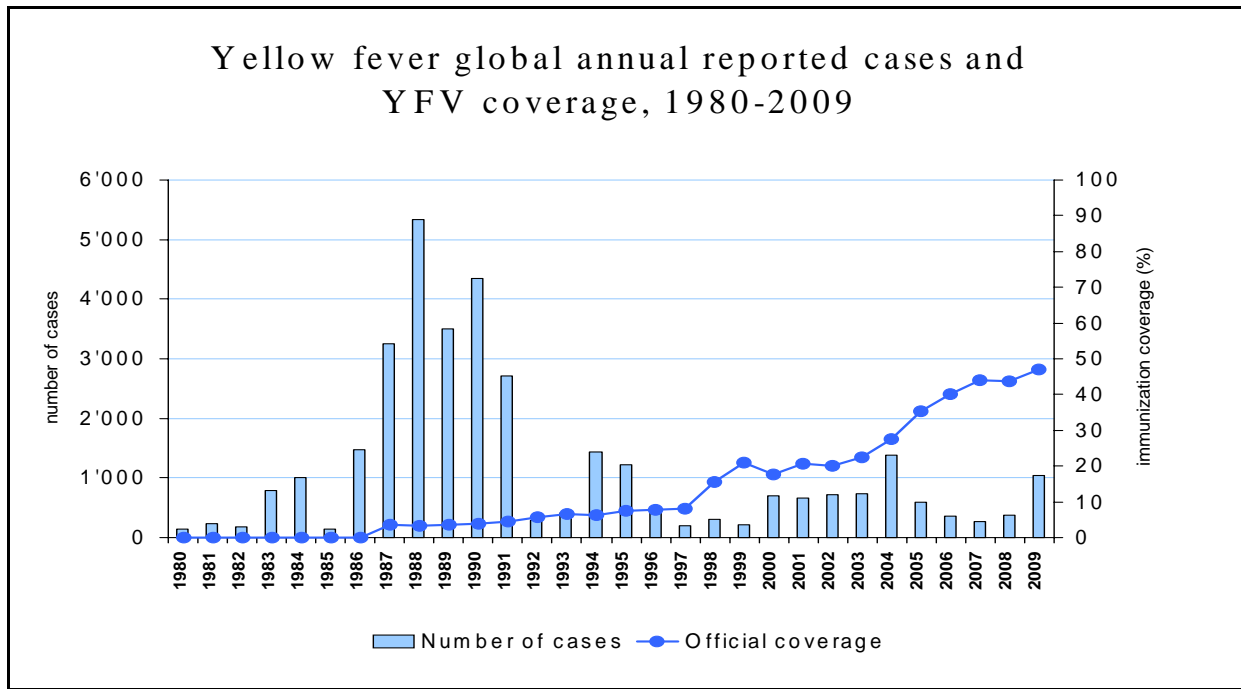
Regional and global summaries of total tetanus incidence (number of reported cases): 1980, 1990, 1999-2009.

WHO regions	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
African Region	17'241	12'281	5'835	6'482	10'872	2'017	2'417	2'861	5'825	5'157	5'444	4'607
Region of the Americas	7'055	3'142	1'747	1'525	685	902	854	972	917	723	641	559
Eastern Mediterranean Region	17'721	9'815	2'134	2'038	2'900	1'623	847	914	1'023	1'220	1'627	1'194
European Region	1'715	879	412	270	346	359	255	192	195	205	129	181
South-East Asia Region	62'176	35'452	11'554	7'722	13'936	6'305	6'857	7'210	4'866	8'780	5'477	1'703
Western Pacific Region	8'343	3'414	2'020	2'737	2'394	2'207	2'606	3'966	2'330	3'790	3'328	1'592
Global	114'251	64'983	23'702	20'774	31'133	13'413	13'836	16'115	15'156	19'875	16'646	9'836
N° countries	154	149	149	147	156	149	154	166	162	176	177	178

Regional and global summaries of reported, and WHO/UNICEF estimates of, vaccination coverage (%), DTP3 < 1 year of age: 1980, 1990, 1999-2009.

WHO regions	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
African Region	6	55	56	56	61	64	68	72	82	82	80	84
	5	57	55	55	56	59	63	65	67	70	70	71
Region of the Americas	50	71	92	92	92	93	93	94	94	95	92	90
	50	74	91	91	92	93	93	93	93	94	92	92
Eastern Mediterranean Region	23	80	81	81	77	77	79	86	87	88	85	90
	18	71	73	76	76	76	77	83	84	85	82	85
European Region	27	85	93	94	93	92	95	95	96	96	96	96
	64	78	93	94	93	91	94	95	95	96	95	96
South-East Asia Region	38	94	89	67	72	82	86	88	92	95	84	85
	7	70	66	65	64	67	70	72	71	72	72	73
Western Pacific Region	11	93	85	80	94	96	96	88	92	92	95	97
	9	94	85	86	85	87	88	88	92	92	95	95
Global	26	83	82	74	79	83	85	86	90	91	87	89
	20	75	74	74	74	75	77	79	80	81	81	82
% population	55	95	98	96	92	99	95	96	96	100	96	96
N° countries	95	155	183	170	173	181	179	180	182	184	186	186

Yellow fever



WHO recommends that yellow fever (YF) vaccine be introduced in Member States and territories at risk for outbreaks. These include 31 Member States in the WHO African Region, 12 Member States in the Americas, and two Member States in the WHO Eastern Mediterranean Region. Global and regional YF immunization coverage figures are calculated using only these 45 Member States at risk (44 WHO Member States plus French Guyana). The data in the graph and tables represent global and regional summaries using official data reported from Member States to WHO. The table on yellow fever incidence includes all reporting entities in addition to the 45 at risk. The table on yellow fever coverage shows the number of Member States providing data to WHO (labelled "N° Countries" which includes Member States reporting zero cases) and the proportion of the population in the 45 Member States at risk represented by those data (labelled "% population"). Imputation procedures described above were used to complete missing coverage values. The number of Member States providing meaningful data has varied over time and has been generally substandard. The increase of cases reported in 2009 in the African region are mainly due to outbreaks occurring in Burkina Faso (707 cases) and Sierra Leone (205 cases).

Out of the 45 WHO Member States and territories, 35 have introduced yellow fever vaccine in the routine schedule, of which three have introduced it in high-risk areas. In addition, Paraguay and Seychelles (outside the high-risk group) have introduced yellow fever vaccine in the routine schedule.

World-wide annual deaths from yellow fever (2002) were estimated by WHO at 30'000, of which 15'000 occurred among children under five years of age.

(Weekly epidemiological record, 3 October 2003, 78th YEAR, No. 40, 2003, 78, 349–360 2003, Yellow fever vaccine, WHO position paper)



Regional and global summaries of yellow fever incidence: 1980, 1990, 1999-2009.

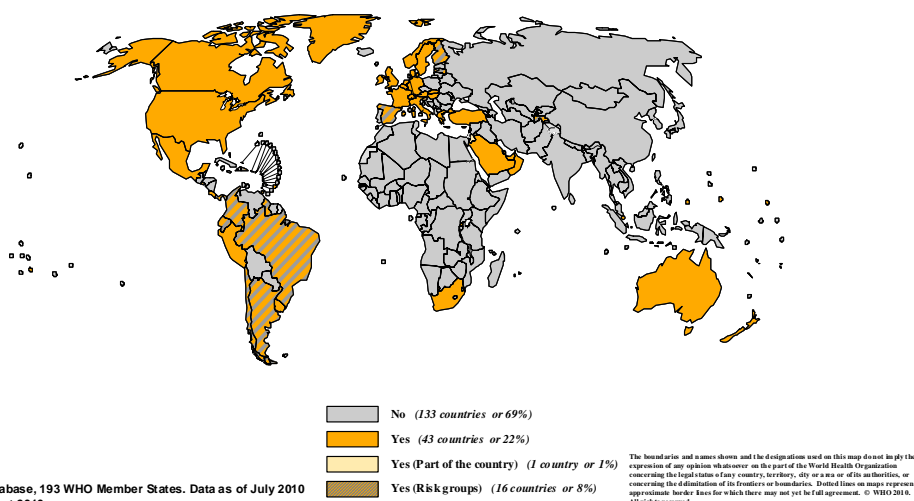
WHO regions	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
African Region	24	4'248	593	572	610	498	1'253	474	272	212	270	984
Region of the Americas	120	91	106	82	105	241	122	117	86	53	102	59
Eastern Mediterranean Region	0	0	0	0	0	0	0	0	0	0	0	0
European Region	0	0	0	2	0	0	1	0	0	0	0	1
South-East Asia Region	0	0	0	0	0	0	0	0	0	0	0	0
Western Pacific Region	0	0	0	0	0	0	0	0	0	0	0	0
Global	144	4'339	699	656	715	739	1'376	591	358	265	372	1'044
N° countries	9	10	99	136	123	127	132	128	135	142	145	143

Regional and global summaries of reported of vaccination coverage (%), YFV < 1 year of age: 1980, 1990, 1999-2009.

WHO regions	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
African Region	0	6	15	19	21	22	28	37	40	45	43	47
Region of the Americas	0	0	29	31	22	28	32	38	51	52	57	59
Eastern Mediterranean Region	0	0	0	0	0	0	0	0	0	0	0	0
Global	0	4	18	21	20	22	28	35	40	44	44	47
% population	-	2	6	29	13	35	35	37	45	70	70	73
N° countries	0	2	5	14	9	15	20	19	21	30	31	32



Countries Using Pneumococcal conjugate Vaccine in National Immunization Schedule, 2009



Source: WHO/IVB database, 193 WHO Member States. Data as of July 2010
Date of slide: 19 August 2010

The map represents the use of pneumococcal conjugate vaccine in national immunization schedule in 2009. The list of Member States is available from http://www.who.int/immunization_monitoring/en/globalsummary/indicatorselect.cfm.

In all, 44 Member States report having pneumococcal conjugate vaccine in their infant immunization schedules by the end of 2009. One of these Member States introduced the vaccine at sub-national level.

The table represents the total number of Member States in each WHO regions and globally using pneumococcal conjugate vaccine from 2005 and (%) of the regional and global birth cohort in these Member States.

World-wide annual deaths among children less than 5 years of age from pneumococcal diseases were estimated by WHO at 520'000.

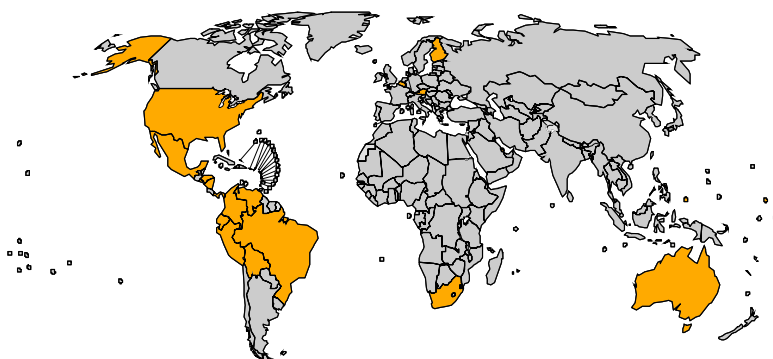
(WHO/IVB provisional estimates based on Global Burden of Diseases estimates)

	2005	2006	2007	2008	2009
African Region (46)	0 (0%)	0 (0%)	0 (0%)	1 (4%)	3 (5%)
Region of the Americas (35)	2 (30%)	2 (30%)	3 (34%)	7 (48%)	8 (48%)
Eastern Mediterranean Region (21)	1 (0.1%)	1 (0.1%)	3 (1%)	5 (1%)	7 (6%)
European Region (53)	1 (0%)	9 (26%)	14 (27%)	16 (40%)	19 (48%)
South-East Asia Region (11)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Western Pacific Region (27)	1 (1%)	1 (1%)	1 (1%)	4 (1%)	6 (1%)
Global (193)	5 (4%)	13 (6%)	21 (6%)	33 (10%)	44 (11%)

Number in parenthesis represents the number of WHO Member States in the WHO Regions and globally



Countries Recommending Rotavirus Vaccine in National Immunization Schedule, 2009



No (171 countries or 89%)

Yes (22 countries or 11%)

The boundaries and names shown and the designation used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement. © WHO 2010. All rights reserved.

Source: WHO/IVB database, 193 WHO Member States. Data as of July 2010
Date of slide: 19 August 2010

The map represents the use of rotavirus vaccine in national immunization schedule in 2009. The list of Member States is available from http://www.who.int/immunization_monitoring/en/globalsummary/indicatorselect.cfm.

In all, 22 Member States report having rotavirus vaccine in their infant immunization schedules by the end of 2009.

The table represents the total number of Member States in each WHO regions and globally using rotavirus vaccine from 2006 and (%) of regional and global birth cohort in these Member States.

World-wide annual deaths among children less than 5 years of age from rotavirus diseases were estimated by WHO at 527'000.

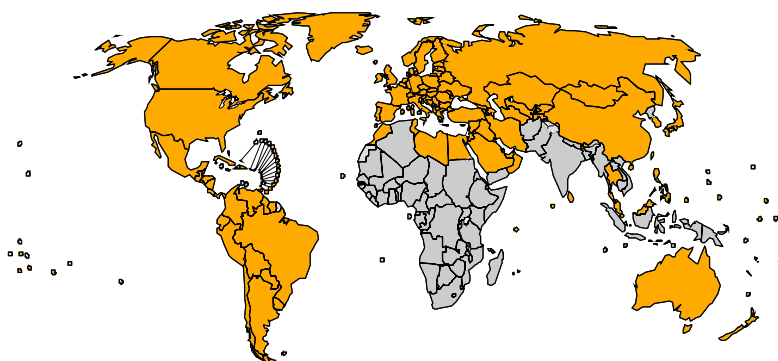
(For year 2004 (Global Mortality Associated with Rotavirus Disease among Children in 2004, Umesh D. Parashar, Anthony Burton, Claudio Lanata, Cynthia Bosch-Pinto, Kenji Shibuya, Duncan Steele, Maureen Birmingham, and Roger I. Glass, JID 2009;200 (Suppl 1))

	2006	2007	2008	2009
African Region (46)	0 (0%)	0 (0%)	1 (4%)	1 (3%)
Region of the Americas (35)	7 (68%)	9 (74%)	10 (75%)	12 (82%)
Eastern Mediterranean Region (21)	0 (0%)	0 (0%)	1 (0.1%)	2 (0.2%)
European Region (53)	2 (1%)	3 (2%)	3 (2%)	4 (2%)
South-East Asia Region (11)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Western Pacific Region (27)	0 (0%)	1 (1%)	2 (1%)	3 (1%)
Global (193)	9 (8%)	13 (9%)	17 (10%)	22 (10%)

Number in parenthesis represents the number of WHO Member States in the WHO Regions and globally



Countries Using Rubella Vaccine in National Immunization Schedule, 2009



No (63 countries or 33%)
Yes (130 countries or 67%)

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Source: WHO/IVB database, 193 WHO Member States. Data as of July 2010
Date of slide: 19 August 2010

The map represents the use of rubella vaccine in national immunization schedule in 2009. The list of Member States is available from http://www.who.int/immunization_monitoring/en/globalsummary/indicatorselect.cfm.

In all, 130 Member States report having rubella vaccine in their infant immunization schedules by the end of 2009.

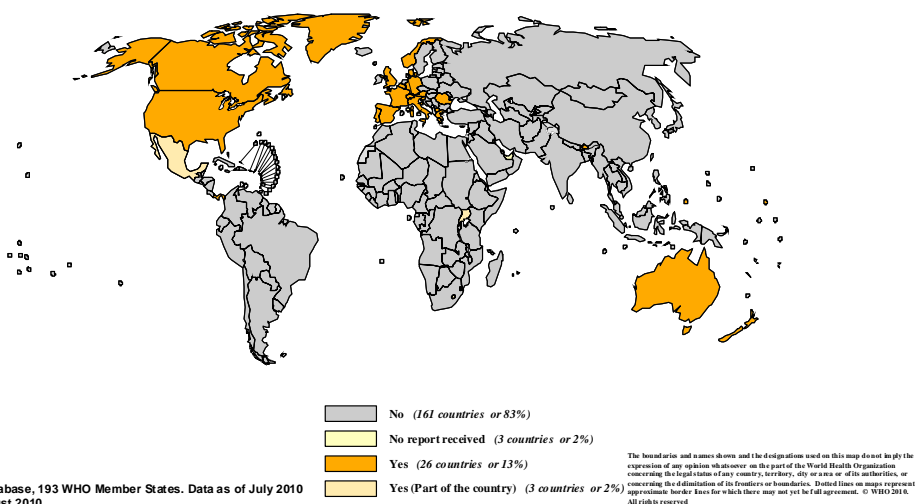
The table represents the total number of Member States in each WHO regions and globally using rubella vaccine and (%) of regional and global birth cohort in these Member States.

	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
African Region (46)	1 (0%)	1 (0%)	2 (0.1%)	2 (0.1%)	2 (0.1%)	2 (0.1%)	2 (0.1%)	2 (0.1%)	2 (0.1%)	2 (0.1%)	2 (0.1%)	2 (0.1%)
Region of the Americas (35)	2 (25%)	12 (32%)	31 (90%)	32 (93%)	32 (93%)	33 (97%)	34 (98%)	34 (98%)	34 (98%)	34 (98%)	35 (100%)	35 (100%)
Eastern Mediterranean Region (21)	1 (0.1%)	2 (0.4%)	12 (29%)	12 (30%)	12 (30%)	13 (34%)	15 (44%)	15 (43%)	15 (43%)	15 (43%)	15 (43%)	15 (43%)
European Region (53)	18 (32%)	28 (42%)	41 (69%)	43 (71%)	46 (74%)	47 (76%)	50 (84%)	50 (84%)	51 (97%)	52 (98%)	52 (98%)	53 (100%)
South-East Asia Region (11)	0 (0%)	1 (3%)	2 (3%)	2 (3%)	2 (3%)	2 (3%)	2 (3%)	2 (3%)	3 (4%)	4 (4%)	4 (4%)	4 (4%)
Western Pacific Region (27)	5 (10%)	7 (7%)	12 (10%)	12 (10%)	13 (10%)	13 (10%)	15 (10%)	16 (10%)	18 (10%)	19 (82%)	19 (82%)	21 (91%)
Global (193)	27 (9%)	51 (10%)	100 (22%)	103 (23%)	107 (23%)	110 (24%)	118 (26%)	119 (26%)	123 (27%)	126 (40%)	127 (40%)	130 (42%)

Number in parenthesis represents the number of WHO Member States in the WHO Regions and globally



Countries Using HPV Vaccine in National Immunization Schedule, 2009



Source: WHO/IVB database, 193 WHO Member States. Data as of July 2010
Date of slide: 19 August 2010

The map represents the use of HPV vaccine in national immunization schedule in 2009.

In all, 29 Member States report having HPV vaccine in their infant immunization schedules by the end of 2009. Three of these Member States have introduced the vaccine at sub-national level.

The table represents the total number of Member States in each WHO regions and at global level using HPV vaccine and (%) of 10-14 year old girls in these Member States.

	2006	2007	2008	2009
African Region (46)	0 (0%)	0 (0%)	1 (5%)	2 (5%)
Region of the Americas (35)	0 (0%)	2 (30%)	4 (44%)	4 (44%)
Eastern Mediterranean Region (21)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
European Region (53)	2 (8%)	5 (19%)	11 (29%)	17 (38%)
South-East Asia Region (11)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Western Pacific Region (27)	0 (0%)	1 (1%)	3 (1%)	5 (1%)
Global (193)	2 (1%)	8 (5%)	19 (9%)	29 (9%)

Number in parenthesis represents the number of WHO Member States in the WHO Regions and globally