

MORTALITY IN THE DEMOCRATIC REPUBLIC OF CONGO

AN ONGOING CRISIS



photo: Marcus Bleasdale/VII.



INTERNATIONAL
RESCUE
COMMITTEE

75 YEARS FROM
HARM TO HOME



Burnet Institute
Incorporating
Austin Research Institute
Joining together for a healthier world

Reported by

Dr. Benjamin Coghlan
Burnet Institute, Melbourne, Australia

Dr. Pascal Ngoy
International Rescue Committee,
Kinshasa, DR Congo

Flavien Mulumba
International Rescue Committee,
Kinshasa, DR Congo

Colleen Hardy
International Rescue Committee,
New York, USA

Dr. Valerie Nkamgang Bemo
International Rescue Committee,
Abidjan, Ivory Coast

Dr. Tony Stewart
Burnet Institute, Melbourne, Australia

Jennifer Lewis
Burnet Institute, Melbourne, Australia

Dr. Richard Brennan
International Rescue Committee,
New York, USA

TABLE OF CONTENTS

Table of Contents	i
Executive Summary	ii
Acronyms and Abbreviations	iv
Introduction	1
Methods	2
Results	7
Discussion	14
Conclusion	18
Acknowledgements	19
References	20

List of Tables and Figures

Table 1	Summary of key equations	4
Table 2	Mortality rates for each stratum and subdivision of DR Congo over time	9
Table 3	Deaths in <i>East</i> and <i>West</i> DR Congo by age and sex	10
Table 4	Comparison of 2006–07 survey findings for individual health zones with IRC surveys from previous years	11
Table 5	CMRs and U5MRs for individual health zones, 2006–07	12
Figure 1	Stratification of DR Congo for the 2007 survey	5
Figure 2	Location of health zones selected for 2007 survey	6
Figure 3	Trends in excess deaths, CMRs and deaths from violence in DR Congo, 1998–2007	13

EXECUTIVE SUMMARY

The Democratic Republic of Congo (DR Congo) has been mired in conflict for over a decade, with devastating effects on its civilian population. The most recent war of 1998–2002 was characterized by mass displacement, collapse of health systems and food shortages, all contributing to major elevations of mortality. Although a formal peace accord was signed in December 2002, the war has since given way to several smaller conflicts in the five eastern provinces that have continued to exact an enormous toll on the lives and livelihoods of local populations.

Since 2000, the International Rescue Committee (IRC) has documented the humanitarian impact of war and conflict in DR Congo through a series of five mortality surveys. The first four studies, conducted between 2000 and 2004, estimated that 3.9 million people had died since 1998, arguably making DR Congo the world's deadliest crisis since World War II. Less than 10 percent of all deaths were due to violence, with most attributed to easily preventable and treatable conditions such as malaria, diarrhea, pneumonia and malnutrition.

Recent political developments together with improvements in security and humanitarian funding have raised hope that DR Congo could emerge from years of crisis. A number of international agencies have expressed optimism that such progress would yield an early humanitarian dividend. But DR Congo faces many challenges on its road to recovery and development.

This fifth and latest survey, covering the period from January 2006 to April 2007, aims to evaluate the current humanitarian situation in DR Congo by providing an update on mortality. Investigators used a three-stage cluster sampling technique to survey 14,000 households in 35 health zones across all 11 provinces, resulting in wider geographic coverage than any of the previous IRC surveys.

The key findings and conclusions are:

1. Elevated mortality rates persist across DR Congo.

More than four years after the signing of a formal peace agreement, the DR Congo's national crude mortality rate (CMR) of 2.2 deaths per 1,000 per month is 57 percent higher than the average rate for sub-Saharan Africa. This rate is unchanged since the previous IRC survey in 2004. These findings indicate that DR Congo remains in the midst of a major humanitarian crisis. As with previous surveys, mortality rates are significantly higher in the volatile eastern provinces than in the west of the country. In addition, mortality rates have risen significantly in the center of DR Congo (a region referred to as *Transition East* in the attached survey). Based on the results of the five IRC studies, we now estimate that 5.4 million excess deaths have occurred between August 1998 and April 2007. An estimated 2.1 million of those deaths have occurred since the formal end of war in 2002.



2. Modest, yet statistically significant improvements in mortality were documented in the eastern provinces.

For the period covered by the survey, the only region to record a significant reduction in mortality since 2004 was that encompassing the five eastern provinces (referred to as *East 2002* in the attached report). This improvement coincided with a reduction in the risk of violent death, as well as a more robust U.N. peacekeeping effort by MONUC, the international force in DR Congo. Nonetheless, the CMR in this region is still 2.6 deaths per 1,000 per month, a rate that is 85 percent higher than the sub-Saharan average. Ironically, it is these slight but notable improvements that are now being threatened by the current escalation of violence in North Kivu province.

3. Most deaths are due to preventable and treatable conditions.

While insecurity persists in the eastern provinces, only 0.4 percent of all deaths across DR Congo were attributed directly to violence. As with previous IRC studies in DR Congo, the majority of deaths have been due to infectious diseases, malnutrition and neonatal- and pregnancy-related conditions. Increased rates of disease are likely related to the social and economic disturbances caused by conflict, including disruption of health services, poor food security, deterioration of infrastructure and population displacement. Children, who are particularly susceptible to these easily preventable and treatable conditions, accounted for 47 percent of deaths, even though they constituted only 19 percent of the total population.

4. Recovery from conflict is a slow and protracted process.

The persistent elevation of mortality more than four years after the official end of the 1998–2002 war provides further evidence that recovery from conflict can take many years, especially when superimposed on decades of political and socioeconomic decline. These data are consistent with those from other conflict-impacted states. Sustained and measurable improvements in key indicators such as mortality will require committed national and international engagement for many years.

The IRC survey overlaps only partially with the period since December 2006, during which there has been an escalation of violence in North Kivu province, resulting in the displacement of more than 400,000 persons. Recent political and humanitarian gains are in jeopardy and further escalation of the conflict could potentially destabilize the region beyond DR Congo's own borders. Steadfast international commitment to secure recent gains, prevent further deterioration and scale up assistance to other regions of the country is as necessary now in DR Congo as at any other recent period.

ACRONYMS AND ABBREVIATIONS

CI	Confidence interval
CMR	Crude mortality rate
deff	Design effect
DR Congo	Democratic Republic of Congo
ICC	Intra-class correlation
IRC	International Rescue Committee
MOH	Ministry of Health
MONUC	Mission des Nations Unies en République Démocratique du Congo (United Nations Mission in the Democratic republic of Congo)
U5MR	Under-5 mortality rate
WHO/EPI	World Health Organization Expanded Program on Immunization



INTRODUCTION

The persisting humanitarian crisis in the Democratic Republic of Congo (DR Congo) is among the most complex, deadly and prolonged ever documented. The wars of 1996 and 1998 resulted in massive disruption to the social, political and economic fabric of the country. The second war officially ended in December 2002 but has since given way to several smaller conflicts in the five eastern provinces that continue to exact an enormous toll on the lives and livelihoods of the Congolese people.

Between 2000 and 2004, the International Rescue Committee (IRC) conducted a series of four mortality surveys to evaluate the humanitarian impact of conflict in DR Congo.^{1,2,3,4,5} The first two surveys (2000 and 2001) were confined to the five eastern provinces; the latter two (2002 and 2004) were nationwide, covering all 11 provinces. In aggregate, these studies estimated that 3.9 million excess deaths had occurred between 1998 and 2004, arguably making DR Congo the deadliest humanitarian crisis since World War II. Less than 10 percent of deaths were directly attributable to violence. The vast majority of Congolese died from the indirect public health effects of conflict, including higher rates of infectious diseases, increased prevalence of malnutrition and complications arising from neonatal- and pregnancy-related conditions.

The most recent survey in 2004 found a national crude mortality rate (CMR) of 2.1 deaths per 1,000 population per month—a rate 40 percent above the accepted baseline rate for sub-Saharan Africa at that time (1.5).⁶ Mortality was again highest in the volatile eastern provinces, where the CMR averaged an alarming 2.9 deaths per 1,000 population per month.

Recent progress on political, security and humanitarian fronts has offered hope that DR Congo may eventually break free of its unremitting cycle of conflict and crisis. DR Congo's first democratically elected president took power in a relatively peaceful transition in January 2007 following successful nationwide elections. A more forceful international peacekeeping force has led to fewer major clashes among the disparate armed forces and militias. And significant increases in humanitarian funding have provided relief agencies with more scope to respond to the enormous needs.

In spite of these encouraging developments, DR Congo still faces formidable challenges on its road to recovery and development. To evaluate the prevailing humanitarian situation, IRC conducted a nationwide mortality survey between May and July 2007. The specific aims of the study were to estimate national and regional mortality rates; to evaluate mortality trends through comparisons with recent historical data; and to estimate the number of deaths in excess of the sub-Saharan baseline occurring throughout DR Congo. The survey overlaps only partially with the period since December 2006, during which there has been an escalation of violence in North Kivu province and the displacement of over 400,000 persons.

METHODS

Sampling strategy

We employed the same study design used in our 2004 nationwide survey. DR Congo was divided into two strata along the 2001 military frontline: an *East* stratum of territory formerly held by rebel groups and a *West* stratum of territory formerly held by government forces. We surveyed each stratum using a three-stage, household-based cluster sampling technique.

Sample size was calculated to detect a difference between *East* and *West*, assuming the *West* had reverted to the sub-Saharan baseline rate for 2006 (1.4 deaths per 1,000 population per month)⁷ and the *East* had reduced to the 2003–04 survey result for the *West* (1.8).⁵ We used design effects from the 2004 IRC survey for the *East* (5.3) and *West* (3.4) in our calculations to determine sample size. We considered it important to detect a difference in mortality in these strata because their populations continue to experience different security and health conditions and contexts. We used Optimal Design for Multi-level and Longitudinal Research version 1.77 to then determine the optimal number of health zones, clusters per health zone and households per cluster, following a consideration of the survey budget, logistical issues and the intra-class correlations (ICC) and average household sizes from our 2004 survey. In the *East*, the ICC at the health zone level was 0.51 and the average household size was 7.2. These figures were 0.18 and 5.2 respectively in the *West*. Ethical approval for the study was provided by the Ethics Committee of the School of Public Health, Kinshasa University.

In the first stage, four *East* health zones surveyed by the IRC on at least three prior occasions (Kalemie, Kalima, Katana and Kisangani-Ville) were purposely selected to allow for historical comparisons. These were excluded from the sampling frame. A single health zone in the *West* was excluded because it contained a military base and access was not granted by the Congolese government. From the remaining population, 15 health zones were randomly selected from 261 western zones and 16 health zones were randomly selected from 248 eastern zones for study. Probability of selection was proportional to population size using 2006 data from the Congolese Ministry of Health (MOH).⁸ Total population for DR Congo was estimated at 69.9 million (*East* stratum 32.6 million; *West* stratum 37.3 million; inaccessible = 44,000).

In the second stage, clusters were assigned to the smallest population units within each health zone (villages or avenues). Twenty clusters were selected for each health zone, with a probability of selection proportional to population size. Where populations were unknown, the relative size of smallest units was crudely weighted using estimates of local leaders.

In the third stage, 20 households in each cluster were surveyed. A household was defined as a group of persons who eat and sleep together. The type of sampling used at household level depended upon the size and geographical distribution of the village or avenue. For well ordered units (grid pattern or along a single road)



and/or small units (<100 houses), systematic random sampling was used: all households in the cluster were counted (N), a sampling interval (x) was calculated by dividing N by the number of households required in the sample (20), and the starting household was selected by choosing a random number between 1 and x. The sampling interval was then added to this random number to select the next household and the process repeated until completion of the cluster. For widely distributed and/or larger units (>100 houses), households were selected according to the standard World Health Organization Expanded Program on Immunization (WHO/EPI) cluster sampling random walk and proximity method.⁹ Interviewers walked in a randomly chosen direction from the center of the unit to its edge, counting the number of houses (n) along the route. The first household surveyed was selected by randomly choosing a number between 1 and n. Subsequent households were selected by proximity until the cluster was finished.

Neighbors were asked to assist in tracing the occupants of empty households. If occupants could not be found or if they refused to participate, or if no household member over 16 years of age was home, that household was skipped and the next nearest visited. We recorded the number of households replaced and the reasons for replacement. Logistical, security and time constraints prevented revisiting empty households.

Household data collection

The survey questionnaire was standardized and consisted of the same three questions used in the 2002 and 2004 surveys. It was back-translated into French and the four most common local languages (Lingala, Kikongo, Tshiluba and Swahili). The purpose of the study was explained to all heads of households and oral consent obtained. Wherever possible, the questionnaire was conducted with a senior female member of the household, as previous experience had indicated that they provided more rapid and accurate information concerning household members, births and deaths.

The current household census method was used¹⁰ to limit field time in remote and potentially insecure sites. The age and sex of persons sleeping in the household on the night preceding the interview was documented. All pregnancies, births or deaths occurring in the household during the recall period (Jan. 1, 2006 to April 30, 2007) were recorded. Decedents needed to have resided with the interviewed family at the time of their death or else normally slept in the interviewed household if they died in a health care facility. Age, sex, and date and cause of death were recorded for each decedent. We used a pre-defined list for cause of death with the option of specifying the cause if it did not meet any of our classifications. No independent confirmation of death or verbal autopsy was conducted.

Interviewers were experienced local nursing staff drawn from IRC programs and health zone personnel assigned to the survey by Ministry of Health offices. All spoke French and the local language(s). IRC's local staff members had extensive experience in the conduct of similar surveys. The interviewers received standardized training that included field exercises. Data collection in all health zones was supervised by a senior IRC staff member or Burnet Institute consultant. Whenever possible, data entry was done in the field after each day of surveying: we used personal digital assistants with Pocket PC Creations ver. 4.0. All data were double-entered.

Statistical analysis

EpiData 3.0 was used to cross-check duplicate entries and errors were compared against original paper questionnaires. STATA 9.2 was used for analysis. Data were weighted according to the probability of selecting each individual in the sample. Mortality rates have been expressed as deaths per 1,000 population per month using the equations listed in Table 1. No adjustment is made for live births in the denominator for the under-five mortality rate because we assumed that the total number of children born during the recall period was equal to the number of children turning five during the recall period. Rate ratios were estimated using Poisson regression. We accounted for the survey design in the calculation of all rates and rate ratios.

As with our survey in 2004, we analysed two subdivisions within the *East* stratum reflecting areas with ongoing unrest as investigated in the 2002 IRC survey (designated *East 2002*) and areas with minimal current security concerns (called *Transition East*). The western division investigated this year is termed *West*. However, the western Congo investigated in the 2002 IRC survey also included the *Transition East* and so, for the purposes of this report has been called *West 2002*. Figures 1 and 2 illustrate the stratification of DR Congo and the location of the selected health zones.

To estimate total excess mortality for the period covered by the survey, we subtracted the average crude mortality rate for sub-Saharan Africa from the CMR we measured for each stratum. We then applied these rates to the median population of 10 separate population estimates for DR Congo (59.9 million).^{5,11,12,13,14,15,16,17,18} We did so since no official census has been conducted for over 20 years, a broad range of population figures has been reported and the MOH population estimates were the highest of the 10 available. Population sizes reported prior to 2006 were assumed to have a per annum growth rate of 2.5 percent¹⁷ to estimate the population for the study period (range 56.8 million–69.9 million).

Table 1: Summary of key equations

Crude mortality rate (CMR)	$\frac{\text{Number of deaths in the sample}}{(\text{Number living in sample} + \frac{1}{2} \text{ deaths in the sample} - \frac{1}{2} \text{ live births in the sample})}^{\wedge}$	x	$\frac{1000}{\text{Recall period}^*}$
Under-five mortality rate (U5MR)	$\frac{\text{Number of deaths among those < 5 years of age in the sample}}{(\text{Number living < 5 years of age} + \frac{1}{2} \text{ deaths among those < 5 years})}^{\wedge}$	x	$\frac{1000}{\text{Recall period}^*}$

* Recall period is 16 months

^ The denominator is an estimate of the sample population at the midpoint of the recall period

Figure 1: Stratification of DR Congo for the 2007 survey

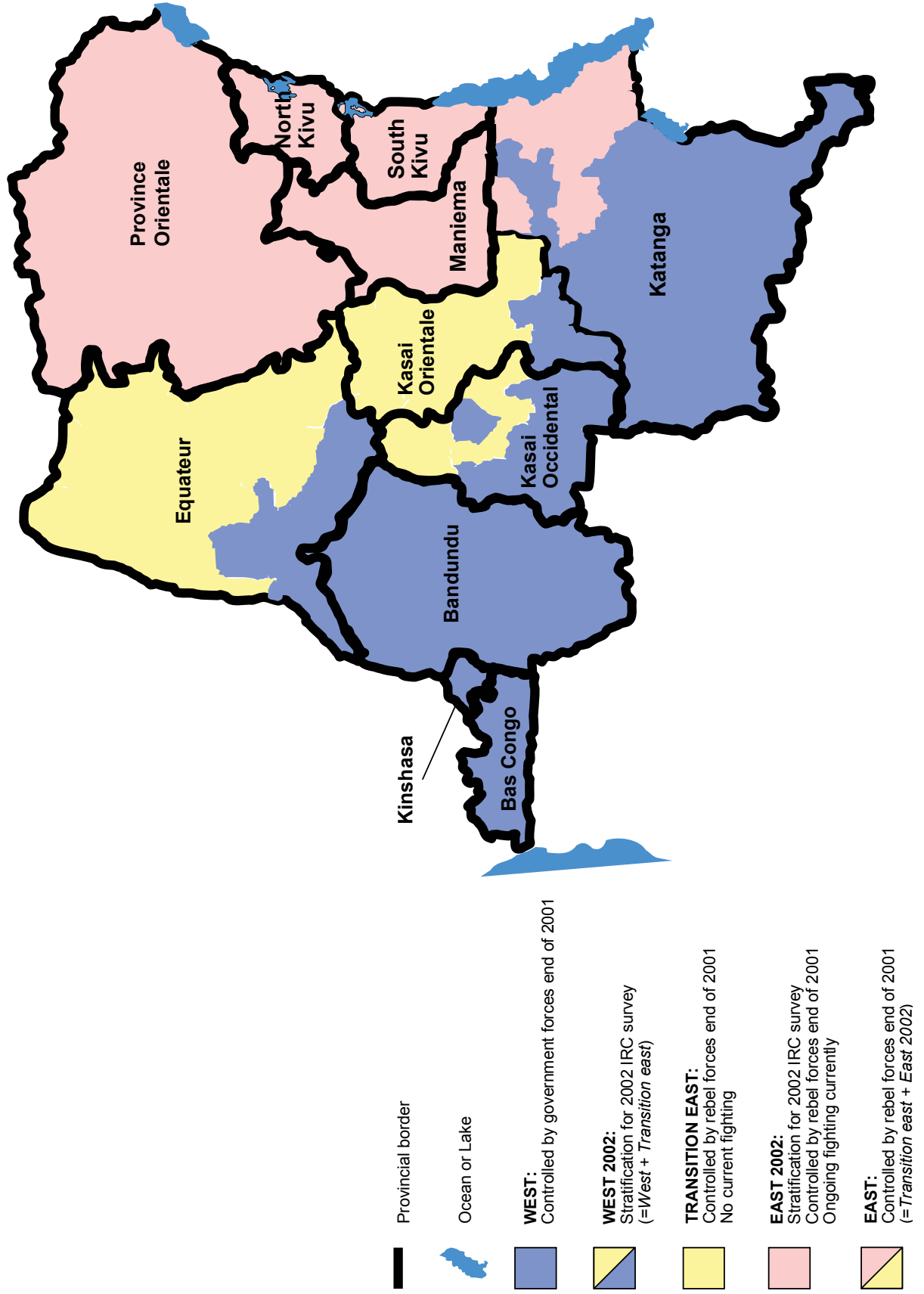
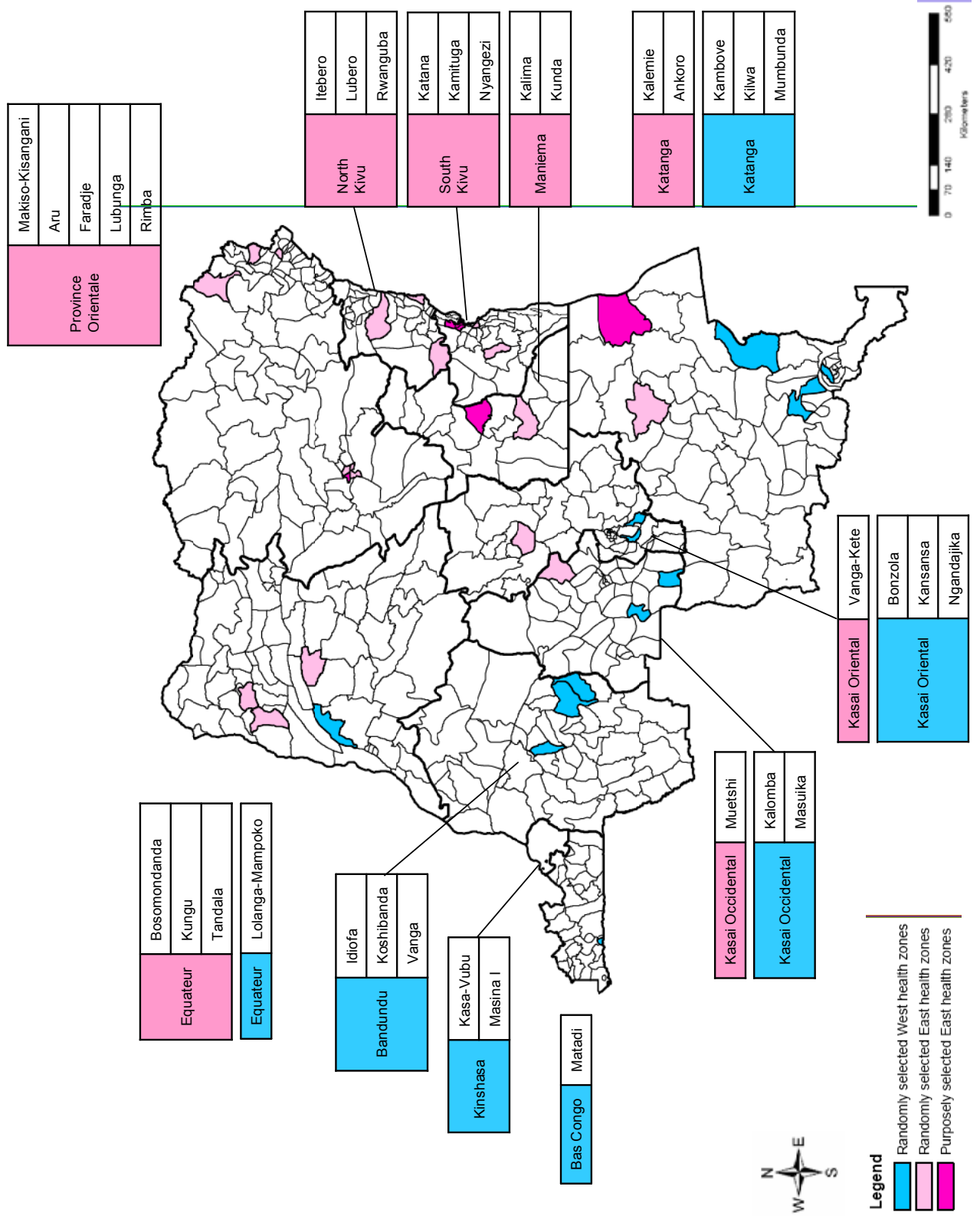


Figure 2: Location of health zones selected for the 2007 survey



RESULTS

In the *East*, about half of the population of Itebero health zone (44,004) could not be surveyed because of security concerns and were excluded from selection. Two selected clusters could not be accessed and were replaced with alternate randomly selected sites. One of these was a military camp in Rwanguba zone where permission to survey was refused. The other was a remote village in Lubero that could not be reached in the time allocated for the survey. Respondents from 14,000 households were interviewed: we counted 51,205 people in 8,000 households in the *East* and 34,260 people in 6,000 households in the *West* for a total population of 85,465 people. The average household size was 6.4 in the *East* and 5.7 in the *West*. For both strata, 47 percent of the sample was male and 53 percent female. Of the total 700 clusters visited, 112 (16 percent) were sampled using systematic random sampling and 588 (84 percent) by the WHO/EPI proximity method. Few households declined to participate in the survey: 58 (0.7 percent) in the *East* and 50 (0.8 percent) in the *West*. However, empty households or households where no family member over 16 years of age could be found were more common: 2,300 (22 percent) in the *East* and 1,838 (23 percent) in the *West*.

From January 2006 to April 2007, the CMR for the country was 2.2 deaths per 1,000 population per month. This rate is 57 percent higher than the reported baseline for sub-Saharan Africa (1.4)⁷ and over 80 percent greater than the UNICEF estimate for DR Congo prior to the commencement of war in 1998 (1.2)¹⁹. The CMR in 16 of 35 health zones (46 percent) exceeded the sub-Saharan regional norm. Five of these zones were in the *West* (33 percent of western zones) and 11 in the *East* (55 percent of eastern zones).

The CMR for the *East* was significantly higher than for the *West* (rate ratio=1.2, 95 percent CI 1.2–1.4; Table 2). The under-five mortality rate, however, was not different between the strata (rate ratio=1.1, 95 percent CI 1.0–1.3, $p=0.12$; Table 2). The fact that the point estimates of the under-five mortality rates (U5MR) show the same trend as the CMRs across all subdivisions suggests that we may have failed to detect an actual difference in the U5MRs in the *East* and *West* because our study was not specifically designed to measure this indicator. Three eastern zones—Ankoro, Kalemie and Kunda—and one western zone—Ngandanjika—had death rates that, at minimum, surpassed the emergency threshold of 0.9 deaths per 10,000 per day²⁰ (or 2.7 deaths per 1,000 per month) for the entire 16 months (range = 2.8 to 8.2).

The five principal causes of death in the *East* and *West* were fever/malaria, diarrhea, respiratory infections, tuberculosis and neonatal conditions, together accounting for over 55 percent of deaths (Table 3). Measles appears to be a significant public health threat in eastern DR Congo. This preventable infection was reported to have caused 9.9 percent of deaths in children under five years of age in this stratum and 15.1 percent (95 percent CI 8.9–24.6) of all deaths in Ankoro health zone in northern Katanga. Three years earlier, a wave of measles affected the region to the immediate south of Ankoro²¹ and there are recent reports of recurring outbreaks of infectious diseases in northern Katanga.²²

Young children are especially vulnerable to communicable diseases and malnutrition: 47.2 percent of all deaths were in children under five, who make up 19.4 percent of the sample population. The relative risk of dying for children under five years compared with people aged five or over was 3.5, 95 percent CI 3.2–3.8.

Deaths from violence accounted for just 0.4 percent of deaths nationally, including 0.6 percent of all mortality reported in the *East* and 0.3 percent in the *West*. Two of three deaths in the *West* appeared to be associated with the crackdown on opposition supporters in Kinshasa and Bas-Congo during March 2007. One was a boy of nine, the other a boy of 12. Of 11 deaths in the *East*, seven were in North Kivu. Perpetrators were identified in nine instances and included police, Mai Mai, Forces Démocratiques de Libération du Rwanda and the Congolese national army. There was only one violent death of a female; she was shot by police in Itebero province, North Kivu.

Unlike the last IRC survey in 2004, health zones reporting a death from violence did not have a higher crude mortality rate than those without violent deaths. Violent deaths now seem to be isolated events, no longer reliably indicative of zone-wide insecurity or health conditions. In fact, the risk of death from violence has declined by almost 30 percent in the unstable eastern provinces since the 2004 IRC survey (relative risk ratio=0.7, 95 percent CI 0.6-0.9) and the proportion of all mortality attributable to violence has declined from 1.5 percent to 0.6 percent.

Despite these positive trends, the crude mortality rate in the *East* stratum has not changed significantly since 2004 (Table 2). Similarly, there has been no change for the *West* stratum or the national CMR. The *East 2002* division, which comprises the five most unstable provinces, had a small significant decrease in CMR (relative risk ratio=0.96, 95 percent CI 0.93-1.00, p=0.026), continuing the downward trend in mortality across all four surveys since 2000 (Table 2). In contrast, the CMR for the *Transition East* was significantly higher for this survey than the last (relative risk ratio=1.10, 95 percent CI 1.04-1.17, p=0.001).

Mortality data in the four eastern zones purposely selected show different trends over time (Table 4). Kalima and Katana had significant reductions in CMR since 2004. The situation has been calm in Kisangani since our last survey and this zone experienced a further nonsignificant reduction in CMR and U5MR from the peak rates observed during the intense conflict of 2002. Mortality rates in Kalemie, on the other hand, have not changed. This means that the crude and under-five mortality rates in Kalemie have been above the emergency threshold for at least 32 months since 2003. Two other zones were selected randomly in both 2004 and 2007. Rwanguba in North Kivu province, which has experienced increased violence and displacement since December 2006, had a statistically significant increase in CMR. Bosomondanda in Equateur province was unchanged. Table 5 lists the CMR and U5MR for all zones surveyed in 2007.

We compared the crude mortality rates from this survey to the regional baseline and used the median of 10 reported national population figures to estimate that 727,000 excess deaths occurred across all of DR Congo between January 2006 and April 2007. If the lower confidence interval for each rate is used and the total population of DR Congo is taken as the lower 2006 MONUC figure of 56,828,595,¹⁵ a minimum estimate of 522,000 excess deaths is calculated. A maximum reasonable estimate of 1.05 million assumes that the upper confidence interval for each rate is valid and the country population is as reported by the Congolese MOH.

Similarly, we used the median of the 10 reported national population figures and the average of the crude mortality rates reported in our 2004 and 2007 surveys to estimate the excess death toll during May 2004 to December 2005, a period not covered by any IRC survey. Assuming the regional baseline was 1.5 deaths per 1,000 per month, we estimate that about 735,000 excess deaths occurred across all of DR Congo during this time. Figure 3 illustrates the excess death toll calculated during each survey and the cumulative total during the war and into the post-war period.

Table 2: Mortality rates for each stratum and subdivision of DR Congo over time

Rate	Year	National	East ^	Transition East	West	East 2002 ^	West 2002
	1999-2001	.	.	.	.	5.4	.
Crude mortality rate*	2002	2.4	.	.	.	3.5 (2.2-4.9)	2.0 (1.5-2.6)
	2003-04	2.1 (1.6-2.6)	2.4 (2.2-2.7)	1.5 (1.3-1.7)	1.8 (1.7-2.0)	2.9 (2.6-3.2)	1.8 (1.6-1.9)
	2006-07	2.2 (2.1-2.3)	2.4 (2.3-2.6)	2.1 (1.8-2.3)	2.0 (1.8-2.1)	2.6 (2.4-2.7)	2.0 (1.9-2.1)
	1999-2001	.	.	.	.	Range 4.8-24.5	.
Under-five mortality rate*	2002	.	.	.	.	9.0 (4.0-14.0)	4.4 (3.2-5.7)
	2003-04	4.5 (3.6-5.4)	4.9 (4.4-5.4)	3.1 (2.7-3.6)	4.3 (3.8-4.8)	5.9 (5.3-6.6)	4.1 (3.7-4.5)
	2006-07	5.0 (4.6-5.3)	5.2 (4.8-5.7)	4.2 (3.5-4.9)	4.7 (4.3-5.1)	5.7 (5.1-6.3)	4.6 (4.2-5.0)

* Mortality rates are expressed as deaths per 1,000 per month (95 percent confidence intervals).

^ Reported rates for *East* and *East 2002* include the four purposely selected zones. Rates were not different whether these zones were included or excluded.

2006-07 design effects for CMR: $East=2.2$, $West=1.4$

2006-07 design effects for U5MR: $East=2.2$, $West=1.3$

2006-07 intra-class correlations: $East=0.48$ (zone), 0.09 (cluster); $West=0.33$ (zone), 0.03 (cluster)

Table 3: Deaths in *East* and *West* DR Congo by age and sex

<i>EAST</i>	Total reported (weighted %)		5yrs and older				Young children	
			Male		Female		0-4yrs	
Fever / malaria	498	26.3%	116	21.0%	83	18.2%	299	34.2%
Other / unknown	395	21.4%	187	34.2%	144	31.1%	64	7.9%
Diarrhea	174	9.1%	59	10.3%	35	6.6%	80	9.7%
Acute respiratory-tract infections	136	7.5%	37	6.7%	35	7.5%	64	8.1%
Neonatal death	142	7.1%	N/A	N/A	N/A	N/A	142	15.5%
Tuberculosis	129	6.6%	69	11.5%	54	11.4%	6	0.7%
Measles	115	5.5%	11	1.7%	10	2.1%	94	9.9%
Malnutrition	75	4.0%	11	2.1%	10	2.3%	54	6.3%
Anemia	71	3.2%	8	1.4%	11	2.4%	52	4.8%
Meningitis	55	2.8%	18	3.2%	15	3.1%	22	2.3%
Accident / injury	45	2.4%	30	5.2%	11	2.5%	4	0.6%
Maternal	42	2.3%	N/A	N/A	42	9.1%	N/A	N/A
AIDS	27	1.2%	9	1.1%	18	3.5%	0	0
Violence	11	0.6%	10	1.8%	1	0.2%	0	0
Total	1915	100.0%	565	100.0%	469	100.0%	881	100.0%

<i>WEST</i>								
Fever / malaria	268	27.7%	51	19.5%	47	21.2%	170	35.0%
Other / unknown	232	22.8%	111	39.9%	80	34.1%	41	8.5%
Diarrhea	86	8.9%	14	5.3%	10	4.6%	62	12.8%
Tuberculosis	68	6.8%	37	13.4%	23	10.5%	8	1.6%
Neonatal death	62	6.5%	N/A	N/A	N/A	N/A	61	12.9%
Acute respiratory-tract infections	55	5.5%	11	4.2%	11	4.6%	33	6.6%
Anemia	41	4.3%	5	2.1%	1	0.4%	35	7.2%
Malnutrition	41	4.3%	8	2.9%	10	5.3%	23	4.5%
Accident / injury	35	3.4%	22	8.1%	6	2.5%	7	1.3%
Meningitis	30	3.2%	6	2.1%	2	0.9%	22	4.7%
Measles	29	2.9%	1	0.4%	3	1.6%	25	4.8%
Maternal death	26	2.8%	N/A	N/A	26	12.7%	N/A	N/A
AIDS	8	0.8%	4	1.4%	4	1.6%	0	0
Violence	3	0.3%	2	0.6%	0	0	1	0.2%
Total	984	100.0%	272	100.0%	223	100.0%	488	100.0%

All percentages are weighted proportions.

N/A = not applicable

Table 4: Comparison of 2006-07 survey findings for individual health zones with IRC surveys from previous years

Health Zone	Mortality rate*	Duration of recall period for survey					
		1998-99	1999-2000	2000-01	2002	Jan. 03-April 04	Jan. 06-April 07
Kalemie	CMR	Not surveyed	Not surveyed	10.8 (9.5-12.1)	4.2 (2.8-5.6)	4.0 (3.4-4.5)	3.6 (2.9-4.2) [deff=1.2]
	U5MR	Not surveyed	Not surveyed	23.8 (19.8-27.8)	14.9	9.8 (8.1-11.8)	8.9 (6.9-10.9) [deff=1.0]
Kalima	CMR	Not surveyed	Not surveyed	7.5 (6.3-8.7)	3 (2.2-3.9)	4.1 (3.3-5.1)	2.1 (1.5-2.7)^ [deff=1.8]
	U5MR	Not surveyed	Not surveyed	17.1 (13.2-21.)	8.9	8.4 (6.4-11.0)	5.2 (3.1-7.3) [deff=1.9]
Katana	CMR	3.8	3.0	4.9 (3.8-6.0)	1.9	2.5 (2.0-3.3)	1.5 (0.9-2.0)^ [deff=1.8]
	U5MR	10.1	6.9	12.9 (9.3-16.5)	2.9	5.8 (4.6-7.4)	4.5 (2.1-6.9) [deff=2.1]
Kisangani-Ville	CMR	Not surveyed	2.9	Not surveyed	6.2	1.4 (1.1-1.7)	1.0 (0.7-1.4) [deff=1.3]
	U5MR	Not surveyed	4.8	Not surveyed	10.4	2.2 (1.6-3.0)	1.6 (0.6-2.5) [deff=1.1]
Bosomondanda#	CMR	Not surveyed	Not surveyed	Not surveyed	Not surveyed	1.2 (0.9-1.5)	1.0 (0.7-1.3) [deff=1.0]
	U5MR	Not surveyed	Not surveyed	Not surveyed	Not surveyed	2.2 (1.6-2.9)	2.6 (1.6-3.5) [deff=1.0]
Rwanguba#	CMR	Not surveyed	Not surveyed	Not surveyed	Not surveyed	1.3 (0.9-1.7)	2.2 (1.4-2.9)^ [deff=2.1]
	U5MR	Not surveyed	Not surveyed	Not surveyed	Not surveyed	3.8 (2.6-4.9)	4.5 (2.6-6.4) [deff=1.5]

* Mortality rates expressed as deaths per 1,000 per month (95 percent confidence intervals quoted if available).

Bosomondanda and Rwanguba were both randomly selected in 2003-04 and 2006-07.

^ CMRs for 2006-07 are significantly different from 2003-04: Kalima rate ratio=0.8, p<0.000; Katana rate ratio=0.8, p=.001; Rwanguba IRR=1.2, p=.002.

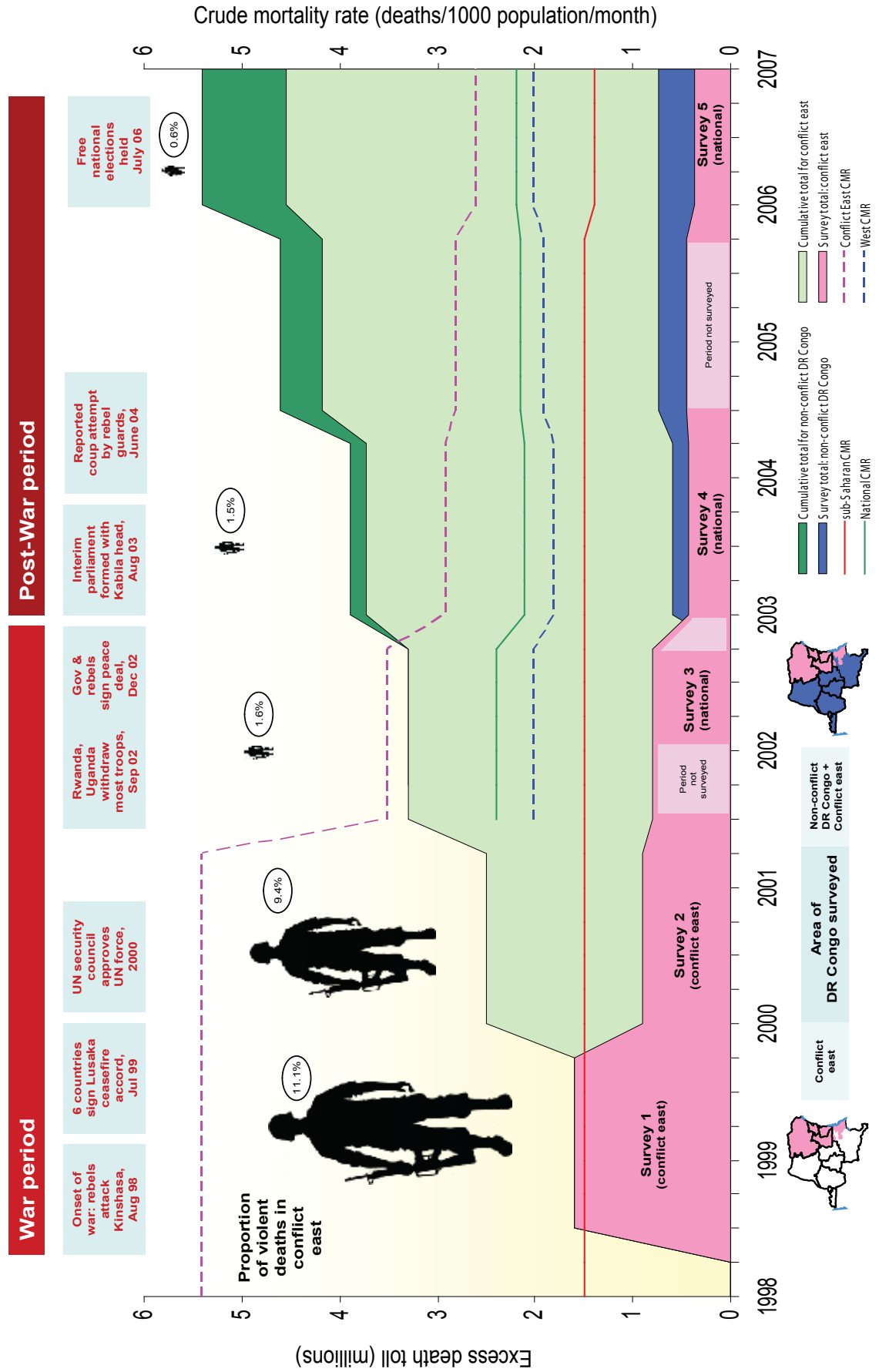
Table 5: CMRs and U5MRs for individual health zones, 2006-07

Stratum	Province	Zone	CMR*	95% CI		U5MR*	95% CI	
<i>West</i>	Equateur	Lolanga Mampoko	0.9	0.6	1.2	1.9	1.2	2.7
	Katanga	Mumbunda	1.0	0.6	1.3	2.1	1.1	3.1
	Kasai Orientale	Bonzola	1.0	0.7	1.3	2.2	1.3	3.1
	Kinshasa	Kasa-vubu	1.1	0.8	1.4	1.9	0.7	3.2
	Kinshasa	Masina 1	1.3	1.0	1.6	2.5	1.3	3.7
	Bas Congo	Matadi	1.5	1.1	1.8	3.1	2.2	4.0
	Katanga	Kambove	1.5	1.0	2.1	5.7	4.1	7.3
	Kasai Occidental	Kalomba	1.6	0.8	2.4	3.8	2.1	5.5
	Bandundu	Koshibanda	1.7	1.4	2.0	3.9	2.5	5.3
	Kasai Occidental	Masuika	1.8	1.3	2.3	4.4	2.8	6.0
	Bandundu	Idiofa	2.8	2.1	3.5	6.7	3.4	10.0
	Bandundu	Vanga	3.0	2.5	3.6	7.1	5.4	8.7
	Katanga	Kilwa	3.1	2.3	3.9	6.8	4.3	9.2
	Kasai Orientale	Kasansa	3.4	2.7	4.1	7.7	5.7	9.7
Kasai Orientale	Ngandanjika [^]	3.6	2.8	4.5	8.1	5.8	10.5	
<i>Transition East</i>	Equateur	Bosomondanda	1.0	0.7	1.3	2.6	1.6	3.5
	Equateur	Tandala	1.8	1.3	2.2	4.4	2.9	5.8
	Equateur	Kungu	2.0	1.5	2.6	3.0	1.9	4.1
	Kasai Orientale	Vanga-kete	2.5	1.8	3.2	4.9	3.1	6.7
	Kasai Occidental	Muetshi	2.9	1.9	4.0	5.9	3.4	8.4
<i>East 2002</i>	Nord Kivu	Lubero	0.8	0.5	1.2	1.8	0.5	3.1
	Prov Orientale	Makiso Kisangani	1.0	0.7	1.4	1.6	0.6	2.5
	Sud Kivu	Katana	1.5	0.9	2.0	4.5	2.1	6.9
	Prov Orientale	Aru	1.6	1.1	2.0	4.2	2.7	5.7
	Sud Kivu	Kamituga	1.7	1.3	2.2	4.3	2.4	6.1
	Prov Orientale	Faradje	1.8	1.1	2.4	2.5	1.0	3.9
	Nord Kivu	Itebero	1.8	1.4	2.2	3.8	2.5	5.1
	Maniema	Kalima	2.1	1.5	2.7	5.2	3.1	7.3
	Nord Kivu	Rwanguba	2.2	1.4	2.9	4.5	2.6	6.4
	Prov Orientale	Lubunga	2.2	1.5	2.9	4.5	2.7	6.3
	Sud Kivu	Nyangezi	2.4	1.5	3.2	5.5	3.0	8.0
	Prov Orientale	Rimba	2.8	2.0	3.6	5.9	3.2	8.6
	Katanga	Kalemie [^]	3.6	2.9	4.2	8.9	6.9	10.9
	Maniema	Kunda [^]	4.1	3.2	5.0	7.0	5.1	8.9
Katanga	Ankoro [^]	7.1	6.0	8.2	16.6	13.1	20.2	

* Mortality rates expressed as deaths per 1,000 per month.

[^] Mortality rates statistically significantly above the emergency threshold of 2.7 deaths per 1,000 population per month.

Figure 3: Trends in excess deaths, CMRs and deaths from violence in DR Congo, 1998-2007



DISCUSSION

Mortality rates

The crude mortality rate in DR Congo remains well above the accepted norm for sub-Saharan Africa in 2005. In fact, while the death rate in sub-Saharan Africa has reportedly declined slightly since 2004⁷, there has been no reduction in the national crude mortality rate over the same period in DR Congo. As with our previous studies, most deaths have been attributed to the so-called indirect consequences of conflict, especially increased rates of infectious diseases and malnutrition. Children continue to bear a disproportionate burden of the humanitarian crisis in DR Congo, accounting for almost half of all deaths.

As previously documented, mortality rates remain significantly higher in the *East* than in the *West*. Nonetheless, we found rates that exceeded important international benchmarks on both sides of the former frontline. Ngandanjika health zone of Kasai Orientale province in the *West* recorded a CMR above the accepted emergency threshold of 0.9 deaths per 10,000 per day (2.7 deaths per 1,000 per month).²⁰ In the *East*, northern Katanga, known as “Congo’s forgotten crisis,”²³ is of particular concern: Ankoro health zone surpassed the threshold for a severe emergency of 2.0 deaths per 10,000 per day (6.0 deaths per 1,000 per month).²⁴ And Kalemie has had death rates above the emergency threshold for every period measured by IRC back to 2000.

While the national CMR has remained unchanged since 2004, the CMR in the unstable *East 2002* region has decreased since the last survey. In fact, the level of decline may be greater than we have been able to demonstrate. That is because our 2007 survey was the first of the five studies where health zones in the *East* were not excluded from the sampling frame due to insecurity.¹⁻⁵ In comparison, we left out 23.6 percent of the total population in the *East* during our 2004 survey (5.4 million of an estimated 22.9 million people). Mortality rates at that time were considered to be conservative because we found a strong association between insecurity and all-cause mortality.⁵

This small decline in mortality in the *East 2002* has occurred during a period when there has been a more robust international peacekeeping effort in this region of the country. MONUC, the U.N. peacekeeping force in DR Congo, has been credited with improving civilian protection²⁵ and reducing the number of major attacks in the eastern provinces. When considered in light of the documented decline in violent deaths in the current survey and the demonstrated association between insecurity and all-cause mortality from our 2004 study, it would be reasonable to infer that this improved security situation has contributed to the decline in CMR in *East 2002*. Ironically, it is these small but measurable gains that are now being threatened by the recent escalation of violence in North Kivu province.

Surprisingly, the *Transition East* recorded significantly increased mortality rates since the last survey. In fact, the sustained elevation in the national CMR can be attributed to increased mortality in this region, plus a nonsignificant elevation of mortality in the *West*—the two regions that have been largely free of conflict since 2002. While this increase in CMR was unexpected, we believe that our data reflect the true circumstances in this region from January 2006 to April 2007. We sampled four *Transition East* zones in 2004 and five in 2007. Although these are theoretically representative of the entire population of the *Transition East*, by chance we may have chosen zones with lower mortality rates in 2004 or higher rates in 2007. If mortality rates vary widely across zones in the area, we may not have sampled enough zones to accurately estimate the average mortality in the *Transition East*. However, our results are similar to other surveys and consistent with recent events that have impacted the lives and livelihoods of people in the region. We found the CMRs in four of the five zones studied in 2007 were well above the sub-Saharan norm. Similarly, four studies by other agencies in Kasai Orientale in 2004 found an average mortality rate of 2.0 per 1,000 per month.¹⁸ In addition, more

recent surveys in two different areas in Equateur in 2006 indicated an emergency situation based on crude mortality, under-five mortality and the prevalence of acute malnutrition.¹⁸ Major problems with food security due to poor agricultural yields and insect infestations, together with regional floods, have added to a complex humanitarian situation in this part of DR Congo.^{26,27,28}

Comparisons with other countries

Given that there are few comprehensive, longitudinal examinations of the “natural history” of mortality rates for countries through war and into the early recovery period, it is difficult to make confident projections about what should be expected with respect to mortality trends in DR Congo. Direct comparisons with other wars have limitations because of DR Congo’s size and complexity. Its current circumstances cannot simply be described as either an emergency or development situation, or as a conflict or post-conflict scenario, as all of these phases can be observed to be occurring in different regions of the country. Nonetheless, the decade-long civil war in Sierra Leone which displaced half the country’s 4.5 million people may offer a relevant comparison. Three years after the end of conflict in 2002, the average crude mortality rate in four rural districts—representing about a third of the population—was almost four times higher than the sub-Saharan baseline.²⁹ In Angola, while the post-conflict period was generally associated with a steady decline in mortality, some provinces still documented mortality rates above the emergency threshold two years after the end of the war.³⁰ Similarly, data from Liberia and South Sudan demonstrate that sustained increases in mortality are not uncommon even years after official peace processes and successful political transitions.³¹ In addition, a retrospective study of 51 countries demonstrated that civil wars greatly increase the risk of death and disability for years after the end of conflict.³² Finally, studies from other disciplines, including economics, have demonstrated that recovery from civil wars takes many years and requires sustained international engagement including aid, trade, legal assistance and military interventions.³³

On the one hand, DR Congo’s experience of sustained increases in mortality is therefore neither unusual compared to other conflicts nor out of keeping with its own history of conflict superimposed on decades of socioeconomic and political decline. In fact, the “crisis of neglect” has been pervasive, affecting all regions of the country.²³ Today, Congolese in the western regions brave rates of poverty that reportedly are comparable to the eastern provinces; for example, there is 80 percent unemployment in Kinshasa and Bas-Congo provinces,³⁴ and 75 percent of residents in the capital lack money to meet basic daily needs.³⁵ Improvements in health indicators in DR Congo are further constrained by the lowest per capita health expenditures for any country in the world.³⁶ One must have reasonable expectations about the rate of recovery and the need for ongoing international assistance for a nation that ranks 168th (out of 177 countries) on the Human Development Index³⁷ and seventh (out of 177 countries) on the Failed States Index.³⁸

On the other hand, it would be inappropriate to dismiss such sustained elevations of mortality four years after the official end of the war as inevitable. For example,



a reduction in mortality was achieved in the *East 2002* since 2004, although its CMR is still 85 percent higher than the regional norm. This is the section of the country that has received the bulk of international peacekeeping support and humanitarian assistance, but at a level that is reported to be out of proportion to the documented need.^{39,40} Arguably a more robust engagement by the Congolese government, peacekeepers and international agencies would have contributed to even greater reductions in mortality in this area.

Excess death toll estimates

During the period covered by this most recent survey, we estimate that approximately 727,000 Congolese died in excess of the expected total, when compared with the average regional rate. This figure is higher than the total excess mortality reported in our last survey for two reasons: the baseline mortality rate for sub-Saharan Africa has decreased and our estimates for crude mortality in the *West* and the *Transition East* have increased since 2003-04. These higher point estimates were applied to the two-thirds of the Congolese population living in these regions. Despite this, 50 percent of the excess mortality occurred among the remaining third of the population in the five most insecure provinces in the *East*.

In 2002, IRC reported that 3.3 million Congolese in the insecure *East* had died in excess of regional norms during the war.⁴ For the post-war period, January 2003 to April 2007, we estimate that an additional 2.1 million excess deaths have occurred across the whole country: 1.3 million in the five eastern provinces and 0.8 million in the *West* and *Transition East*. These estimates include the period for which we have no data, May 2004 to December 2005 (the assumptions for this period are described in the results section). We now estimate the excess death toll in DR Congo since 1998 to be 5.4 million, of which 4.6 million occurred in the five insecure eastern provinces.

Survey Limitations

As noted, this survey is the first IRC survey in DR Congo where zones were not omitted from the sampling frame in advance, due to insecurity. Except for one small, militarized zone in the *West*, all health zones were eligible for selection. Nonetheless, as with all surveys in conflict settings, our results could have underestimated mortality because of survival bias,⁴¹ underreporting of infant deaths,^{42,43} and exclusions of segments of the population from the survey. Specifically, large areas in one zone in North Kivu became unsafe to visit after surveying began, and a military camp and a remote village could not be accessed.

Based on our findings, fever/malaria is the No. 1 killer in DR Congo, and our inclusion of two wet seasons in the recall period could overestimate mortality rates. However, this should not influence comparisons between our 2004 and 2007 surveys because recall periods for both surveys covered exactly the same months. Cause of death data were as reported by interviewees and must be interpreted with care. Deaths due to trauma (violent and accidental) and measles, and deaths during the neonatal period, are likely to be accurate, although the latter may be underreported. Our cause of death data should only be used in a general sense to alert planners to possible health priorities, and should be followed by more accurate local assessments to determine cause-specific mortality rates.

The number of empty households was high in both strata and is a clear limitation. This problem has occurred in previous surveys: 18 percent of households in the *East* and 23 percent in the *West* were vacant at the time of interview in 2002.³ A limited assessment during that survey found that mortality was 43 percent higher in empty households than in households where occupants were home at the time of the initial survey. We do not know if this pattern holds true in DR Congo today. Ideally, surveys should return to empty households at a later date and not simply replace them with a neighboring household. In this context (and more generally), daytime household sampling runs the risk of excluding many families, as adults are often away from the home. We tried to minimize these exclusions by surveying in the early morning or late afternoon and avoiding

public holidays and Sundays in Christian communities. Insecurity, limited resources and time restricted our options for minimizing replacement (e.g. surveying during the evenings).

Inaccuracies in external data used for selection of zones, rate comparisons and estimates of excess mortality might have introduced other forms of bias. As with previous studies, we have erred on the conservative side in our use of external sources, especially for estimates of excess mortality where we used the average CMR for sub-Saharan Africa (1.4) as a baseline rate rather than the reported pre-war CMR of 1.2¹⁹. Pre-war data for key demographic and health indicators is limited for DR Congo, with U.N. agencies the main source of information. UNICEF's documented estimate for CMR prior to the 1996 war was 1.2 deaths per 1,000 per month;¹⁹ by 1998, the year that the most recent war started, at least two sources reported that the rate was 1.25.^{44,45} We acknowledge the limitations of such data, including reservations concerning its validity and ability to capture regional differences in a country as vast as DR Congo. Nonetheless, we are aware of no more authoritative sources or estimates. We believe that it is important to estimate aggregate excess mortality in conflict zones in spite of the methodological challenges. For these reasons, our use of the average CMR for sub-Saharan Africa as a baseline rate in our calculation has resulted in a conservative estimate of excess deaths, but one that allows us to compare mortality in DR Congo with the norm for the region.

CONCLUSION

Elevations in mortality across the DR Congo indicate that the country remains in the midst of a major humanitarian crisis. The only region to record an improvement in the CMR since 2004 was *East 2002*, where declines in violent deaths and all-cause mortality coincided with a more determined international peacekeeping effort. Ironically, these measurable gains are now being threatened by the escalation of violence in North Kivu province. Our findings provide further evidence that recovery from conflict is a protracted process in fragile states such as DR Congo, especially when it is superimposed on decades of socioeconomic stagnation and decline. When considered in light of the renewed fighting in North Kivu, these results indicate how delicate progress can be in complex humanitarian settings. Sustained, measurable improvements in mortality and health will require years of unwavering commitment from the Congolese government and tenacious engagement from the international community on a range of humanitarian, military and political issues. It will also require a determination to intervene rapidly and effectively when new emergencies arise. Without such an approach, improvements in mortality and other key public health indicators will be impossible to achieve and sustain.

ACKNOWLEDGEMENTS

We thank all of our IRC national staff from DR Congo who worked tirelessly and energetically during the data collection phase, as well contributing to the data entry. We also wish to acknowledge colleagues from all 35 health zone offices of the Congolese Ministry of Health, without whose assistance the data collection would not have been possible. The dedication, courage and good humor of our field teams was invaluable as they dealt with many challenges, often in remote and potentially insecure areas.

Thanks also to Susan Bartels of the Harvard Humanitarian Initiative, and to Franklin Broadhurst and Charles Lubula Muganda of IRC, who helped supervise field teams. Damian Jolley of the Monash University made valuable contributions to the statistical analysis.

We acknowledge the assistance provided by the Ethics Committee of the Kinshasa School of Public Health, who were highly supportive and professional during the preparatory stages.

Finally, we wish to extend special thanks to the British government's Department for International Development (DFID), which provided generous funding for the study. Without such support, this survey would not have been possible.



REFERENCES

(Endnotes)

- 1 Roberts L. Mortality in eastern DRC: results from five mortality surveys. New York: International Rescue Committee, 2000.
- 2 Roberts L, Belyadoumi F, Cobey L, et al. Mortality in the eastern Democratic Republic of Congo: results from 11 mortality surveys. New York: International Rescue Committee, 2001.
- 3 Roberts L, Ngoy P, Mone C, et al. Mortality in the Democratic Republic of Congo : results from a nationwide survey. New York: International Rescue Committee, 2002.
- 4 Roberts L, Zantop M. Elevated mortality associated with armed conflict–Democratic Republic of Congo, 2002. *MMWR Morb Mort Wkly Report* 2003; 52: 469-71.
- 5 Coghlan B, Brennan RJ, Ngoy P, et al. Mortality in the Democratic Republic of Congo : a nationwide survey. *Lancet* 2006; 367: 44-51.
- 6 UNICEF. State of the World’s Children Report 2005. New York: UNICEF, 2004.
- 7 UNICEF. State of the World’s Children Report 2007. New York: UNICEF, 2006.
- 8 Ministry of Health, Democratic Republic of Congo. Direction d’Etude et de Planification. <http://www.minisanterdc.cd/leministere/diretudeetplanif.htm> (Accessed April 2007)
- 9 World Health Organization, Expanded Programme of Immunization. Training for midlevel managers: the EPI coverage survey WHO/EPI/MLM/91.10 Geneva: WHO, 1991.
- 10 Checchi F, Roberts L. Interpreting and using mortality data in humanitarian emergencies: a primer for non-epidemiologists. Humanitarian Practice Network; Network Paper No. 52. London: Overseas Development Institute, Sept. 2005.
- 11 U.S. Department of State. Background note: Democratic Republic of Congo. <http://www.state.gov/r/pa/ei/bgn/2823.htm> (Accessed Nov. 1, 2007).
- 12 Democratic Republic of Congo Mission to the United States. People. <http://www.un.int/drcongo/People.htm> (Accessed Nov. 1, 2007).
- 13 U.N. Development Programme. Human Development Reports: Democratic Republic of Congo. http://hdrstats.undp.org/countries/data_sheets/cty_ds_COD.html (Accessed Nov. 1, 2007).
- 14 World Bank. Democratic Republic of Congo: Data and Statistics. <http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/AFRICAEXT/CONGODEMOCRATICEXTN/O,,menuPK:349492~pagePK:141132~piPK:141109~theSitePK:349466,00.html> (Accessed November 1, 2007)
- 15 MONUC. Key indicators: population. <http://www.monuc.org/news.aspx?newsID=11434> (Accessed Nov. 1, 2007)
- 16 Central Intelligence Agency. CIA Factbook. <https://www.cia.gov/library/publications/the-world-factbook/geos/cg.html> (Accessed Nov. 1, 2007).
- 17 World Health Organization. World Health Report. Geneva: WHO, 2006
- 18 Tschoegl E, Degomme O, Guha-Sapir D. The Democratic Republic of Congo: a brief analysis of anthropometric surveys from 2000-2006. Centre for Epidemiology of Disasters. Jan. 8, 2007.
- 19 UNICEF. State of the World’s Children Report 1998. Oxford, Oxford University Press, 1998.
- 20 The Sphere Project. Minimum standards in health services, in The Sphere Project: Humanitarian Charter and Minimum Standards in Disaster Response. Oxford: Oxfam Publishing, 2004.
- 21 Medecins Sans Frontieres. MSF opens new emergency operations in Katanga region of the Democratic Republic of Congo. MSF-USA press release. March 6, 2003. <http://www.doctorswithoutborders.org/pr/2003/03-06-2003.cfm> (Accessed Oct. 2, 2007)
- 22 Medecins Sans Frontieres. The humanitarian situation in the Democratic Republic of Congo. United Nations Security Council Meeting. Jan 24, 2006. <http://www.msf.org.au/features/drc/arria.250106.shtml> (Accessed Oct. 2, 2007).

MORTALITY IN THE DEMOCRATIC REPUBLIC OF CONGO: AN ONGOING CRISIS

- 23 International Crisis Group. Katanga: The Congo's Forgotten Crisis. Africa Report No.103. Brussels. Jan. 9, 2006 <http://www.crisisgroup.org/home/index.cfm?id=3861&l=1> (Accessed Oct. 25, 2007).
- 24 UNHCR. Handbook for Emergencies, 2nd Edition. Geneva: UNHCR, 2000.
- 25 United Nations. Humanitarian Action Plan 2007: Democratic Republic of Congo. <http://ochaonline.un.org/humanitarianappeal/webpage.asp?Page=1504> (Accessed Oct. 25, 2007).
- 26 Integrated Regional Information Networks. DRC: UN decries insecurity, malnutrition in Kasai Orientale. U.N. Office for the Coordination of Humanitarian Affairs. May 11, 2007. <http://www.irinnews.org/report.aspx?reportid=54346>
- 27 International Federation of Red Cross and Red Crescent Societies. Central Africa: Floods and landslides DREF Bulletin No. MDR62002. Jan. 9, 2007. <http://www.reliefweb.int/rw/RWB.NSF/db900SID/EVOD-6XAKQE?OpenDocument> (Accessed Sept. 30, 2007)
- 28 U.N. Office for the Coordination of Humanitarian Affairs. Humanitarian Crisis Watch: Democratic Republic of Congo. UNOCHA. September 2006. <http://vspot.vday.org/documents/2007/spotlight/HumanitarianImpactofElections.pdf> (Accessed Sept. 30, 2007)
- 29 Medecins Sans Frontieres. Access to healthcare in post-war Sierra Leone. Summary of a 2005 survey in four districts: Kambia, Tonkolili, Bombali, Bo. MSF-Holland and MSF-Belgium. January 2006. http://artszonderegrenzen.nl/usermedia/files/Sierra_Leone_survey_2006_summary.pdf (Accessed Oct. 2, 2007)
- 30 Sapir DG, Gomez VT. Angola: The human impact of war: a data review of field surveys in Angola between 1999 and 2005. Centre for Research on the Epidemiology of Disasters, Catholic University of Louvain, June 2006.
- 31 Centre for the Research on the Epidemiology of Disasters. Complex Emergency Database (CE-DAT). <http://www.cedat.be/CEDAT/search/advsearch.php> (Accessed Oct. 25, 2007).
- 32 Ghobarah HA, Huth P, Russett. The post-war public health effects of civil conflict. *Soc Sci Med* 2004;59:869-884
- 33 Collier P. *The Bottom Billion*. Oxford: Oxford University Press, 2007.
- 34 Stearns JK. Congo's peace: miracle or mirage? *Current History*. April 23, 2007. <http://www.crisisgroup.org/home/index.cfm?id=4799&l=1> (Accessed Sept. 4, 2007)
- 35 International Crisis Group. Congo: Consolidating the Peace. Africa Report No. 128. Brussels. July 5, 2007.
- 36 U.N. Development Programme. World Development Report 2006. http://hdr.undp.org/hdr2006/pdfs/report/HDR_2006_Tables.pdf (Accessed Oct. 24, 2007)
- 37 UNDP. 2007/2008 Human Development Index Rankings. <http://hdr.undp.org/en/statistics> (Accessed Dec. 28, 2007).
- 38 Fund for Peace. Failed States Index Scores 2007. http://www.fundforpeace.org/web/index.php?option=com_content&task=view&id=229&Itemid=366com.lifli.iblog.NewWindow (Accessed Dec. 28, 2007).
- 39 Brennan R, Husarska A. Inside Congo, an unspeakable toll. *Washington Post*, July 16, 2006, page B3.
- 40 Prendergast J, Thomas-Jensen C. Averting the nightmare scenario in eastern Congo. *Enough Strategy Paper #7*. Sept. 2007.
- 41 Spiegel PB, Salama P. War and mortality in Kosovo, 1998-1999: an epidemiological testimony. *Lancet* 2000, 355:2204-2209.
- 42 Taylor WR, Chahnazarian A, Weinman J, et al. Mortality and use of health services surveys in rural Zaire. *International Journal of Epidemiology* 1993; Vol 22, suppl. 1, pp S15-19.
- 43 Becker SR, Diop F, Thornton JN. Infant and child mortality in two counties of Liberia: results of a survey in 1988 and trends since 1984. *International Journal of Epidemiology* 1993; 22, suppl. 1, pp S56-63.
- 44 UNICEF. *State of the World's Children Report 2000*. New York: UNICEF, 2000.
- 45 Central Intelligence Agency. *World Factbook 1998*. Country listing for Democratic Republic of Congo. <http://www.umsl.edu/services/govdocs/wofact98/61.htm> (Accessed Jan. 8, 2008).