

# Global burden of diphtheria in the year 2000

## 1. Introduction

Diphtheria is an infectious disease caused by the action of a toxin produced by *Corynebacterium diphtheria*. Infection with the bacterium occurs through personal contact and affects the tonsils (often characterised by a grayish membrane), the pharynx, larynx and nose, but may also manifest as cutaneous diphtheria. The bacterium releases a toxin which may act on tissues and organs, including the heart leading to myocarditis and the nervous system, leading to muscle weakness or paralysis. The case fatality (CFR) of diphtheria is thought to have changed little in the last 50 years and is estimated as approximately 10%.

## 2. Case and sequelae definitions

The case definition and sequelae used for diphtheria are given in Table 1 below.

**Table 1. Case and sequelae definitions for diphtheria**

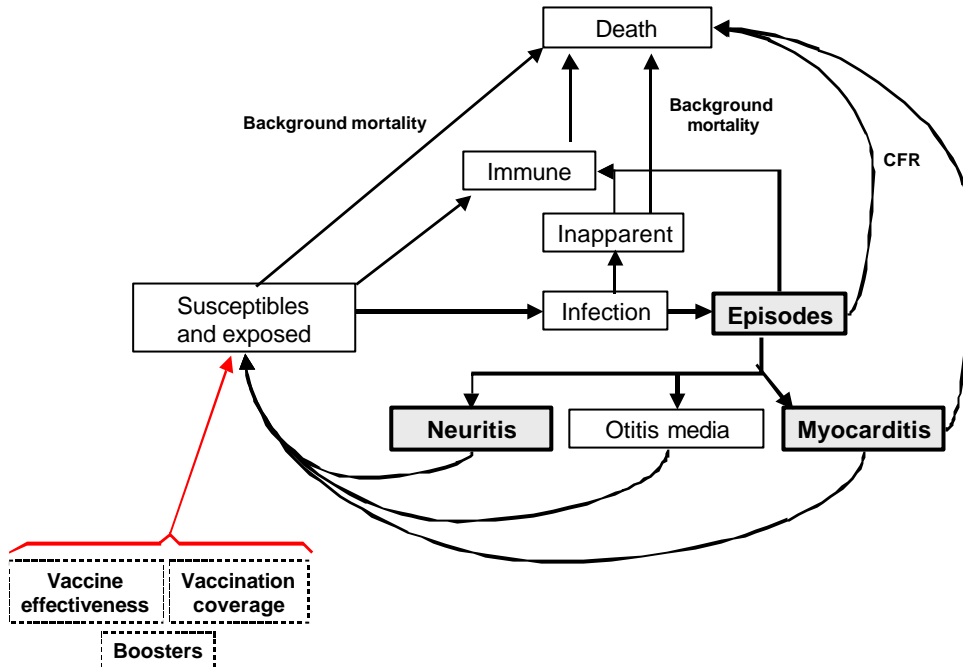
<b>Cause category</b>	<b>GBD 2000 Code</b>	<b>ICD 9 code</b>	<b>ICD 10 code</b>
Diphtheria	U014	032	A36

<b>Sequela</b>	<b>Definition</b>	<b>Alternate definitions that are useable</b>
Episode	Acute bacterial disease involving primarily tonsils, pharynx, larynx, nose and other sites, characterised by grayish plaques or membranes with surrounding tissue inflammation.	Acute disease caused by toxin-producing <i>corynebacterium diphtheriae</i>
Polyneuritis	Polyneuritis involving both cranial and peripheral nerve palsies, which are largely reversible.	
Myocarditis	Inflammation of the heart muscle leading to electrocardiographic aberrations and sometimes permanent damage with congestive heart failure, which may be fatal.	

### 3. Disease model

Years lived with disability (YLDs) were calculated for the boxes shaded in gray.



**Figure 1. Diphtheria disease model.**

**Table 2. Disease model assumptions**

Definitions	As above
Incidence/Prevalence	Incidence from country surveillance systems assuming <b>20%</b> overall reporting of incident cases. Incidence of sequelae: Neurological complications = 2% of new cases, myocarditis = 15% of new cases.
Case fatality	Age dependent: CFR overall 10%; <1 yrs = 20%; 1-4 yrs = 10%, >4 yrs = 5%
Other assumptions	Age distribution of cases: 0-4 = 60%, 5-14 = 30%, 15+ = 10%
Data	Reported cases through country surveillance from WHO Vaccine Preventable Disease Monitoring System 1999.

## 4. Disability weights and health state descriptions

Disability weights from the Global Burden of Disease 1990 study have been used (see Table 3).

**Table 3. Disability weights**

<b>Sequela/stage/severity level</b>	<b>Disability weight</b>	<b>Health state description</b>
Episode	<b>0.230-0.231 treated and untreated</b>	Acute inflammation of tonsils, pharynx, larynx, nose and occasionally other mucous membranes or skin and sometimes the conjunctivae or genitalia. The lesions are moderately sore and lymph nodes may be enlarged and tender.
Polyneuritis	<b>0.078 treated and untreated</b>	Painful inflammation of cranial or peripheral nerves, which may lead to mild muscle weakness or complete paralysis of the affected region of the nerve. It could include involvement of the ocular nerves (leading to blurred vision) and the diaphragm (leading to respiratory failure).
Myocarditis	<b>0.323 treated and untreated</b>	Painful inflammation of the heart muscle, often characterised by fever and/or heart failure. Patients present with fatigue, increased heart rate and breathlessness.

## 5. Epidemiological data

The methodology used in the GBD 1990 has been replicated here as little new information has evolved since (1,2). The method assumes that no more than 20% of diphtheria cases worldwide are reported through surveillance systems. Using this assumption, the total number of cases of diphtheria estimated in the GBD 2000 is based on the reported number of cases from the WHO Vaccine Preventable Disease Monitoring System 2000 (3) and corrected for 20% reporting efficiency.

As in the GBD 1990, the age distribution of cases was assumed to be as follows: 0-4 yrs = 60%, 5-14 yrs = 30%, 15+ yrs = 10%.

As previously, it was assumed that 2% of all incident diphtheria cases would develop neurological complications, and 15% would develop myocarditis. The overall case fatality was estimated as 10%, and the age-specific CFR was approximated as follows:

<b>Age (years)</b>	<b>CFR (%)</b>
<1	20%
1-4	10%
>4	5%

**Table 4. Data sources and assumptions - summary**

AFRO D	Reported cases through country surveillance from WHO Vaccine Preventable Disease Monitoring System 2000.
AFRO E	Reported cases through country surveillance from WHO Vaccine Preventable Disease Monitoring System 2000.
AMRO A	Reported cases through country surveillance from WHO Vaccine Preventable Disease Monitoring System 2000.
AMRO B	Reported cases through country surveillance from WHO Vaccine Preventable Disease Monitoring System 2000.
AMRO D	Reported cases through country surveillance from WHO Vaccine Preventable Disease Monitoring System 2000.
EMRO B	Reported cases through country surveillance from WHO Vaccine Preventable Disease Monitoring System 2000.
EMRO D	Reported cases through country surveillance from WHO Vaccine Preventable Disease Monitoring System 2000.
EURO A	Reported cases through country surveillance from WHO Vaccine Preventable Disease Monitoring System 2000.
EURO B1	Reported cases through country surveillance from WHO Vaccine Preventable Disease Monitoring System 2000.
EURO B2	Reported cases through country surveillance from WHO Vaccine Preventable Disease Monitoring System 2000.
EURO C	Reported cases through country surveillance from WHO Vaccine Preventable Disease Monitoring System 2000.
SEARO B	Reported cases through country surveillance from WHO Vaccine Preventable Disease Monitoring System 2000.
SEARO D	Reported cases through country surveillance from WHO Vaccine Preventable Disease Monitoring System 2000.
WPRO A	Reported cases through country surveillance from WHO Vaccine Preventable Disease Monitoring System 2000.
WPRO B1	Reported cases through country surveillance from WHO Vaccine Preventable Disease Monitoring System 2000.
WPRO B2	Reported cases through country surveillance from WHO Vaccine Preventable Disease Monitoring System 2000.
WPRO B3	Reported cases through country surveillance from WHO Vaccine Preventable Disease Monitoring System 2000.

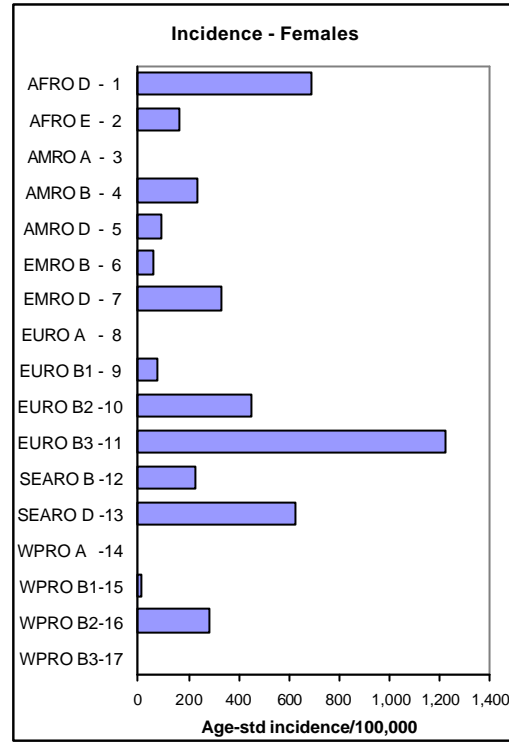
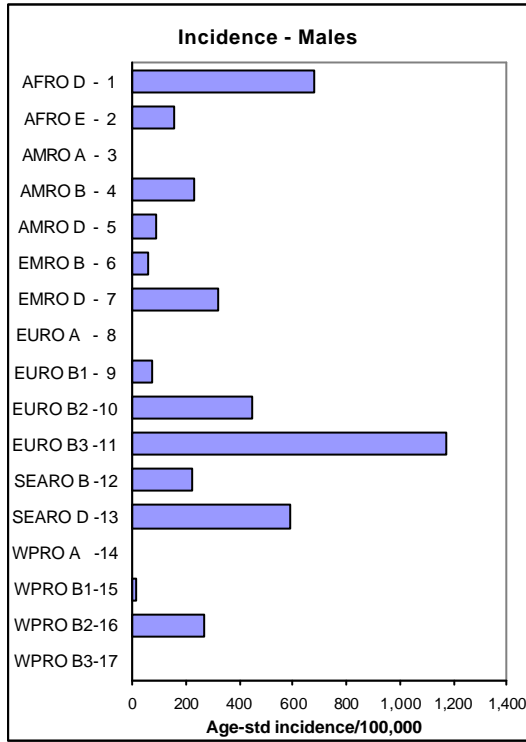
## 6. Incidence, prevalence and mortality estimates for 2000

**Table 5. Age-standardized incidence, prevalence and mortality rate estimates for diphtheria, WHO epidemiological subregions, 2000.**

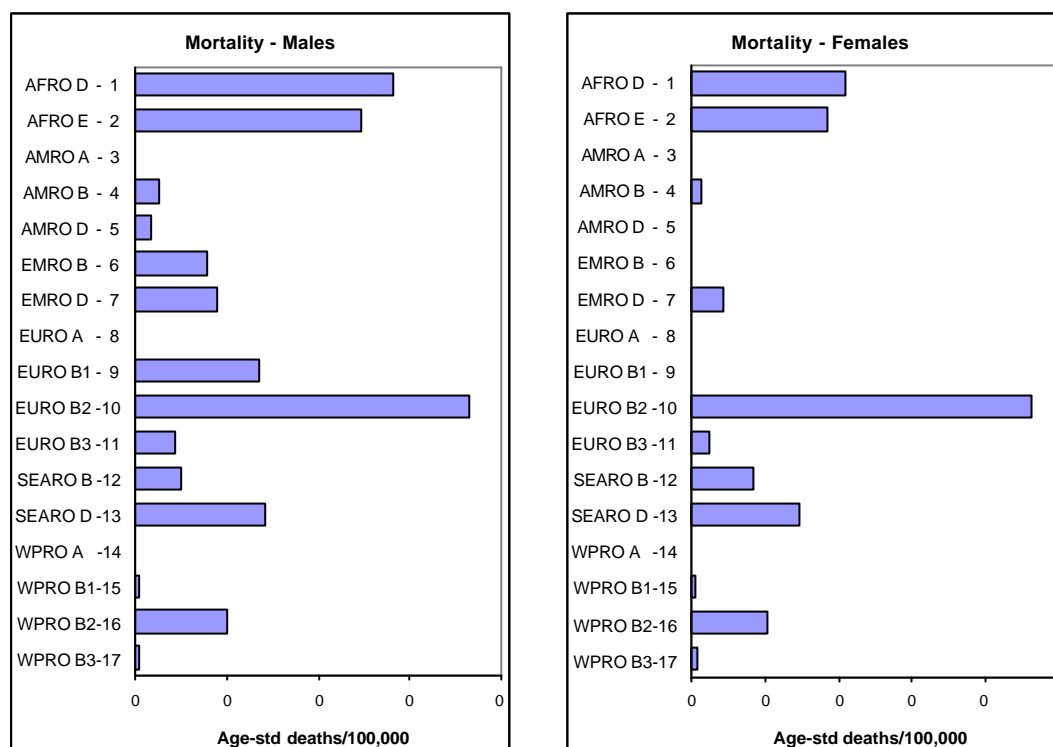
Subregion	Episodes		Neurological complications		Myocarditis	
	Age-std. incidence/100 million		Age-std. incidence/100 million		Age-std. incidence/100 million	
	Males	Females	Males	Females	Males	Females
AFRO D	677.2	688.0	7.8	7.9	101.6	103.2
AFRO E	156.7	158.4	1.8	1.8	23.5	23.8
AMRO A	0.3	0.3	0.0	0.0	0.0	<b>0.0</b>
AMRO B	225.6	234.4	2.8	2.9	33.8	35.2
AMRO D	89.1	92.4	1.1	1.1	13.4	13.9
EMRO B	57.3	59.9	0.7	0.8	8.6	9.0
EMRO D	319.7	333.9	3.8	4.0	48.0	50.1
EURO A	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
EURO B1	71.4	74.6	0.4	0.4	10.7	11.2
EURO B2	440.7	455.8	2.4	2.5	66.1	68.4
EURO C	1170.6	1221.3	7.7	8.0	175.6	183.2
SEARO B	222.8	232.1	2.7	2.9	33.4	34.8
SEARO D	589.2	625.8	7.2	7.6	88.4	93.9
WPRO A	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>

WPRO B1	9.4	10.5	0.1	0.1	1.4	1.6
WPRO B2	266.7	278.3	3.4	3.5	40.0	41.8
WPRO B3	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	2.9	<b>0.0</b>	<b>0.0</b>
<b>World</b>	<b>314.5</b>	<b>331.8</b>	<b>3.6</b>	<b>3.8</b>	<b>47.2</b>	<b>49.8</b>

- Age-standardized to World Standard Population (4).



**Figure 2. Age-standardized diphtheria episode incidence rate estimates, WHO epidemiological subregions, by sex, 2000.**



**Figure 3. Age-standardized diphtheria mortality rate estimates, WHO epidemiological subregions, by sex, 2000.**

## 7. Global burden of diphtheria in 2000

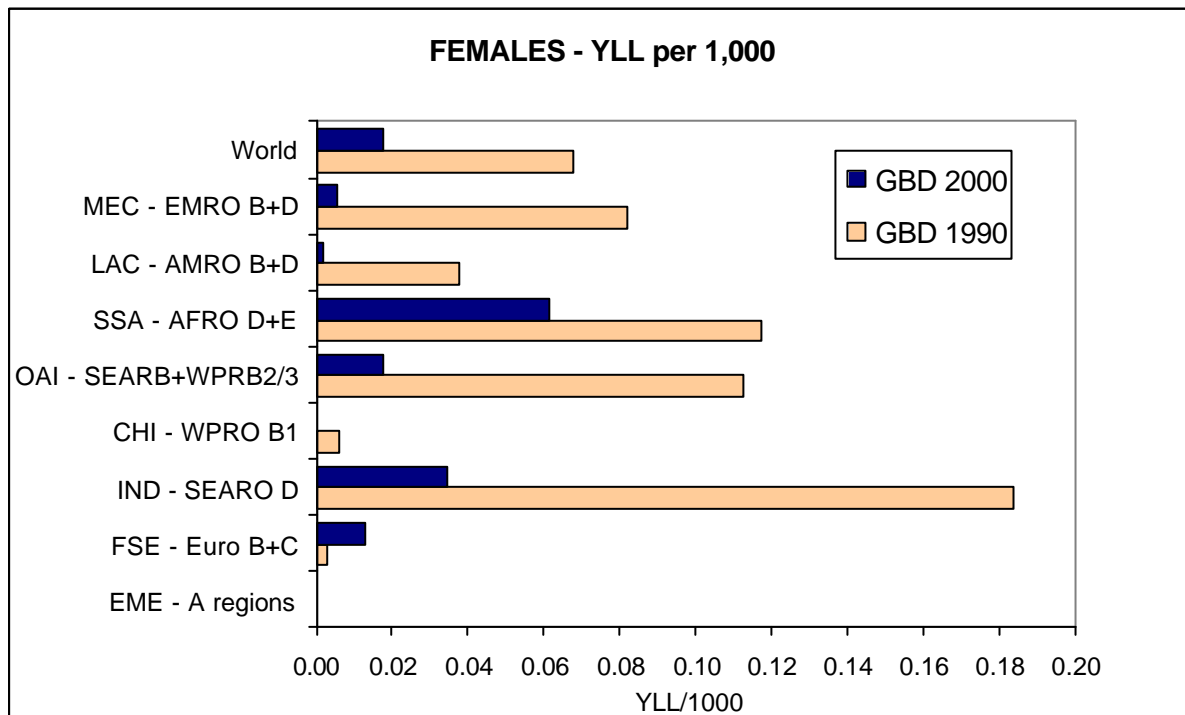
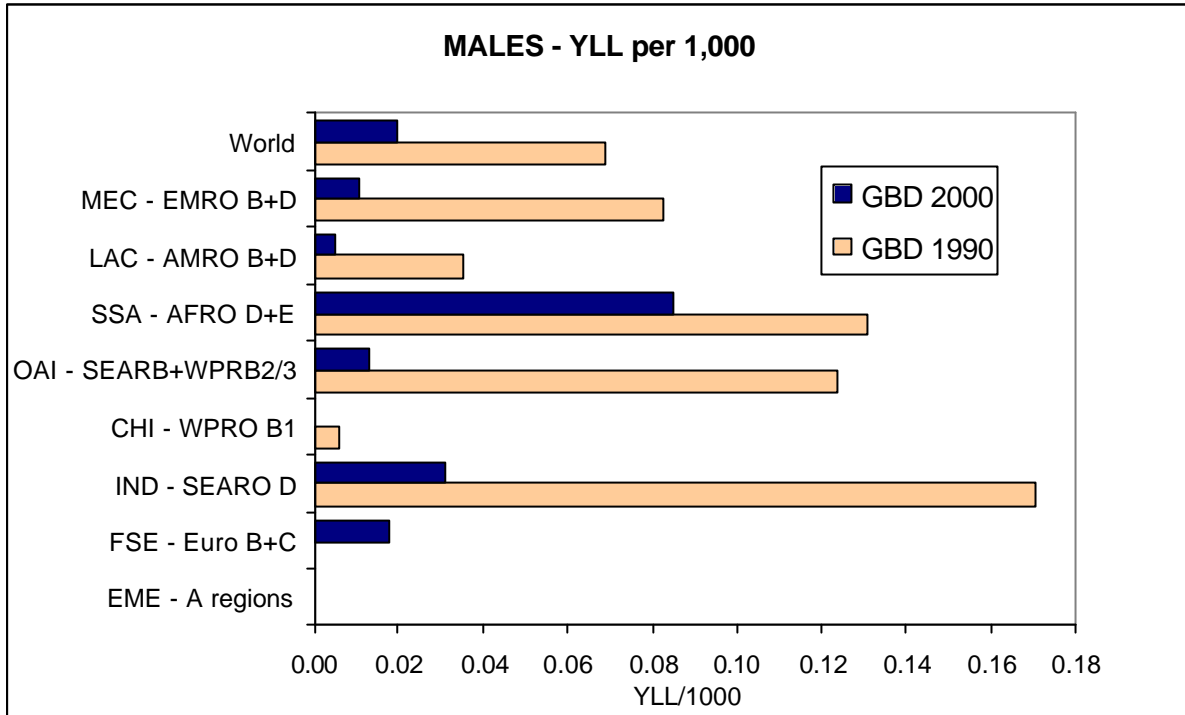
General methods used for the estimation of the global burden of disease are given elsewhere (5). The tables and graphs below summarise the global burden of diphtheria estimates for the GBD 2000 and compare them with the diphtheria estimates from the GBD 1990 (6).

**Table 6. Global total YLD, YLL and DALY estimates, 1990 and 2000.**

	<i>Males</i>	<i>Females</i>	<i>Persons</i>
<b>YLD('000)</b>			
<i>GBD1990</i>	-	-	-
<i>GBD2000</i>	0	0	0
<b>YLL('000)</b>			
<i>GBD1990</i>	183	177	360
<i>GBD2000</i>	61	53	114
<b>DALY('000)</b>			
<i>GBD1990</i>	183	177	360
<i>GBD2000</i>	61	53	114

**Table 7. YLD, YLL and DALY estimates for WHO epidemiological subregions, 2000.**

<b>Subregion</b>	<b>YLD/100,000</b>		<b>YLL/100,000</b>		<b>YLD</b>	<b>YLL</b>	<b>DALY</b>
	<b>Males</b>	<b>Females</b>	<b>Males</b>	<b>Females</b>	<b>('000)</b>	<b>('000)</b>	<b>('000)</b>
AFRO D	0.01	0.01	8.89	6.43	0	27	27
AFRO E	0.00	0.00	8.06	5.84	0	23	23
AMRO A	0.00	0.00	0.00	0.03	0	0	0
AMRO B	0.00	0.00	0.53	0.22	0	2	2
AMRO D	0.00	0.00	0.37	0.00	0	0	0
EMRO B	0.00	0.00	0.09	0.00	0	0	0
EMRO D	0.00	0.00	2.09	1.14	0	2	2
EURO A	0.00	0.00	0.00	0.00	0	0	0
EURO B1	0.00	0.00	1.81	0.00	0	1	1
EURO B2	0.01	0.01	7.34	10.52	0	5	5
EURO C	0.02	0.01	0.49	0.26	0	1	1
SEARO B	0.00	0.00	0.98	1.65	0	5	5
SEARO D	0.01	0.01	3.07	3.45	0	44	44
WPRO A	0.00	0.00	0.00	0.00	0	0	0
WPRO B1	0.00	0.00	0.05	0.06	0	1	1
WPRO B2	0.00	0.00	2.17	2.09	0	3	3
WPRO B3	0.00	0.00	0.10	0.15	0	0	0



**Figure 4. Total YLL rates, by sex, broad regions, 1990 and 2000.**

## 8. Uncertainty analysis

General methods for uncertainty analysis of estimates for the Global Burden of Disease 2000 are outlined elsewhere (7). Uncertainty analysis for diphtheria estimates has not yet been completed.

## 9. Conclusions

These are version 2 estimates for the GBD 2000. Apart from the uncertainty analysis, updating estimates to reflect revisions of mortality estimates and any new or revised epidemiological data or evidence, it is not intended to undertake any major addition revision of these estimates.

We welcome comments and criticisms of these draft estimates, and information on additional sources of data and evidence. Please contact Claudia Stein (EBD/GPE) on email [steinc@who.int](mailto:steinc@who.int).

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## 10. References

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