Mortality in the
Democratic Republic of Congo:
Results from a Nationwide Survey

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Executive Summary

The Democratic Republic of Congo (DR Congo) is struggling to recover from a devastating six-year conflict that continues to destabilize Central Africa and cause immense suffering to the country's civilian population. The war that commenced in August 1998 and quickly engulfed the country has been characterized by extreme violence, mass population displacements, widespread rape, and a collapse of public health services. The outcome has been a humanitarian disaster unmatched by any other in recent decades.

Over the past four years the International Rescue Committee (IRC) has documented the magnitude of the humanitarian crisis in DR Congo through a series of four mortality surveys. The first three surveys, conducted between 2000 and 2002, demonstrated that an estimated 3.3 million people had died as a result of the conflict. The fourth and latest study, covering the period from January 2003 to April 2004, is among the largest ever conducted in a conflict zone. Investigators used a three-stage cluster sampling technique to survey 19,500 households in total, visiting every province in the country, and measuring mortality among nearly 58 million people (over 90% of the Congolese population). An estimated five million people were inaccessible due to security problems. The key findings and conclusions are:

1. **The humanitarian crisis in DR Congo remains the world's deadliest: More than 31,000 people die every month as a result of the conflict.** Eighteen months after the signing of a formal peace agreement, people in DR Congo continue to die at a rate that is one third higher than the average rate for sub-Saharan Africa. The national crude mortality rate (CMR) of 2.0 deaths per 1,000 per month is 67% higher than that reported for DR Congo prior to the war (1.2). Between January 2003 and April 2004 almost 500,000 deaths occurred beyond what would normally be expected during this period. This is equivalent to over 31,000 lives lost every month and more than 1,000 people dying every day as a result of the conflict. Nearly half of them are children under five years of age. When analyzed in conjunction with the IRC's previous mortality surveys, the findings indicate that from the beginning of the war in August 1998 to the end of April 2004, **approximately 3.8 million people have died as a result of the crisis.** The survey demonstrates that the Congolese conflict is by far the deadliest war in the world since World War II and the deadliest in Africa ever recorded.

2. **Death rates are highest in the unstable eastern provinces.** The CMR in the eastern regions of DR Congo (CMR = 2.3) are more than one third higher than those for the West (1.7). The five eastern provinces, where the conflict has been most intense and protracted, have a CMR of 2.7, which is 80% higher than the average rate for sub-Saharan Africa (1.5). The mortality rate for children under five years of age (U5MR) in these provinces is 90% higher than the regional norm. The eastern provinces account for 77% of the excess mortality documented in DR Congo, with 27% of eastern health zones experiencing a CMR that is higher than the accepted emergency threshold of 1 death per 10,000 per day for the entire 16-month recall period. These rates do not include the period since April 2004, during which there have been several violent incidents in the East.

3. **The majority of deaths are due to easily preventable and treatable diseases.** While security problems continue in the eastern provinces, less than two percent of deaths over the past 16 months have been due to war-related violence. The most devastating by-products of the conflict have been the disruption of the country's health services and food supplies. As a result, the vast majority of deaths have been among civilians and have been due to easily preventable and treatable illnesses such as fever and malaria, diarrhea, respiratory infections, and malnutrition. Children under five years old are at particular risk from these diseases. They account for 45.4% of the 500,000 deaths documented in this last survey period, even though they represent less than 20% of the total population.

4. **Lack of security has a direct effect on the number of deaths from both violent and non-violent causes.** Deaths from non-violent causes, such as infectious diseases, are highest in the most conflict-prone regions where security problems continue to impede access to health care and humanitarian assistance. In health zones where violent deaths were reported, CMRs are 75% higher than those of health zones where no violent deaths were reported. If the effects of insecurity and violence in the eastern provinces were removed entirely, it is estimated that mortality rates would reduce to almost normal levels (from 2.7 to 1.6 deaths per 1,000 per month). In the health zone of Kisangani-Ville, for example, fighting stopped in 2002 allowing health, water, and sanitation services to be rehabilitated. Since then, the CMR has declined by 79% and excess mortality has been eliminated.

5. **In spite of positive trends, mortality rates in DR Congo have not improved significantly since 2002.** During the period of this survey, January 2003 to April 2004, there was a gradual decrease in the total number of deaths in eastern provinces, largely due to improvements in security that allowed for increased humanitarian access. The national CMR has reduced from 2.4 to 2.0 since 2002, but this change was not statistically significant because of overlapping confidence intervals with the previous survey. Similarly, the CMRs for both eastern and western DR Congo have declined, but – for the same reason - are not significantly different from the survey of 2002.

For the fourth time since 2000, data from representative mortality surveys has demonstrated that the conflict in DR Congo dwarfs other emergencies in both its scale and humanitarian impact. No other recent conflict has claimed as many lives as DR Congo and mortality rates remain elevated at an alarming level. In spite of these unambiguous facts, the international community has not yet mobilized the necessary will or resources to effectively address the crisis. The survey's findings provide compelling evidence that improving security and increasing access to simple, cost-effective health interventions such as clean water, immunizations, and basic medical care would dramatically reduce preventable deaths.

During the months the survey was undertaken and since its completion, a number of serious security incidents have occurred that threaten to further destabilize the country and the region. The few recent political and humanitarian gains are now in jeopardy and a return to a full-scale war that engulfs the region is a distinct possibility. International engagement is tragically lacking in DR Congo, and hundreds of thousands of innocent people are dying as a result.

Acronyms and Abbreviations

CBR	Crude birth rate
CMR	Crude mortality rate
DR Congo	Democratic Republic of Congo
IRC	International Rescue Committee
MLC	Mouvement de Liberation du Congo (Congolese Liberation Movement)
MONUC	Mission des Nations Unies en République Démocratique du Congo (United Nations Mission in the Democratic Republic of Congo)
NGO	Non-governmental organization
RCD	Rassemblement Congolais pour la Democratie (Congolese Rally for Democracy)
U5MR	Under five years of age mortality rate
UN	United Nations
UNICEF	United Nations Children's Fund
WHO	World Health Organization
WHO/EPI	World Health Organization Expanded Programme on Immunization

Background

The roots of the conflict in the Democratic Republic of Congo are in many ways similar to those of other recent wars: at their source are a complex mix of poverty, ethnic rivalries, tribal divisions, land disputes, and competition over natural resources. However, a complete understanding of the war can only be gained through a consideration of the political situation in neighboring Rwanda, especially those events dating from the genocide in 1994, during which an estimated 500,000–800,000 ethnic Tutsis and moderate Hutus lost their lives.

In late 1996, the Rwandan army invaded eastern Zaire, ostensibly in response to cross-border guerrilla raids by the perpetrators of the Rwandan genocide who had fled into Zaire some two years earlier. Rwanda also began supporting Zairian rebel forces opposed to the then-President of Zaire, Mobutu Sese Seko. With additional assistance from Uganda, the Zairian rebels succeeded in toppling the Kinshasa government and seizing control of the country in only a few months. Zaire was then renamed the Democratic Republic of Congo (DR Congo).

The new government of Laurent Kabila formed a coalition with its foreign allies, but the alliance broke up just a year later and Kabila ordered the expulsion of all Rwandan and Ugandan armed forces from DR Congo. A wave of persecution of ethnic Tutsis then followed, precipitating a Rwandan and Ugandan re-invasion in August 1998.[1] Rwanda and Uganda again cited the need to improve border security and continue their unfinished hunt for the *genocidaires* as justifications for their action. This prompted neighbors Angola, Namibia and Zimbabwe to commit military forces on the side of the Kinshasa government, and the conflict soon escalated into what has been described as "Africa's World War."[2]

In July 1999, a framework to end the crisis was developed in Lusaka, Zambia. It outlined a process for the withdrawal of foreign troops, the disarmament of Congolese rebels and non-Congolese forces operating within DR Congo, and the formation of a government of reconciliation. It also defined the role of Mission des Nations Unies en République Démocratique du Congo (MONUC), the United Nations (UN) peacekeeping mission to DR Congo.

Despite this accord and a subsequent ceasefire agreement, fighting persisted. The country split into an eastern half controlled by Congolese rebel forces and their Rwandan and Ugandan backers, and a western half under the control of troops loyal to Kinshasa. All sides have violated the agreements: local militias have continued to attack both government and rebel Congolese forces; the Rwandan Hutu rebels within DR Congo maintain their aggression against the Rwandan army and their Congolese allies, the Rassemblement Congolais pour la Democratie (RCD); and Ugandan-backed Mouvement de Liberation du Congo (MLC) have failed to consistently meet their obligations under the peace agreements. All forces involved in the conflict have also been guilty of attacks on civilian populations and of human rights abuses, thereby contributing to a major humanitarian crisis.

Competition over the rich natural resources of eastern DR Congo, including diamonds and minerals, has also served to fuel the conflict[3] and remains a threat to peace and security today. All of the belligerents have been involved in appropriating the natural wealth of the region. Access to the rich Congolese mines is reported to be one of the major reasons that both Rwanda and Uganda maintained troops in DR Congo for so long[3] and it was not until late 2002 that both governments ratified an agreement to withdraw their forces.

In December 2002 a peace agreement was finally endorsed by the DR Congo government, the civilian opposition, and all major rebel groups. Under its provisions, a two-year transitional government was established in July 2003 with President Joseph Kabila remaining in the position of head of state. Four vice presidents have been drawn from the government, the political opposition, the Rwandan-backed RCD, and the Ugandan-backed MLC. The new Congolese army has representatives from the pre-existing DR Congo military, the RCD, the MLC, rebel splinter groups, and pro-government Mai Mai militias. Although protracted and behind schedule, an important disarmament, demobilization and reintegration process was initiated in early 2004. The peace agreement, if it stays on track, will lead to national, representative elections during 2005. However, a series of events in eastern provinces since May 2004, including the brief occupation of Bukavu by rebel forces and threats by the Rwandan government that it may attack DR Congo, highlight the fragility of the current ceasefire agreement. Indeed, the International Crisis Group states that not all parties have yet concluded "that the benefits of peace outweigh the illusory gains of further fighting."[4]

Introduction

DR Congo has been the scene of a horrific and complex war that began in August 1998 and quickly developed into a regional and international conflict. The war strained the already inadequate infrastructure of the country and exacerbated the difficulties faced by a poor and vulnerable population. The tactics employed by all factions to gain territorial control fractured the country politically, exposed civilians to brutal violence, destroyed livelihoods, and led to the collapse of social services, especially public health.

The broader health consequences of the war have been similar in nature but much greater in scale compared to those of other conflicts over the past two decades. In a series of three major mortality surveys, the International Rescue Committee (IRC) has demonstrated that between 1998 and 2002, an estimated 3.3 million people have died as a consequence of the war.[5,6,7,8] These data indicate that the Congolese conflict has been the world's most deadly since the end of World War II[9] and that the death toll far exceeds those of other recent crises, including Bosnia (estimated 250,000 dead),[10] Rwanda (800,000),[11] Kosovo (12,000),[12] and Darfur in Sudan (70,000).[13] Importantly, the vast majority of deaths have been among civilians, with 80–90% due to easily preventable and treatable causes such as infectious diseases and malnutrition. However, the killing of civilians was widespread and indiscriminate[6] and a large proportion of the civilian population was subjected to the practices of 'total war': beatings, theft and destruction of property, civil repression, and forced recruitment. The war has also been notable for its association with massive population displacements (including 3.2 million internally displaced persons and 440,000 refugees[14]) and the systematic use of gender-based violence as a military tactic.[15]

A viable solution to the crisis, and a lasting peace in DR Congo, can only be achieved through a concerted political and diplomatic process, involving local, regional, and international actors. Over the past two years, there have been some encouraging developments in this regard. The Pretoria and Luanda peace agreements of 2002 resulted in the withdrawal of Rwandan and Ugandan troops, which were widely seen as de-stabilizing influences. In July 2003 an interim Government of National Unity and Transition was formed with representatives from all political factions. A disarmament, demobilization and reintegration program for rebel forces and militias was initiated early in 2004. In addition, plans were drawn to conduct nation-wide democratic elections in 2005 that would be open to all major political parties. Finally, the deployment of approximately 10,000 UN peace-keeping troops had earlier held out the hope for greater security and stability in the violence-prone eastern region of the country.

The IRC's survey in 2002 validated the early success of some of these events—mortality rates had substantially improved since 2001 while remaining in excess of regional norms and well above the pre-war level. The better security conditions were believed to have led to improved food security, return of many displaced persons, restored livelihoods, and increased access to essential services, including health care.

In spite of these improvements, however, the potential for political instability in DR Congo remains high, with the eastern territories a particular source of concern. Tensions persist in the Ituri district of Orientale Province, where ethnic rivalries and competition over natural resources have only been controlled by international peace keeping efforts. Several outbreaks of violence occurred in both North and South Kivu during the first half of 2004 Other recent political and security incidents, especially centered around the eastern cities of Bukavu and Goma, indicate that the peace process still faces many complex challenges. A further deterioration has the real potential to develop into a "full-scale war" that could draw in several of DR Congo's neighbors[16]

The humanitarian needs also remain enormous and the resources available to address those needs are grossly inadequate. Over 70% of the population suffers severe food insecurity,[17] while high rates of malnutrition affect northern and eastern DR Congo.[18] Outbreaks of epidemic diseases such as measles, influenza and cholera remain common[19,20] and other infectious diseases are expanding their range: plague has resurged in Ituri[21] and sleeping sickness in Kasai Occidental province.[22] A recent report by the World Health Organization (WHO) states that "only 10-20% of the population currently (mid 2003) has access to essential health services."[23] Furthermore, the number of internally displaced people actually increased during 2003, but less than 40% of the funding required to implement UN agency projects was received by the Consolidated Agencies Appeal process during that year.[15]

Against this backdrop, the IRC decided to conduct its fourth mortality survey in DR Congo from May–July 2004. This was the second survey in the series to be conducted nationwide, the first two surveys having concentrated only on the eastern provinces.

The specific objectives of the survey were to determine the crude mortality rate (CMR) and the under five mortality rate (U5MR) for eastern and western DR Congo, to identify trends in mortality through comparison with recent historical data, to determine if there were regional differences in mortality rates, and to estimate the total number of excess deaths since the previous survey. This report summarizes the results of the study and makes recommendations concerning appropriate action. However, it must be noted that the document does not include mortality data for the period since the beginning of June 2004, during which there has been a resurgence of violence, including a brief occupation of Bukavu by rebel forces, an attempted coup in Kinshasa, and the massacre of over 150 Congolese Tutsi refugees in neighboring Burundi. Its conclusions therefore need be considered in the wider context of the deteriorating social, political and economic situation now confronting DR Congo.

Methods

DR Congo was divided into two strata along the 2001 line of military control: an "East" stratum of territory formerly held by rebel groups and a "West" stratum of territory formerly held by government forces. Each stratum was surveyed using a three-stage, household-based cluster sampling technique. Sample size was calculated to detect a difference of 10 deaths per 1000 people per year from the 2002 IRC survey point estimates of crude mortality (3.5 per 1000 people per month in the East and 2.0 per 1000 people per month in the west). A design effect of four for a recall period of 16 months was assumed.

In the first stage, four East health zones surveyed by the IRC on at least two prior occasions (Kalemie, Kalima, Katana and Kisangani-Ville) were purposively selected to allow for historical comparisons. These were excluded from the sampling frame. Forty-six health zones in the East (approximately 5.4 million people) were excluded due to security problems and three in the West (unknown population) were excluded due to inaccessibility. From the remaining population, 10 health zones in the West and 11 health zones in the East were randomly selected for study. Probability of selection was proportional to population size using 2004 government census data. Total population was estimated at 63.7 million (East = 22.9 million; West = 35.4 million; inaccessible = 5.4 million).

In the second stage, clusters were assigned to the smallest population units within each health zone (villages or avenues). Thirty clusters were selected in 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 by visual assessments or estimates by local leaders.

In the third stage, 20 households in each cluster were surveyed in the West and 30 in the East. A household was defined as a group of persons eating and sleeping together. The type of sampling depended upon the size and geographical distribution of the village or avenue. For well ordered and/or small units, 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, and the starting household 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, households were selected according to the standard World Health Organization Extended Program on Immunization (WHO/EPI) method.[24] 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 14 years of age was home, that household was skipped and the next nearest visited. Logistical, security and time constraints prevented a re-visiting of empty households.

The survey questionnaire was standardized and consisted of three questions taken from the 2002 IRC survey. The purpose of the study was explained to all heads of households and oral consent obtained. The age and sex of persons sleeping in the household on the night preceding the interview was documented. Any pregnancies, births or deaths occurring in the household since January 1, 2003 were recorded. Pregnancy outcomes were categorized either as a live birth, spontaneous abortion, stillbirth, or ongoing pregnancy. Decedents

needed to have normally slept in the interviewed household or have resided with the interviewed family at the time of their death. The age, gender, date, and cause of death were recorded for each decedent. 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 the local language(s) and dialects and all had excellent literacy and numeracy skills. Many of IRC's local staff members were already experienced in the conduct of similar surveys. The interviewers received standardized training that included field exercises. At a minimum, each interviewer was supervised by a senior IRC staff member or Burnet Institute consultant for the data collection of at least one entire health zone. Questionnaires were checked at the completion of each cluster for completeness and accuracy.

Data were entered into EpiData 3.0 with 5% cross-checking. STATA 8.0 and EpiInfo 6 were used for analysis. The data were weighted according to the probability of selecting each individual in the sample, as well as a post-stratification weighting accounting for the age and sex distribution of the sample. All mortality rates have been expressed as deaths per 1000 per month. The equation for the under-five mortality rate assumes that the total number of children being born is equal to the number of children turning five during the recall period. Table 1 lists the key equations used in this report.

Two subdivisions have been identified within the East stratum to allow analysis of mortality based on changes in the security situation over time and within specific geographic areas (see Figure 1 and Table 2). The divisions of the East have been classified according to regions of ongoing unrest as investigated in the 2002 IRC survey (designated "East 2002") and according to 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 Transitional East and so for the purposes of this report has been called "West 2002." Figure 2 illustrates the location of the selected zones throughout DR Congo.

Table 1: Summary of key equations			
Crude Mortality Rate (CMR)	$\dfrac{\text{Number of deaths in the sample}}{(\text{Number living in sample} + \frac{1}{2}\text{ deaths in the sample} - \frac{1}{2}\text{ live births in the sample})^{\#}}$	x	**1000** **Recall period***
Under five mortality rate (U5MR)	$\dfrac{\text{Number of deaths among those} < 5 \text{ years of age in the sample}}{\text{Number living} < 5 \text{ years of age} + \frac{1}{2}\text{ deaths among those} < 5 \text{ years}^{\#}}$	x	**1000** **Recall Period***
% Under one Mortality Rate	$\dfrac{\text{Number of deaths among those} < 1 \text{ year of age in the sample}}{\text{Number of live births in the sample}}$	x	**100**
* Recall Period is 16 months.			
# The denominator is an estimate of the sample population at the mid-point of the recall period.			

Figure 1:
Stratification of the Democratic Republic of Congo for the 2003-04 Survey

Figure 2: Health zones selected for 2004 countrywide mortality survey

	Health Zone	Subdivision of East stratum		Mode of selection	
		East 2002	Transition East	Random	**Purposive**
1	Bosomandanda		✓	✓	
2	Lisala		✓	✓	
3	Mushenge		✓	✓	
4	Tshofa		✓	✓	
5	Adi	✓		✓	
6	Isangi	✓		✓	
7	Kalemie	✓			✓
8	Kalima	✓			✓
9	Katana	✓			✓
10	Kisangani-Ville	✓			✓
11	Moba	✓		✓	
12	Oicha	✓		✓	
13	Rwanguba	✓		✓	
14	Shabunda Centre	✓		✓	
15	Titule	✓		✓	

Table 2: Eastern health zones by subdivision and mode of selection

Results

Surveys were conducted from late April to July 2004, though fighting in South Kivu during May and June resulted in a suspension of the study for three weeks. One health zone and two villages in the East could not be visited due to security concerns. They were replaced with the nearest unit of a similar size. In all, 19,500 households were visited: 13,500 in the East and 6,000 in the West, accounting for a total population of 119,378 persons. Of the total 750 clusters surveyed, 186 (24.8%) were sampled using systematic random sampling and 564 (75.2%) by the WHO/EPI method. Few households declined to participate in the survey: 22 (0.16%) in the East and only 3 (0.05%) in the West.

Tables 3 and 4 list demographic and mortality data for each of the health zones surveyed. The demographic profile of the population was consistent with national figures.[25] The average household size in the East (6.6 persons/household) was 29% larger than the average household size in the West (5.1).

We found that from January 2003 to April 2004, the CMR for both the eastern and western halves of DR Congo was significantly higher than the reported baseline for sub-Saharan Africa of 1.5 deaths per 1000 per month[26] (see Table 5). Over this period, rates for eastern Congo (CMR = 2.3, 95% confidence intervals 2.1-2.5) were significantly higher than for western Congo (1.7, 95% CI = 1.5-1.8). In the East 2002 subdivision, the CMR of 2.7 (2.4-3.0) and the U5MR of 5.8 (5.2-6.4) were also significantly higher than the corresponding rates for the West 2002 subdivision, where the CMR was 1.6 (1.5-1.7) and the U5MR was 4.0 (3.7-4.4). Seven of 15 (47%) eastern health zones and five of 10 (50%) of western health zones had a CMR higher than the regional norm.

These findings indicate a national mortality rate of 2.0 deaths (1.6-2.4) per 1000 per month if it is assumed that the zones excluded due to insecurity have the same rate as East 2002, or 1.9 deaths (1.5-2.4) per 1000 per month if it is assumed that the excluded zones experience a rate equal to the regional norm. Thus from January 2003 to April 2004, DR Congo as a whole still suffered a level of mortality approximately 67% greater than it did before the onset of war in 1998.[27]

The CMR for the East was not significantly different regardless of whether the four health zones that were purposively selected were included (CMR = 2.3) or not included (CMR = 2.2) (see Table 5). Four eastern zones—Shabunda Centre, Kalemie, Kalima and Moba— experienced death rates that, at a minimum, were more than twice DR Congo's pre-war rate of 1.2 deaths per 1000 per month.[27] Disturbingly, the CMRs in these four eastern zones surpassed even the "emergency situation" benchmark of one death per 10,000 per day[28] for the entire 16 months.

Deaths due to violent injury were concentrated in the East, where nine of 15 health zones reported at least one war-related violent death. The CMR in these zones (2.8) was 75 percent higher than the level of those eastern zones that did not report violent deaths (1.6) (see Table 6). Areas experiencing ongoing conflict and insecurity (East 2002) also had death rates that were almost twice those of the former rebel territories where there is minimal fighting (Transition East) (2.7 and 1.4 respectively). Only one violent death was recorded in the West for 2003-04, in a zone bordering former rebel-held territory (Kalonda East).

Adult males aged 15 years and over were at greater risk of being killed, constituting 72% of all violent deaths, although women and children were not exempt (see Table 7). Interviewees recounted military forces killing their relatives by shooting or beating them, cutting their throats, and, in one case, torturing a family member to death. The disease-specific mortality

rate due to violence (0.05 deaths per 1,000 per month) and the percentage of all deaths due to violence (1.8%) have not changed significantly since the 2002 survey.

On the other hand, the number of violent deaths (and the proportion of violent deaths) showed a significant decrease over the 16-month period of the survey in eastern health zones reporting war-related deaths (see Figure 3). Similarly, the reduction of non-violent mortality in these health zones over the same period was statistically significant (a chi-square test for linear trend for both lines in Figure 3 had p-values of <0.05). In addition, logistical regression analysis of all eastern health zones demonstrated that the CMR would be 1.6 (1.4-1.7) in the absence of all violence. This is the same as the average CMR in eastern zones that did not experience a violent death during the recall period (see Table 6). These associations suggest a strong link between insecurity and deaths from both violent and non-violent causes. The situation is less clear in the West. The number of deaths in the first third of 2004 is well above that recorded during the same period the year before (see Figure 4). The reasons for this increase are unclear, but appear not to be directly linked to increases in either insecurity or violence.

The majority of deaths for both the East and West strata continue to be due to preventable and easily treatable diseases (Figures 5 to 8). Fever/malaria, diarrhea, respiratory infections, and malnutrition are the principal causes of death, together accounting for more than 50% of deaths in both the East and the West. Children under five years of age are at particular risk from these diseases and, indeed, accounted for 45.4% of all deaths, even though they make up only 18.7% of the sample population (relative risk of dying compared to persons over the age of 5 years = 3.5).

Malnutrition was cited as a primary or a contributing cause in 10.9% of all deaths in the East and 8.1% in the West. Maternal deaths were also more common in the East (maternal mortality ratio of 1174 deaths per 100,000 live births) than the West (811 deaths per 100,000 live births). Deaths from meningitis and deaths in the neonatal period were higher in the East, while measles-related deaths were higher in the West, a finding that reflects a large epidemic within two zones in Kasai Occidental this year. In the West, there were almost three times as many measles deaths in 2003-04 (4.6% of all deaths at a rate of 0.085 deaths per 1000 per month) than recorded in 2002 (1.6% at a rate of 0.034 deaths per 1000 per month).

The national CMR of 2.0 (1.6-2.4) has not changed significantly since 2002 (CMR = 2.4). In addition, although the point estimates for crude mortality decreased by 23% in the East and by 20% in the West between the IRC surveys of 2002 and 2003-04, these changes did not reach statistical significance (see Table 8). Comparisons of 2002 and 2004 mortality data for the four eastern zones that were purposively selected demonstrated mixed findings (see Table 9). While two of four zones demonstrated a decrease in both CMR and U5MR (Kalemie and Kisangani-Ville), two others showed a non-significant increase in CMR (Kalima and Katana), with Katana also demonstrating a non-significant increase in U5MR. The only zone to show a statistical improvement, Kisangani-Ville, was the scene of heavy fighting before the 2002 IRC survey but has had a strong UN military presence since.

Using the weighted CMRs, we estimate that approximately 500,000 excess deaths above baseline have occurred across all health zones of DR Congo between January 2003 and April 2004. This represents more than 31,000 excess deaths per month. Seventy-seven percent of these deaths have occurred in the East 2002 health zones. When combined with the findings of previous surveys, we estimate that almost 3.8 million people have died as a result of the conflict in the DR Congo from August 1998 until April 2004. This "best estimate" makes three assumptions: firstly, that the prior estimate by the IRC of 3.3 million deaths up until the end of 2002 was reasonable; secondly, that the baseline mortality rate for DR Congo is equal to the sub-Saharan norm of 1.5 deaths per 1,000 per month; and, finally, that the zones excluded in the East due to security problems had the same CMR as the East 2002 subdivision, as this was the most insecure region to which the researchers had access. These assumptions can be adjusted to estimate a minimum and a maximum death toll. If the baseline CMR is equal to

the 2003-04 rate for the West, and the excluded zones have a rate equal to this baseline, then the minimum number of deaths due to this conflict is approximately 3.5 million. If the baseline is the same as the pre-war mortality rate as reported by the United Nations Children's Fund (UNICEF) (1.2 deaths per 1,000 per month), and the excluded zones experience the same death rate as the worst eastern zone recorded in 2003-04, then the maximum reasonable estimate is 4.4 million deaths due to the conflict.

EAST		Population Sampled				Reported Deaths		Mortality Rates	
	Health Zone	Total	Children under 5 years	Male: female ratio	Mean household size	Total	Children under 5 years	Crude	**Children under 5 years**
1	Bosomondanda	7576	1551 (20.5%)	0.92	8.4	124	56	1.0 (0.8-1.3)	**2.2 (1.6-2.9)**
2	Rwanguba	4519	841 (18.6%)	0.97	5.0	84	50	1.1 (0.8-1.5)	**3.6 (2.6-4.7)**
3	Kisangani-Ville	7189	1196 (16.6%)	0.91	8.0	143	43	1.3 (1.0-1.6)	**2.2 (1.5-2.9)**
4	Oicha	5591	1052 (18.8%)	0.90	6.2	118	53	1.4 (1.1-1.8)	**3.0 (2.2-3.7)**
8	Tshofa	6552	1184 (18.1%)	0.99	7.3	162	67	1.4 (1.1-1.8)	**3.2 (2.2-4.2)**
5	Lisala	6616	1360 (20.6%)	0.93	7.4	150	74	1.4 (1.2-1.7)	**3.2 (2.5-4.0)**
7	Adi	4929	963 (19.5%)	0.92	5.5	117	62	1.5 (1.2-1.7)	**3.9 (3.1-4.7)**
9	Mushenge	5031	1129 (22.4%)	0.92	5.6	123	63	1.5 (1.2-1.8)	**3.3 (2.5-4.2)**
6	Isangi	6521	1274 (19.5%)	0.92	7.2	156	60	1.7 (1.3-2.0)	**2.9 (2.1-3.7)**
10	Titule	3609	561 (15.5%)	0.95	4.0	116	34	2.1 (1.6-2.6)	**3.8 (2.6-5.0)**
11	Katana	5650	1063 (18.8%)	0.94	6.3	220	103	2.3 (1.7-2.9)	**5.7 (4.5-7.0)**
13	Moba	4841	794 (16.4%)	0.89	5.4	267	155	3.3 (2.7-3.9)	**11.3 (9.4-13.3)**
14	Kalemie	5373	941 (17.5%)	0.93	6.0	311	158	3.6 (3.2-4.1)	**9.8 (8.2-11.5)**
12	Kalima	7763	1260 (16.2%)	0.94	8.6	431	176	3.7 (2.9-4.4)	**8.1 (6.2-10.0)**
15	Shabunda Centre	6986	1159 (16.6%)	0.94	7.8	652	245	6.4 (5.7-7.2)	**12.0 (10.2-13.9)**
	TOTAL	88746	16328 (18.4%)	0.93	6.6	3174	1399		

Table 3: Eastern health zone profiles for a 16-month recall period (1/1/2003 to 4/30/2004)

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All Rates expressed as deaths per 1000 per month (95% Confidence Intervals)

Table 4: Western health zone profiles for a 16-month recall period (1/1/2003 to 4/30/2004)

	WEST	Population Sampled				Reported Deaths		Mortality Rates	
	Health Zone	Total	Children under 5 years	Male: female ratio	Mean household size	Total	Children under 5 years	Crude	Children under 5 years
1	Sona Bata	3037	591 (19.5%)	0.92	5.1	42	26	0.8 (0.5-1.1)	2.8 (1.8-3.8)
2	Kikwit North	3451	522 (15.1%)	0.84	5.8	65	24	1.1 (0.9-1.4)	2.8 (1.5-4.1)
3	Dilolo	2627	468 (17.8%)	0.93	4.4	49	28	1.1 (0.9-1.5)	3.6 (2.3-4.8)
5	Panzi	3434	671 (19.5%)	0.97	5.7	78	38	1.4 (1.0-1.7)	3.5 (2.4-4.6)
4	Maluku I	3201	612 (19.1%)	0.95	5.3	69	36	1.4 (1.1-1.8)	3.8 (2.6-5.0)
6	Tshilenge	2730	571 (20.9%)	0.83	4.6	71	29	1.6 (1.1-2.0)	3.0 (2.0-4.0)
7	Mutena	2789	614 (22.0%)	0.98	4.6	89	54	1.8 (1.4-2.2)	5.2 (3.9-6.5)
8	Kipushi	2874	573 (19.9%)	0.92	4.8	98	41	2.2 (1.7-2.7)	4.4 (3.1-5.7)
9	Kalonda East	3443	704 (20.4%)	0.89	5.7	133	73	2.3 (1.9-2.7)	6.2 (4.8 -7.6)
10	Kalonda West	3046	667 (21.9%)	0.86	5.1	132	74	2.6 (2.0-3.3)	6.6 (4.7 -8.6)
	TOTAL	30,632	5993 (19.6%)	0.91	5.1	826	423		

All Rates expressed as deaths per 1000 per month (95% Confidence Intervals)

Table 5: Aggregated mortality rates for a 16-month recall period (1/1/2003 to 4/30/2004)						
Stratum	Subdivision of stratum	Number of health zones and type of selection	Mortality rates and design effects			
			CMR	DE	U5MR	DE
EAST	EAST	11 random and 4 purposive	2.3 (2.1-2.5)	7.4	4.8 (4.4-5.3)	**3.2**
	EAST	11 random	2.2 (2.0-2.4)	6.2	4.7 (4.-5.1)	**2.7**
	EAST 2002	7 random and 4 purposive	2.7 (2.4-3.0)	8.2	5.8 (5.2-6.4)	**3.6**
	EAST 2002	7 random	2.7 (2.3-3.0)	6.2	5.7 (5.0-6.3)	**2.7**
	TRANSITIONAL EAST	4 random	1.4 (1.2-1.5)	1.9	3.0 (2.6-3.4)	**1.4**
WEST	WEST 2003-04	10 random	1.7 (1.5-1.8)	1.6	4.3 (3.8-4.7)	**1.4**
	WEST 2002	10 random + 4 transitional east	1.6 (1.5-1.7)	2.2	4.0 (3.7-4.4)	**1.9**
All Rates expressed as deaths per 1000 per month (95% Confidence Intervals)						

| Table 6: Comparison of East health zones with and without violent deaths (1/1/2003 to 4/30/2004)				
Subdivision of former East	Mortality Rates[^] and Design effects			
	Crude	DE	Under 5 years of age	DE
Health zones reporting violence [*]	2.8 (2.5-3.1)	8.9	6.3 (5.6-7.0)	**3.6**
Health zones not reporting violence[#]	1.6 (1.4-1.7)	2.5	3.0 (2.7-3.4)	**1.5**

[*] Adi, Tshofa, Kalemia, Kalima, Katana, Moba, Oicha, Rwanguba and Shabunda Centre

[#] Mushenge, Bosomondanda, Lisala, Kisangani-Ville, Isangi, Titule,

[^] Mortality rates are weighted by population and expressed as deaths per 1000 per month (95% Confidence Intervals)

| Table 7: Proportionate mortality of violent deaths and relative risk of violent death in the East		
Population Group	Proportionate mortality for violent deaths	**Relative Risk**
Children younger than 15 years	5 of 1707 (0.3%)	**Reference**
Women aged 15 years or over	9 of 681 (1.3%)	**4.5 (1.5-13.3)**
Men aged 15 year or over	36 of 774 (4.7%)	**15.2 (6.0-38.6)**
		Recall Period = January 2003 to end of April 2004

Figure 3: Violent and Non-Violent Deaths over 16 months in Eastern Zones reporting war-related deaths
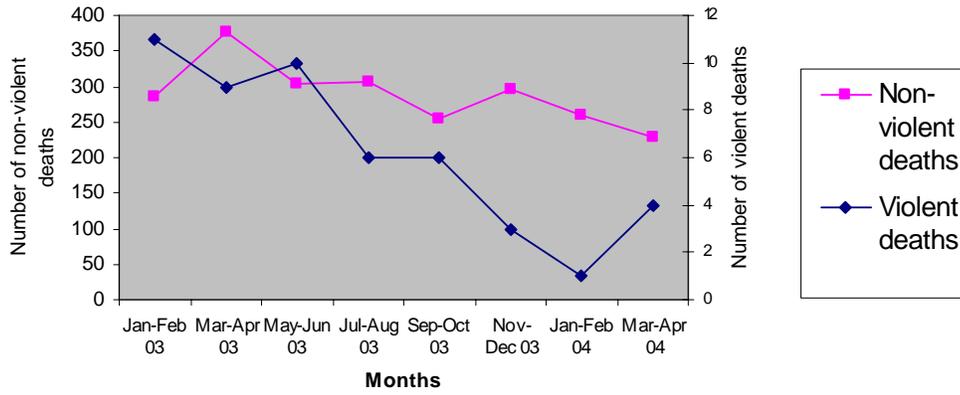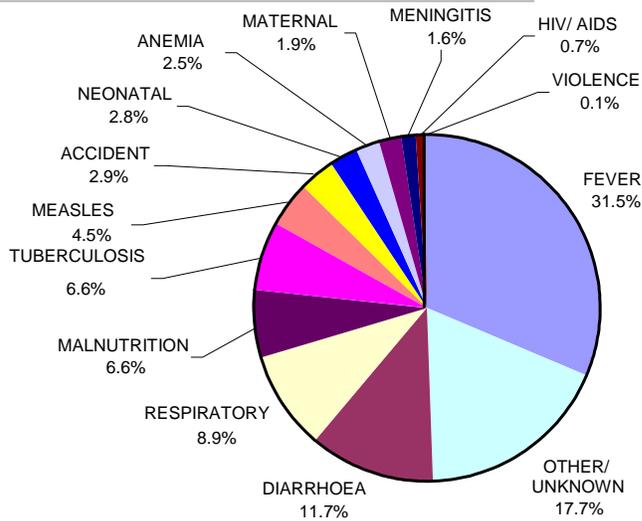

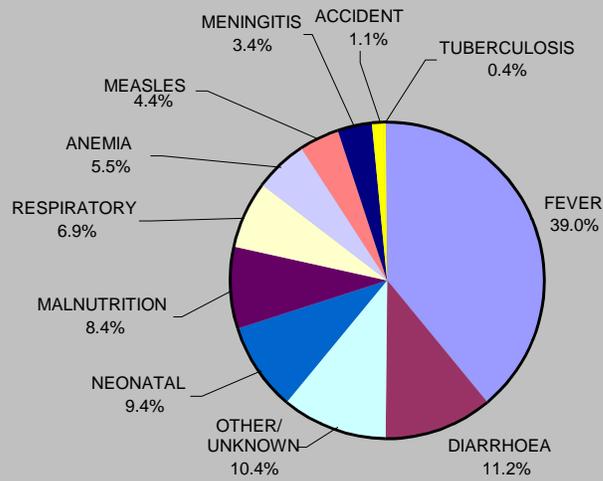**Figure 4: All deaths reported in the West over 16 months**
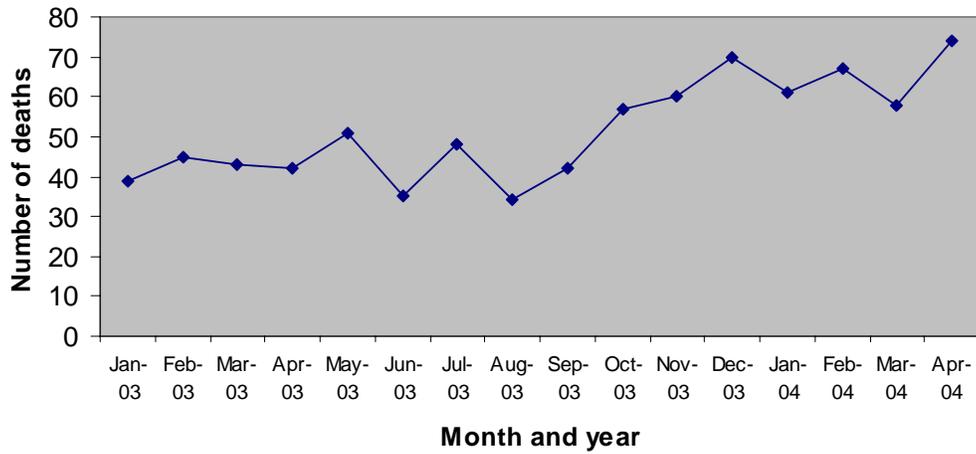
Figure 5:
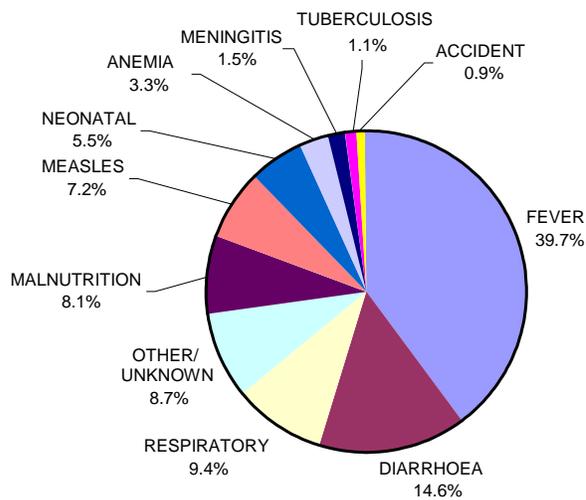**Proportionate cause specific mortality for all age groups in East DR Congo from 1/1/03 to 4/30/04**
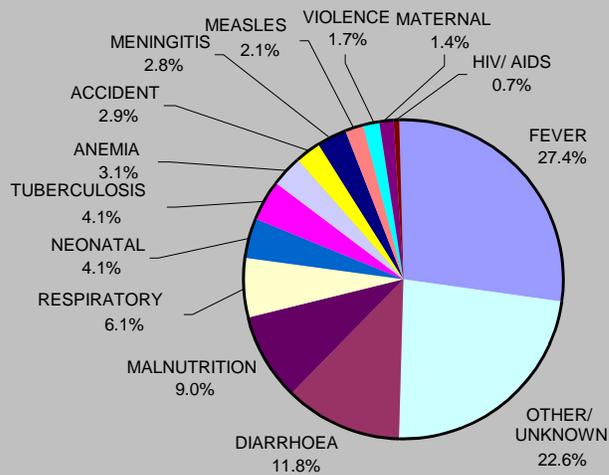
Figure 6
Proportionate cause specific mortality for all age groups in West DR Congo from 1/1/03 to 4/30/04

Figure 7.
**Proportionate cause specific mortality in children
under 5 years in East DR Congo from 1/1/03 to 4/30/04**

MENINGITIS 3.4%
ACCIDENT 1.1%
TUBERCULOSIS 0.4%
MEASLES 4.4%
ANEMIA 5.5%
RESPIRATORY 6.9%
FEVER 39.0%
MALNUTRITION 8.4%
NEONATAL 9.4%
OTHER/UNKNOWN 10.4%
DIARRHOEA 11.2%

Figure 8
**Proportionate cause specific mortality in children
under 5 years in West DR Congo from 1/1/03 to 4/30/04**

MENINGITIS 1.5%
TUBERCULOSIS 1.1%
ANEMIA 3.3%
ACCIDENT 0.9%
NEONATAL 5.5%
MEASLES 7.2%
FEVER 39.7%
MALNUTRITION 8.1%
OTHER/UNKNOWN 8.7%
RESPIRATORY 9.4%
DIARRHOEA 14.6%

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Table 8: Comparison of 2002 and 2003-04 survey findings

Stratum	Year	Mortality Rates			% of Violent Deaths	% newborns dead by 12 months[#]	% pregnancies lost[+]	Crude Birth Rate (CBR)
		Crude	Children under 5 years	Cause Specific (Violence)				
EAST[*]	2002	3.5 (2.2-4.9)	9.0 (4.0-14.0)	0.06	1.6%	21.0%	21%	**44 (38-50)**
	2003-04	2.7 (2.4-3.0)	5.8 (5.2-6.4)	0.05 (0.03-0.07)	1.8%	15.0%	10.4%	**49 (47-50)**
WEST[^]	2002	2.0 (1.5-2.6)	4.4 (3.2-5.7)	0	0%	11.6%	7.0%	**52 (43-60)**
	2003-04	1.6 (1.5-1.7)	4.0 (3.7-4.4)	0.002 (-0.001-0.006)	0.2%	9.7%	11.8%	**51 (50-53)**

Mortality rates expressed as deaths per 1000 per month (95% Confidence intervals only available for 2003-04)

CBR expressed as live births per 1000 per year (95% Confidence intervals)

[*] For 2003-04 (East 2002) is equivalent to the areas in the East that were surveyed in 2002

[^] For 2003-04 (West 2002) is equivalent to the areas in the West that were surveyed in 2002 West. This is equal to (West 2003-04 + Transition East).

[#] Percentage newborns dead by 12 months = [(number of deaths of children under 1 year of age) / (number of live births)] *100

[+] Percentage of pregnancies lost = [(number of spontaneous abortions and stillbirths) / (number of live births + spontaneous abortions + stillbirths)]

Table 9: Comparison of 2003-04 survey findings for individual health zones with IRC surveys from previous years						
Health Zone	**Mortality Rate** [*]	**Duration of recall period for IRC survey**				
		1998-99	1999-2000	2000-01	2002	**Jan 2003-April 04**
Kalemie	Crude	Not Surveyed	Not Surveyed	10.8 (9.5-12.1)	4.2 (2.8-5.6)	**3.6 (3.2-4.1)**
	Under 5 years			23.8 (19.8-27.8)	14.9	**9.8 (8.2-11.5)**
Kalima	Crude	Not Surveyed	Not Surveyed	7.5 (6.3-8.7)	3.0 (2.2-3.9)	**3.7 (2.9-4.4)**
	Under 5 years			17.1 (13.2-21.0)	8.9	**8.1 (6.2-10.0)**
Katana	Crude	3.8	3.0	4.9 (3.8-6.0)	1.9	**2.3 (1.7-2.9)**
	Under 5 years	10.1	6.9	12.9 (9.3-16.5)	2.9	**5.7 (4.5-7.0)**
Kisangani-Ville	Crude	Not Surveyed	2.9	Not Surveyed	6.2	**1.3 (1.0-1.6)**
	Under 5 years		4.8		10.4	**2.2 (1.5-2.9)**
Moba[#]	Crude	Not Surveyed	12.1	Not Surveyed	Not Surveyed	**3.3 (2.7-3.9)**
	Under 5 years		24.5			**11.3 (9.4-13.3)**

[*] Mortality rates expressed as deaths per 1000 per month (95% confidence intervals quoted if available)

[#] Moba was selected randomly in 2003-04

Discussion

This latest survey of DR Congo was conducted under difficult conditions. Surveying was suspended for three weeks during June because of major security concerns. During this time one of the main IRC offices was attacked and burnt, and staff threatened. Nonetheless, the survey was representative of almost the entire national population and a method comparable to the 2002 IRC survey was used to allow a discussion of the key trends in mortality experienced over this time.

It should be noted that our stratification into an East and West DR Congo should not be interpreted as a contemporary political or military divide; indeed, such a military or political division could be viewed as undermining the current democratization of DR Congo. Rather, the East/West stratification should be seen as a reflection of the fact that these two sections of the *same* country are experiencing different conditions as a result of ongoing conflict in the eastern provinces.

The primary finding of this study is that there has been a significant and sustained elevation of mortality in DR Congo from January 2003 to April 2004. The weighted CMR for DR Congo over that period is estimated to be 2.0 deaths per 1000 per month, a rate that is one third higher than the reported baseline for sub-Saharan Africa. This translates into 500,000 total deaths, or 31,000 people dying per month, in excess of what would normally be expected over this time period.

However, this death toll is not uniformly distributed throughout the country: mortality rates in the insecure eastern part of the country remain significantly higher than the West. Eastern DR Congo is currently experiencing a CMR that is more than 50% above the normal rate for sub-Saharan Africa, six years after commencement of the war. In the five most insecure provinces (East 2002), the CMR is 80% higher than the regional norm and the U5MR is 70% higher. Seventy-seven percent of the excess mortality occurred in these provinces. Of particular concern is that four eastern health zones recorded a CMR that exceeded the emergency threshold of one death per 10,000 per day[28] for the entire 16 months covered by the survey.

These findings demonstrate that DR Congo remains in the grip of a major humanitarian crisis that continues to be most severe in the eastern provinces. Three previous mortality surveys conducted by the IRC between 2000 and 2002 showed that an estimated 3.3 million people have already died in eastern DR Congo since the outbreak of the war in August 1998. These prior investigations have also revealed the war to be the world's most deadly in the last 50 years. Data from this most recent survey now suggests that the death toll is closer to 3.8 million and that the highest death rates remain concentrated in the unstable, conflict-prone East.

The persistently high mortality in DR Congo is deeply disturbing and indicates that both the national and international efforts to address the crisis remain grossly inadequate. Far greater efforts are still required in every aspect of the international response: diplomatic, military/peacekeeping, and humanitarian. In spite of the troubling results of this survey, however, there are some findings that reveal hopeful trends and suggest a more positive way forward.

IRC's earlier studies had demonstrated a decrease in mortality in eastern DR Congo from 2001 to 2002. For the most recent survey, the point estimates for CMR and U5MR have improved since 2002 at the national level (CMR=2.4 and 2.0, for 2002 and 2004 respectively)

and in both eastern and western DR Congo. However, none of these decreases reached statistical significance. Comparisons for the four eastern zones that were purposively selected demonstrated mixed findings between 2002 and 2004. One encouraging finding, however, is that trend data since January 2003 demonstrates a significant decline in crude mortality in eastern DR Congo over the 16 month course of the survey.

Further analysis of the data suggests that the reductions in crude mortality are closely associated with reductions in violence and, by extension, improvements in security. The average CMR of health zones for which a violent death was documented is 75% higher than that of health zones where no violent deaths were recorded. In addition, when the effects of violence are removed for all eastern health zones, the CMR for the East would reduce from 2.3 to 1.6 deaths per 1,000 per month, thereby almost eliminating excess mortality. Importantly, the overall CMR in health zones formerly held by rebels where there is no current fighting (i.e., Transition East) is now 1.4 and similar to those in Western DR Congo. Finally, in Kisangani-Ville, the CMR has declined by 79% and excess mortality has almost been eliminated since fighting in the city stopped in 2002.

All of these trends underscore the association between violence and mortality due to all causes in DR Congo. They also provide compelling evidence that improvements in security represent one of the most effective means to reduce excess mortality in DR Congo. The most obvious inference to be drawn is that a larger, more robust peacekeeping force than the current MONUC contingent of 16,700 is urgently required in order to effectively address the security concerns and associated humanitarian needs in DR Congo. But any additional troops must be better trained, better equipped, have a broader mandate, and be willing to engage more forcefully than existing MONUC personnel.

Another key finding of the survey is that the overwhelming majority of deaths were due to preventable causes such as malnutrition and infectious diseases. Some epidemic diseases, like measles, even appear to be on the increase. Moreover, it is young children who are disproportionately affected by these illnesses. Children under the age of five years accounted for more than 45% of all deaths, although they represent only 18.7% of the population. Improving food security and increasing access to essential health services, such as immunizations, clean water, insecticide-treated bednets and case management of common diseases, have the potential to contribute significantly to reductions in excess mortality. The international humanitarian response should emphasize established, cost-effective strategies and interventions related to infectious disease control, child survival and environmental health.

In addition, access to reproductive health services, especially emergency obstetric care and HIV/AIDS prevention and control, should be improved. The maternal mortality ratio in both the East and West, while not significantly different from pre-war levels, remains appallingly high in DR Congo. Although HIV/AIDS was not reported to be a major cause of mortality during the survey (0.7% of all deaths), it was almost certainly under-reported. There are currently few well-established HIV/AIDS control programs in DR Congo and the official national seroprevalence of 5.1% is therefore almost certainly an underestimate.

In spite of the critical need to complement security and diplomatic measures with increased humanitarian interventions, the response of the international community to date has been poor. During 2004, only 42% of funding sought by the UN for its activities in DR Congo through the Consolidated Appeals Process had been raised by August.[29] In addition, contributions by the United States Agency for International Assistance to DR Congo for 2004 have declined by almost 25% when compared with 2003.[30,31]

In interpreting the results, it is important to recognize the limitations of the survey. First, five million people were inaccessible because of security issues and so were excluded from the sampling frame. Second, during the conduct of the survey, security concerns led to the

substitution of one health zone and two villages with the nearest accessible unit of a similar population size. Third, the sample does not capture households where all occupants have died (survival bias). Fourth, under-reporting of infant deaths is a known issue in rural Africa.[32,33] All these factors serve to underestimate the mortality rates.

On the other hand, the seasonal variations in mortality seen in previous IRC studies—with peaks at the end of the rainy season between November and January—may result in a slight overestimation of mortality for the 16-month recall period. Recall bias is likely to affect the results, although it is difficult to measure the extent or direction of bias. Long recall periods may lead to an underestimate of less recent deaths, while traumatic events may be remembered as having occurred more recently than is actually the case.[34]

Formal verbal autopsies were not performed, although information concerning the cause of death was sought. While it is likely that responses were valid for traumatic deaths and common diseases with obvious clinical manifestations, such as measles, other cause of death data must be interpreted with caution. Additionally, no independent confirmation of deaths was sought and pressures on interviewees to under or over report mortality are not well understood.

Lastly, the WHO/EPI method was not designed to measure mortality. The mortality surveys employing this method, therefore, have often reported higher design effects than the usually expected level of two, particularly when examining violent deaths. Despite assuming a design effect of four for the 16-month recall period, values beyond two were still obtained, especially for the eastern strata. Mortality surveys may need to assume design effects of many times greater than two, though this has to be balanced against the consequent increases in costs, time and logistical requirements, not to mention security risks, when studying populations in such contexts.

Notwithstanding these constraints, we believe that periodic surveys are an invaluable tool for mapping the trends in mortality in a conflict situation where regular sources of data are limited. Lack of security has been clearly linked to elevated mortality rates and, consequently, DR Congo still endures a rate among the highest in the world. The limits of the current "peace"—geographically restricted, unaccepted by key factions, and undermined by economic and political interests—is reflected in the great number of excess deaths found in this survey and points to the inadequacy of national and international efforts.

The parsimony and apathy of the international community have continued in the face of gross humanitarian need. Although the UN recently agreed to deploy an additional 5900 peacekeepers in October (bringing the total to 16,700), this was less than half the troops requested by the Secretary General of the UN and below the "minimum required to meet the current challenges in DR Congo."[35] According to the International Crisis Group, the "collapse of the Congo peace process and return to war are real prospects" [36] unless the needs of the country are addressed through the supply of sufficient resources backed by a resolute will. Yet even if this worst-case scenario is averted, maintenance of the status quo is unacceptable: the East remains in conflict and hundreds of thousands of civilians continue to die unnecessarily as a result.

Acknowledgements

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