



**Republic of Mozambique**  
Ministry of Health  
National Institute of Health

# MOZAMBIQUE

## National Child Mortality Study 2009

### SUMMARY

In collaboration with the London School of Hygiene and Tropical Medicine and the  
United Nations Children's Fund



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## ACRONYMS

AIDS	Acquired Immunodeficiency Syndrome
ALRI	Acute lower respiratory infection (including pneumonia)
COD	Cause of death
CSMF	Cause-specific mortality fraction (the proportion of all deaths that is attributable to a specific cause)
DSS	Demographic Surveillance System
HIV	Human Immunodeficiency Virus
ICD-10	International Classification of Diseases, 10 <sup>th</sup> revision
INCAM	Inquérito Nacional sobre as Causas de Morte (National Study on the Causes of Deaths)
INE	National Institute of Statistics
INS	National Institute of Health
INSIDA	National behaviour and HIV seroprevalence survey
LSHTM	London School of Hygiene and Tropical Medicine
MICS	Multiple Indicator Cluster Survey
MOH	Ministry of Health
NCMS	National Child Mortality Study
pyrs	Person years at risk
UNICEF	United Nations Children's Fund
VA	Verbal autopsy
WHO	World Health Organization
WHOSIS	WHO Statistical Information System

## 1 INTRODUCTION

This report summarises the key findings of the National Child Mortality Study, which aims to measure neonatal, infant and under-five mortality rates in Mozambique for all programme-relevant causes using data collected at community level. More detailed analysis can be found in the main report.

Some 10 million children<sup>[1]</sup> die each year mostly in poor countries and from preventable causes. Of these, four million die in the first four weeks of life.<sup>[2]</sup> A better understanding of who these children are and what causes their deaths is essential to improve approaches for child survival interventions.

In a widely circulated study published by Black, Morris, and Bryce in 2000<sup>[1]</sup>, Mozambique was estimated to have the 12<sup>th</sup> highest under-five mortality rate in the world, ranking 13<sup>th</sup> for the number of under-five deaths. A more recent estimate from the Interagency Coordination Group for Child Mortality Estimation, used in the World Health Organization (WHO) and UNICEF publications<sup>[3]</sup> places Mozambique in the 14<sup>th</sup> position in 2007 with an under-five mortality rate of 168 and infant mortality rate of 115 per 1000 live births. UNICEF's *State of the World's Children 2009* quotes a neonatal mortality rate of 35 per 1000 live births in 2004 for Mozambique<sup>[3]</sup>.

## 2 METHODS

This study used verbal autopsy (VA) as the main method for data collection. Verbal autopsy refers to the interviewing of family members or caregivers about the circumstances of the death of a child.<sup>[4]</sup> The VA method developed by King and Lu is the most updated method available with respect to data-derived VA approaches to assign the cause of death (COD)<sup>[5]</sup>.

Starting from a reference set of cases for which the cause of death is 'known' (usually hospital cases), a computer-based programme analyses the statistical relationship between the symptom profiles as captured in the verbal autopsies and the causes of death. It then applies these observed patterns to the full set of community cases for which verbal autopsies have been obtained but the cause of death is unknown. The proportion of deaths attributable to each cause (i.e. the cause-specific mortality fractions) is then estimated for the whole set of cases, but not at individual level.

This study encompassed all under-five deaths identified through the INCAM (National Study on the Causes of Death), which itself captured deaths of all ages in a representative sample of 388 clusters of about 2000 inhabitants from all 11 provinces of Mozambique.<sup>[6]</sup> The identification of all households with child deaths in the one-year period from 1 August 2006 to 31 July 2007 was made during the 2007 general census of the population. The INCAM identified about 10,000 deaths, of which ~4500 were children under five years of age.

The retrospective period of 12 months ensured that the seasonality of some of the COD is adequately taken into account.

In addition to these, the study made use of nearly 500 children under five years of age who died in rural and urban hospitals as reference cases. These cases were reviewed by physicians who used all available information not only from the VA but also from the medical records of the child to attribute the COD.

### 3 ALL-CAUSE UNDER-FIVE MORTALITY RATES

The major source of information for all-cause mortality rates in this report is the Multiple Indicator Cluster Survey (MICS) conducted by the National Institute of Statistics (INE) with the support of UNICEF and the Ministry of Health in 2008. *Table 1* shows the estimated national crude mortality rates for the three most recent five-year periods before the time of the survey while *Table 2* presents disaggregated information for the most recent 10-year period. National results are reported on a graph (*Figure 1*) showing the trends in mortality rates since 1950. The MICS 2008 figures are generally consistent with previous survey estimates, in particular those of the DHS 2003, and point at a continuous downward trend in mortality. The under-five mortality estimate for the most recent five-year period (138) is markedly lower than the one produced by the Inter-agency Coordination Group for Child Mortality Estimate (175 for the year 2005, data not shown).<sup>[7]</sup>

**Table 1: Direct crude mortality estimates from the MICS, for the three most recent 5-year periods, Mozambique**

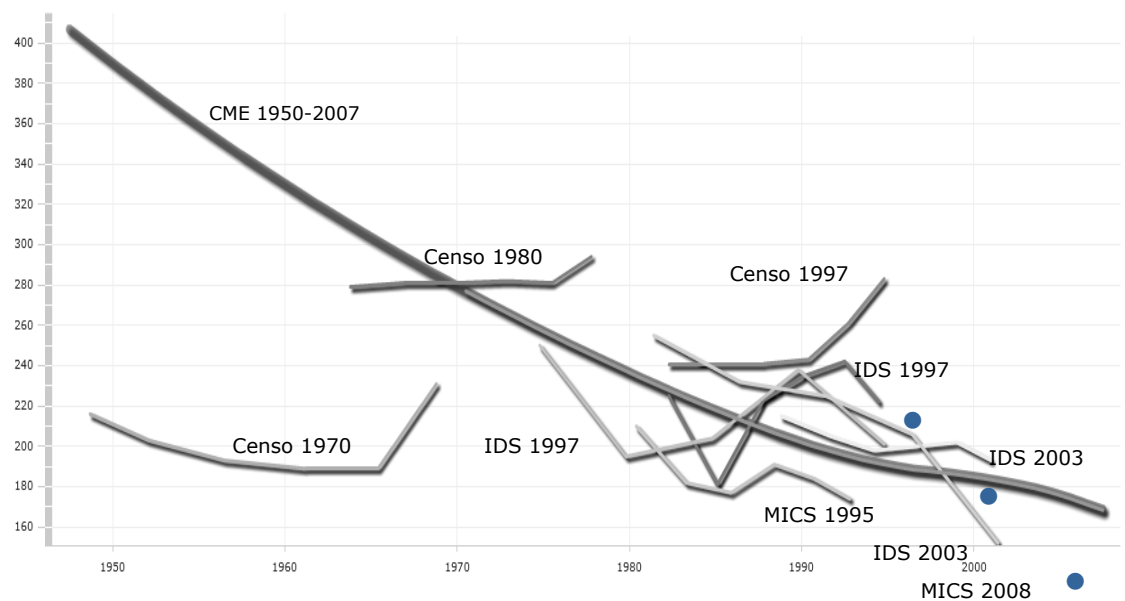
Period of analysis: years before survey	Neonatal mortality	Post neonatal mortality	Infant mortality (1q0)	Child mortality (4q1)	Under-5 mortality (5q0)
	/1000lb*	/1000lb	/1000lb	/1000	/1000lb
0-4 years	37.2	55.9	93.1	50.0	138.4
5-9 years	46.5	72.7	119.2	60.7	172.7
10-14 years	50.5	85.1	135.5	88.7	212.2

\* Per 1000 live births.

**Table 2: Direct crude mortality estimates from the MICS, for the most recent 10-year period, by population of interest**

Period of analysis: most recent 10-year period before the survey	Neonatal mortality	Post neonatal mortality	Infant mortality ( $1q_0$ )	Child mortality ( $4q_1$ )	Under-5 mortality ( $5q_0$ )
	/1000lb*	/1000lb	/1000lb	/1000	/1000lb
Mozambique	41.6	63.7	105.3	54.7	154.2
Urban	38.5	53.9	92.4	46.6	134.7
Rural	42.8	67.5	110.2	58.0	161.8
Male	44.4	64.3	108.7	54.6	157.3
Female	37.4	62.7	100.1	54.3	148.9
Niassa	41.2	56.2	97.4	28.2	122.9
Cabo Delgado	51.2	80.5	131.7	55.2	179.6
Nampula	41.0	63.9	104.9	38.8	139.6
Zambézia	60.1	87.0	147.1	68.0	205.2
Tete	40.9	66.6	107.5	74.9	174.4
Manica	26.9	66.6	93.4	66.4	153.6
Sofala	29.3	46.9	76.2	58.6	130.3
Inhambane	34.6	40.5	75.1	45.2	116.9
Gaza	36.6	61.2	97.8	74.4	164.9
Maputo Province	30.7	36.7	67.3	37.7	102.5
Maputo City	26.1	40.5	66.6	44.3	108.0

\* Per 1000 live births.

**Figure 1: Trends in crude under-5 mortality rates in Mozambique including MICS 2008 results**

Source: Devinfo[7] and MICS 2008. (d)= estimates using the direct method, (i)= estimates using the indirect method.

## 4 CAUSE-SPECIFIC UNDER-FIVE MORTALITY FRACTIONS

The King-Lu verbal autopsy method was used to estimate the cause-specific mortality fractions (CSMF) of major COD in children under five years of age using the 474 reference cases collected during this study and the 3,861 verbal autopsy cases of under-five deaths of the INCAM. Results are presented in *Table 3*.

**Table 3: Cause-specific mortality fractions by main categories of causes of death, for various age groups; Mozambique, overall**

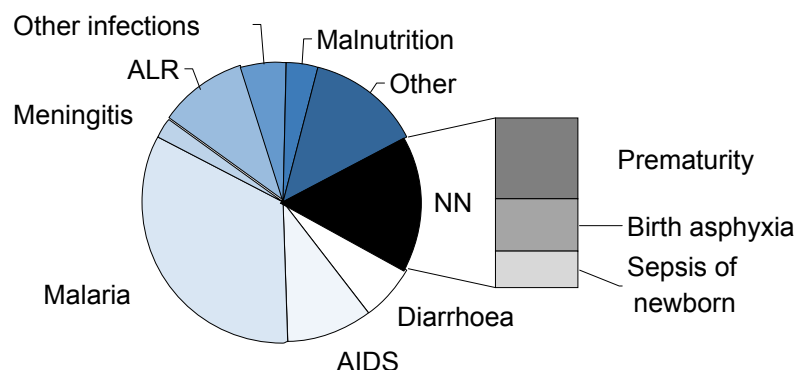
Cause of death	Percentage of deaths*				
	neonatal	post-neonatal	infant	child (1-4y)	under five
<i>n</i>	718	1425	2143	1718	3861
Gastro-intestinal infectious diseases	N/A*	9.1	5.9	7.9	6.7
HIV/AIDS	1.4	10.5	7.2	13.1	9.8
Malaria	4.8	33.3	23.1	46.2	33.2
Meningitis	N/A	3.4	2.2	2.4	2.3
Acute lower respiratory infections	2.2	19.2	13.1	6.3	10.1
Other infectious diseases	3.9	10.0	7.8	2.0	5.3
Malnutrition	N/A	2.8	1.8	6.4	3.8
Prematurity	34.9	1.6	13.6	0	7.6
Birth asphyxia	24.3	N/A	8.8	0	4.9
Sepsis of newborn	16.7	N/A	6.0	0	3.4
Other causes	11.9	10.0	10.7	15.7	12.9

\* The infant and under-five mortality fractions are based on a proportion of neonatal to infant deaths of 36.0%, and of infant to under-five deaths of 56.2%. N/A=not available (due to absence of neonatal or post-neonatal cases in the reference set).

For the neonatal period, research indicates the three major causes of death are: prematurity (35%), birth asphyxia (24%) and sepsis of the newborn (17%), accounting in total for 76% of the mortality in this age group. The remaining deaths are caused by infectious diseases (12%) and other non-infectious causes (12%).

In the post-neonatal period, the main cause of death is malaria (33%), followed by acute lower respiratory infection (ALRI) (19%), AIDS (11%), diarrhoeal diseases (10%), meningitis (3%) and other infectious diseases (10%). Non-infectious diseases account for 14% of deaths.

For one to four-year-old children, malaria accounts for nearly half (46%) of the deaths. Other causes are AIDS (13%), diarrhoeal diseases (8%), ALRI and malnutrition (6% each), other infectious diseases (4%, including meningitis) and 16% for other non-infectious diseases. The fact that over 80% of deaths in the post-neonatal and one to four-year old age groups are of an infectious nature underlines the imminent preventability of most of the deaths in this age group.

**Figure 2: Distribution of the main causes of death in children under five years of age**

\* See text for details (NN= neonatal causes).

Table 4 shows a summary of key findings from the detailed results presented above for four main causes of death in under-fives: diarrhoea (gastro-intestinal infectious diseases), AIDS, malaria and ALRI (acute lower respiratory infections). The highest proportions of deaths from diarrhoeal diseases are found in Inhambane (12%) and Cabo Delgado (11%). AIDS deaths are in somehow higher proportions in urban (11%) than rural (9%) areas, with Maputo Province (18%) and Gaza (16%) showing the highest mortality fractions. With respect to malaria, the rural areas show, as expected, highest proportions of death (34%). Malaria accounts for over a quarter of under-five deaths in all provinces except for Maputo Province and Maputo City (both 18%). Finally, ALRI represent 13% to 14% of under-five deaths in the four provinces of Zambézia, Tete, Manica and Cabo Delgado.

**Table 4: Summary distribution of proportion of deaths in children under five years of age for four main causes, by area of residence**

Population groups	Proportion of under-5 deaths attributed to			
	Diarrhoea	AIDS	Malaria	ALRI
Urban	6.2	11.1	29.8	10.3
Rural	6.8	9.2	34.0	10.1
Niassa	6.9	12.1	30.1	10.5
Cabo Delgado	10.7	6.0	30.0	12.5
Nampula	8.0	9.5	33.8	8.1
Zambézia	8.2	11.5	27.7	13.7
Tete	8.2	9.2	27.7	13.7
Manica	9.0	11.2	29.9	12.6
Sofala	8.9	9.9	32.9	10.9
Inhambane	12.4	8.3	33.1	9.0
Gaza	7.7	16.2	26.8	9.3
Maputo Province	6.3	17.5	17.8	11.0
Maputo City	5.9	11.0	18.0	10.8

## 5 CAUSE-SPECIFIC UNDER-FIVE MORTALITY RATES

Comparing mortality statistics on the basis of mortality fractions is problematic and can easily lead to errors of judgement. Any change in the mortality fraction of one pathological entity automatically has repercussions on the mortality fractions of all other pathologies. It is consequently important for comparison and monitoring purpose to transform the cause-specific mortality fractions into cause-specific mortality rates (CSMR). The results presented below have been arrived at by combining the crude mortality rates estimated through the MICS with the CSMF estimated through the King-Lu method.

**Table 5: Cause-specific mortality rates by main categories of causes of death, for various age groups; Mozambique, overall (most recent 10-year period)**

Cause of death	Cause-specific mortality rates per 10,000 live births Most recent 10-year period				
	Neonatal mortality	Post neonatal mortality	Infant mortality (1q0)	Child mortality (4q1)	Under-5 mortality (5q0)
<i>n</i>	718	1425	2143	1718	3861
Gastro-intestinal infectious diseases	N/A*	58	62	43	104
HIV/AIDS	6	67	76	72	151
Malaria	20	212	243	253	512
Meningitis	N/A	22	23	13	35
Acute lower respiratory infections	9	122	138	35	156
Other infectious diseases	16	64	82	11	81
Malnutrition	N/A	18	19	35	59
Prematurity	145	10	143	0	118
Birth asphyxia	101	N/A	92	0	76
Sepsis of newborn	69	N/A	63	0	52
Other causes	49	64	112	86	198

\*N/A=not available (due to absence of neonatal cases in the reference set).

The overall mortality rates, as shown in *Table 5*, are in accordance with the observations made when presenting mortality fractions in section 4. However, the disaggregated mortality rates by sex, area and province are particularly interesting to observe since each cause-specific mortality fraction has been transformed into a cause-specific mortality rate by multiplying it against the estimated crude mortality rate for its own sub-population of interest. In other words, the cause-specific mortality rates of Niassa, for example, were estimated on the basis of the crude mortality rates of that province, which are quite different from those of Zambézia. Obviously, this can (and often does) change the relationship that had been observed between the areas and provinces on the basis of the mortality fractions alone.

**Table 6: Summary distribution of cause-specific mortality rates in children under five years of age for four main causes, by area of residence.**

Population groups	Mortality rates per 10,000 pyrs*			
	Diarrhoea	AIDS	Malaria	ALRI
Urban	84	150	401	138
Rural	110	149	551	163
Niassa	85	149	370	129
Cabo Delgado	192	107	539	225
Nampula	111	132	473	113
Zambézia	169	237	569	282
Tete	144	161	482	238
Manica	138	172	460	193
Sofala	116	129	429	142
Inhambane	146	97	387	105
Gaza	128	268	442	153
Maputo Province	65	179	182	113
Maputo City	64	119	194	117

\*pyrs: person-years at risk

Table 6 provides a summary by geographical area for the four principal causes of death in children under five years of age. Not unexpectedly, the rural areas have the highest mortality rates for diarrhoeal diseases (110 per 10,000 pyrs), malaria (551) and ALRI (163), while mortality rates for AIDS are similar at around 150 per 10,000 pyrs in both rural and urban areas. At provincial level, Cabo Delgado has the highest mortality rate for diarrhoeal diseases (192), followed by Zambézia (169). Note that this is quite different from the analysis that could be done on the basis of the CSMF alone for which Inhambane came first (12%), followed by Cabo Delgado (10%), Manica (9%), Sofala (9%) and then only Zambézia (8%). This is because Zambézia and Cabo Delgado have the highest mortality rates in the country.

With respect to HIV and AIDS, we find the highest under-five mortality rates in Gaza (268), followed by Zambézia (237). For malaria, mortality rates are highest in Zambézia (569) and Cabo Delgado (539). Finally, for ALRI, the highest rates can be found once again in Zambézia (282), Tete (238) and Cabo Delgado (225).

It is worth noting that Zambézia has high mortality rates in all four pathology groups and Cabo Delgado in three of those, indicating a need to concentrate efforts in these two provinces.

## 6 COMPARISON WITH OTHER STUDIES

Table 7 compares under-five mortality fractions estimated in the NCMS study through the King-Lu method, by the INCAM through medical review of verbal autopsies, by the Manhiça Demographic Surveillance System (DSS) for the period 1997-2006, and by statistical modelling as published by WHO in its Statistics Information System (WHOSIS) for the period 2000-2003.<sup>[8]</sup>

With respect to under-five mortality, the first element of note in *Table 7* is that the results from the Manhiça DSS compare well with those of the NCMS – better in fact than with those of either the INCAM or the WHOSIS.

The population under the Manhiça DSS has been regarded as presenting characteristics typical of southern rural Mozambique. Further, with a couple of exceptions, the results of the NCMS also compare reasonably well with those of the INCAM. They are, however, very different from the WHO estimates with the single exception of HIV and AIDS where all four estimates are similar. WHO estimates are notably higher than the three other studies for diarrhoeal diseases, acute lower respiratory infections and neonatal causes, while they are markedly lower for malaria and ‘other causes’. It is rather surprising that WHO indicates that only 1% of under-five deaths are outside its pre-defined categories, while for the NCMS they add-up to 24%, for the INCAM to 20% and for the Manhiça DSS to 24%. While part of the disagreement is likely to be related to variations in the definitions of the categories, this cannot completely explain such large differences and it seems indeed more than likely that the WHO value of 1% is greatly underestimated.

**Table 7: Comparison of under-five mortality fractions between the NCMS, the INCAM, the Manhiça DSS and the WHO SIS**

VA code	Under-five mortality fractions			
	NCMS	INCAM	Manhiça <sup>1</sup>	WHOSIS <sup>2</sup>
Prematurity	8	3	19 <sup>(3)</sup>	29
Birth asphyxia	5	2		
Bacterial sepsis of newborn	3	8		
Intestinal infectious diseases	7	6	10	17
HIV/AIDS	10	13	10	13
Malaria	33	42	25	19
Acute lower respiratory infections	10	7	12	21
Meningitis	2	2	4	1
Other infectious/parasitic diseases	5	3	4	
Severe malnutrition	4	2	8	
Other causes of death	13	13	8	

<sup>1</sup>Manhiça= Manhiça Demographic Surveillance System for the period 1997-2006 (derived results). <sup>2</sup>WHOSIS= WHO statistical information system for the period 2000-2003. <sup>3</sup>This value of 19% includes all neonatal deaths.

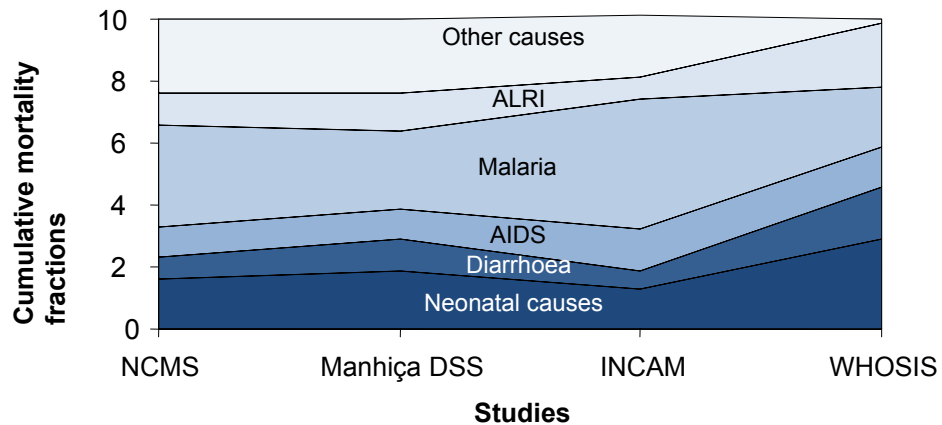
**Table 8: Comparison of neonatal mortality fractions between the NCMS, the INCAM and the WHO statistical information system**

VA code	Neonatal mortality fractions		
	NCMS	INCAM	WHOSIS*
Intestinal infectious diseases	N/A	2	4
HIV/AIDS	1	1	38
Malaria	5	8	
Meningitis	N/A	1	
Acute lower respiratory infections	2	4	
Bacterial sepsis of newborn	17	35	
Other infectious/parasitic diseases	4	1	10 (tetanus)
Prematurity	35	13	19
Birth asphyxia	24	10	19
Other causes of death	12	26	10

\* WHOSIS: WHO statistical information system for the year 2000.

With respect to neonatal mortality, the WHO estimates are approximately mid-way between the NCMS and the INCAM results with regard to severe infections and birth asphyxia. For prematurity, the WHO estimates are also between the NCMS and INCAM results but closer to the latter, while for ‘other causes’ the WHO estimate is close to the NCMS result. The 10% estimate of WHO for the proportion of neonatal deaths from neonatal tetanus appears to be grossly over-estimated, even for the year 2000. The INCAM identified only two cases of neonatal tetanus in its sample of 718 neonatal deaths, and the health information system of the Ministry of Health recorded a total of only 21 such cases (of which 13 deaths) in the paediatric wards countrywide between the years 2000 and 2006.<sup>[10]</sup>

**Figure 3: Cumulative mortality fractions among under-fives by studies\***



\* See text for details.

We lack certainty about which of the four above studies have values closer to reality. Only further studies can help us arrive at a consensus on the most realistic figures.

One should remember, however, that beside the differences in the periods covered by the statistics—2006-2007 for the NCMS and the INCAM, 2000-2003 for the WHOSIS, and 1997-2006 for the Manhiça DSS—the sources of information are also very different. In the case of the NCMS and the INCAM, the information is based on verbal autopsies from a representative sample of deaths identified at community level. The Manhiça DSS, on the other hand, while also relying on verbal autopsies, bases its results on a nearly complete record of deaths in a single district thought to be representative of southern rural Mozambique, while the WHO statistical information system presents model based estimates. This comparison exercise reaffirms the need for more population-based mortality studies to validate and/or challenge the models currently being used.

In the absence of a national death registration system that collects reliable and comprehensive mortality data, only a series of well implemented nationally representative studies can help solve the dilemma.

## 7 CONCLUSIONS AND RECOMMENDATIONS

### 7.1 Conclusions

- a. The study confirms malaria as the primary cause of child mortality in the country, responsible for about one third of deaths in children under five years of age.
- b. The specific neonatal causes (birth asphyxia, sepsis of the newborn and prematurity) are the secondary cause, contributing approximately 16% of the under-five deaths.
- c. Acute lower respiratory infections and AIDS, each contributing about 10% of the child deaths, followed by intestinal infectious diseases responsible for about 7%.
- d. The King-Lu method has shown to be useful for attributing cause-specific mortality fractions.

### 7.2 Recommendations

- a. The country should pursue and intensify its efforts to reduce the incidence as well as the fatality rate of malaria, increasing the proportion of children sleeping under an insecticide treated net (currently 23%)—and reinforcing, where appropriate, its pulverisation programme—as well as increasing the percentage of cases treated with anti-malarial drugs within 24 hours of onset of symptoms (currently 23%).
- b. The country should pursue and intensify its efforts to reduce neonatal mortality, increasing the proportion of deliveries assisted by health professionals (currently 55%), as well as its capacity for obstetrical intervention and timely referral of deliveries requiring specialised assistance.
- c. There is a need to increase the proportion of suspected pneumonias cases that procure health services (currently 65%) and receive antibiotic treatment (currently 22%).
- d. It is also necessary to increase the percentage of pregnant women that receive information on HIV and AIDS (currently 60%) and are tested (currently 29%) during their prenatal consultations, and of sero-positive women and babies that receive adequate treatment for the prevention of vertical transmission.

- e. Although statistics point at significant advances in the reduction of deaths from diarrhoeal diseases, the level of use of oral rehydration therapy (currently 54%) needs to be increased, and the knowledge of care-takers improved in order to reduce further mortality from this eminently preventable cause of death.
- f. Special efforts must be concentrated in the provinces of Zambézia and Cabo Delgado as they show high mortality rates for several of the most important causes of death in under-fives.
- g. It is recommended that experimentation with and development of the verbal autopsy method used in this study be pursued. It would be advantageous that the present set of reference cases be made available to others studies in this and other countries and, if possible, be amplified in order to obtain more precise and reliable estimates.

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