

## Improving Surveillance for Maternal and Perinatal Health in 2 Districts of Rural Tanzania

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Of the more than half million women who die each year from pregnancy-related causes, 99% reside in developing countries.<sup>1</sup> Despite the renewed focus on maternal health brought by the launch of the Safe Motherhood Initiative at an international conference in Nairobi, Kenya, in 1987, maternal mortality ratios in Africa are still alarmingly high, estimated at more than 1000 maternal deaths per 100 000 live births for 1995.<sup>2</sup> At the same time, recognition of the need to consider maternal and newborn care together as a "package" is increasing because many of the same underlying factors lead to both maternal and perinatal deaths.<sup>3</sup> Addressing maternal and newborn health in rural parts of Africa offers particular challenges because of the inadequate public health infrastructure and the distance of communities from facilities providing skilled care. Also, program managers lack access to local data for basic indicators such as maternal and perinatal deaths, cesarean delivery rates, and deliveries by skilled attendants. Available data are often facility based rather than population based, and vital registration systems cover rural areas very poorly.

Cooperative for Assistance and Relief Everywhere (CARE)—Tanzania's Community-Based Reproductive Health Project works to address both health care service and management information and surveillance data needs. The project operates in 2 districts of Mwanza Region in Tanzania, with a goal of improving maternal health, maternal and newborn care, family planning, and HIV and other sexually transmitted disease prevention services.<sup>4</sup> In these districts, with a population of approximately 150 000 women of reproductive age, 50% of births occur at home, often alone or attended by a relative or traditional birth attendant, and the travel time to a facility with emergency obstetric care capacity<sup>5</sup> is often 6 hours or more. Vital registration of births and deaths outside of main towns is virtually nonexistent.

**Objectives.** As part of a community-based reproductive health project in rural Tanzania, a maternal and perinatal health care surveillance system was established to monitor pregnancy outcomes. This report presents preliminary results.

**Methods.** Village health workers were trained to collect data during health education visits to pregnant and postpartum women. Maternal and fetal or infant survival or deaths were tracked on a community monitoring board.

**Results.** Among 904 pregnancies, the fetoneonatal mortality rate was 69.4 deaths per 1000 live births and fetal deaths; 4 maternal deaths occurred. Intrapartum and early neonatal deaths of infants with birthweights of 1500 g or greater represented a large proportion of deaths.

**Conclusions.** These preliminary results will be used to prioritize project interventions, including increasing access to skilled delivery care. (*Am J Public Health.* 2001;91:1636-1640)

Through the CARE—Centers for Disease Control and Prevention (CDC) Health Initiative, a maternal and perinatal health care surveillance system was established in the project area. This village-based system includes the monitoring of pregnancy outcomes and enables local and district-level health officials to determine baseline estimates of perinatal, infant, and maternal mortality and other obstetric care indicators.

The Maternal and Perinatal Health Care Surveillance System incorporates a community monitoring board, displayed in a prominent location in each village, which tracks maternal, fetal, and infant deaths on a table charting birthweight by age at death (see Table 2 later in this article), referred to as "BABIES" (Birthweight by Age-at-Death Boxes for Intervention and Evaluation System).<sup>6</sup> The community monitoring boards are color-coded to match birthweight group and age-at-death "cells" (i.e., square boxes on the board) with clusters of underlying causes and their associated prevention intervention packages. The BABIES model proposes that examining the distribution of perinatal deaths by birthweight and age at death can help to direct intervention planning and monitor the effectiveness of interventions. For example, if the intermediate- and normal-birthweight boxes for the intrapartum period indicate

high rates of mortality, these deaths, which are primarily caused by asphyxia, could be prevented by strategies that increase access to cesarean deliveries.

In this preliminary analysis, we present data collected from March 2000 through February 2001 for the initial 22 participating villages and provide recommendations for using these surveillance data to plan and evaluate maternal and perinatal health care interventions.

### METHODS

The maternal and perinatal health care surveillance system was implemented in 2 clusters of villages in Kwimba and Missungwi districts. The clusters included all segments of the villages and health facilities in a fixed geographic area; 22 of the 32 villages in the clusters were covered in the first phase of implementation reported here.

In each village, 2 to 3 village health workers received training in implementing the surveillance system in conjunction with broader training in reproductive health education. The village health workers identified and registered all pregnant women within their assigned area, generally during the fifth month of pregnancy. They interviewed these women during birth planning and educa-

tional visits; up to 4 times during pregnancy; immediately after delivery; and at 1 month, 6 weeks, 6 months, and 1 year after delivery. They collected information about sociodemographics, medical and obstetric history, behavioral factors, and pregnancy outcome, including place of delivery, type of delivery, delivery attendant, birthweight group, and maternal and fetal or neonatal survival or mortality. Birthweight was measured in grams when village health workers had access to scales; when scales were unavailable, birthweight was estimated based on hand size measurements. Surveillance data collection was integrated with counseling on antenatal nutrition, clean delivery, birth planning, warning signs of obstetric complications requiring medical intervention, and identification of the nearest facility with the capacity to manage complications.

Maternal and perinatal survival and mortality information was routinely displayed on a community monitoring board on which pregnancy outcomes were organized by birthweight group and age at death based on the BABIES model.<sup>6</sup> Community meetings with village leadership and health staff were held periodically to conduct detailed fetal, infant, and maternal mortality reviews, which included opportunities for prevention and intervention planning.

Data from the village health workers' pregnancy registers were entered into Epi Info 6.04b<sup>7</sup> by CARE project staff and analyzed in collaboration with CDC technical advisors. Only singleton births were included in this analysis. The fetoneonatal mortality rate was defined as fetal or neonatal deaths (up to 28 days postpartum) per 1000 live births and fetal deaths. The maternal mortality ratio was defined as the number of maternal deaths per 100 000 live births.

The BABIES model was used to divide outcomes into 3 birthweight groups corresponding to the level of technology associated with care for each group: normal (2500 g), intermediate (1500–2499 g), and very low (<1500 g). Outcomes were divided into time periods: antepartum (macrated stillbirths), intrapartum (fresh stillbirths), 0 to 7 days, 8 to 28 days, and further periods up to 1 year, which are not

TABLE 1—Characteristics of the Study Population

	Pregnant Women (N = 904)	
	n	% <sup>a</sup>
Sociodemographic characteristics		
Age, y		
Median (range)	25 (14–48)	NA
<20	144	16.2
20–34	629	70.8
≥35	116	13.0
Education		
None	116	12.8
1–6 y	106	11.7
7 y (standard primary)	620	68.6
>Primary	62	6.9
Parity		
Median (range)	2 (0–11)	NA
0	159	21.4
1–4	412	55.4
≥5	173	23.3
Delivery characteristics		
Place of delivery		
Home	475	55.1
In transit <sup>b</sup>	16	1.9
Dispensary	187	21.7
Health center	134	15.5
Hospital	50	5.8
Attendant		
Alone or relative	327	40.4
TBA or VHW	125	15.4
Nurse or MCHA	169	20.9
Midwife or clinical officer	183	22.6
Doctor	6	0.7
Mode of delivery		
Vaginal	852	99.1
Assisted <sup>c</sup>	4	0.5
Cesarean	4	0.5
Antenatal care characteristics		
No. of tetanus immunizations		
<2	171	23.8
2–4	387	54.0
≥5	159	22.2
Iron-folate supplementation		
None	499	71.5
Any	199	28.5

Note. NA = not applicable; TBA = traditional birth attendant; VHW = village health worker; MCHA = maternal child health aide.

<sup>a</sup>Denominators vary because of missing values. Percentages may not add up to 100% because of rounding.

<sup>b</sup>Born before arrival (en route to a health care facility).

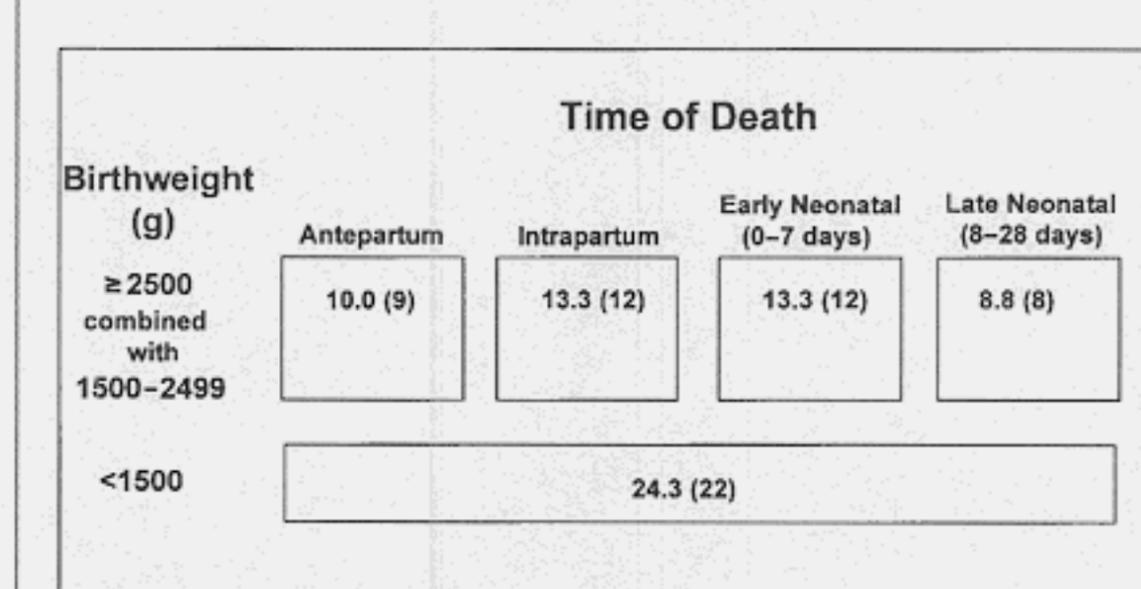
<sup>c</sup>Vaginal birth assisted by vacuum extraction.

reported here. In assessing mortality rates by birthweight and age-at-death categories, birthweight-proportionate mortality rates were calculated (i.e., number of deaths in specific birthweight by age-at-death cells divided by the total number of fetal deaths and live births).

## RESULTS

A total of 904 pregnant women were followed up through delivery, with 858 (94.9%) followed up to at least 28 days and 828 (91.6%) to at least 42 days postpartum. The rate of low-birthweight infants (<2500 g) was 19%, including 16% intermediate-birthweight (1500–2499 g) and 3% very-low-birthweight (<1500 g) infants. The median age of the women was 25 years; few had more than a primary education (Table 1). Of the women aged 20 to 24 years, 16% had a parity of 3 or more. Slightly more than a quarter of the women had received any iron–folate supplementation during their pregnancy. A majority of the women delivered their babies at home, often alone or with a relative. Although 43% delivered at a health care facility, only 5.8% delivered at a hospital, the only type of facility currently providing emergency obstetric care.<sup>5</sup> The rates for vacuum-assisted vaginal delivery and for cesarean delivery were each 0.5%.

The overall fetoneonatal mortality rate was nearly 70 deaths per 1000. The still-birth rate was 38 per 1000, including 21 per 1000 for antepartum fetal deaths and 17 per 1000 for intrapartum fetal deaths. Fetoneonatal mortality varied by birthweight: 24 per 1000 for birthweights



Note. Rate per 1000 live births and fetal deaths (number of deaths).

FIGURE 1—Birthweight-proportionate mortality rates (using total live births and fetal deaths as denominator).

greater than 2500 g, compared with 114 per 1000 for birthweights between 1500 and 2499 g and 956 per 1000 for birthweights less than 1500 g. There were 4 maternal deaths—1 antepartum and 3 within 24 hours of birth—for a maternal mortality ratio of 460 per 100 000 live births.

The number of maternal, fetal, and neonatal deaths is shown, by birthweight and time of death boxes in Table 2. Figure 1 shows birthweight proportionate mortality rates, categorized according to the BABIES model, as they appeared on the community monitoring boards used in the villages.

In Table 3, the deaths that occurred intrapartum and during the first week of life are shown by birthweight group and place of delivery; these deaths occurred at higher rates

among deliveries in the home or at dispensaries, the most basic level of care.

## DISCUSSION

The high maternal and perinatal mortality in this rural population is consistent with that found in other studies done in Tanzania.<sup>8–12</sup> The community-based surveillance system can more accurately assess fetoneonatal mortality rates than facility-based systems can; also, this system helps health care system managers to understand more fully the causes of poor pregnancy outcomes, identify areas to which interventions should be targeted, and monitor the effectiveness of these interventions over time. The simple organization of outcome data by birthweight groupings and age at death provides indicators of underlying causes and suggests the types of prevention interventions that should be implemented.

The organization of the data in Figure 1 highlights the high mortality for birthweights of 1500 g or greater in the intrapartum and early neonatal periods. Generally, these deaths are directly related to intrapartum complications, such as asphyxia and birth trauma.<sup>13</sup> One indicator of the lack of access to essential obstetric care for some of these complications is the strikingly low cesarean delivery rate of 0.4%. When we examined

TABLE 2—Number of Deaths, by Birthweight and Time of Death

Birthweight, g	Time of Death				Alive at 28 d
	Antepartum	Intrapartum	Early Neonatal (0–7 d)	Late Neonatal (8–28 d)	
≥2500	2	7	8	7	708
1500–2499	7	5	4	1	132
<1500	10	3	6	3	1
Maternal deaths	0	1	3	0	900

**TABLE 3—Intrapartum and Early Neonatal Mortality Rates<sup>a</sup> (and Number of Deaths) for Birthweights 1500 g or Greater, by Place of Delivery**

Birthweight, g	Place of Delivery			
	Hospital	Health Center	Dispensary	Home
≥2500	0 (0)	0 (0)	35.3 (6)	23.2 (9)
1500-2499	0 (0)	35.7 (1)	41.7 (1)	84.3 (7)
Total	0 (0)	7.4 (1)	36.1 (7)	34.0 (16)

<sup>a</sup>Fresh stillbirths and early neonatal deaths (0-7 days) per 1000 fetal deaths and live births.

these deaths more closely (Table 3), again by using simple variables of birthweight and place of delivery, we found that the deaths occurred at a higher rate at home or at dispensaries, which provide a very minimal level of care. Interventions aimed at improving maternal care in labor, including the presence of skilled attendants at labor and delivery, use of a partograph to monitor labor, early recognition of obstetric complications, and transport infrastructure, would be effective strategies for preventing these deaths.<sup>3,14</sup> In fact, intrapartum deaths of normal-birthweight babies can be considered sentinel events, as are "near-miss" maternal deaths, and could possibly be used as one proxy outcome measure for maternal care in labor. Detailed case review of intrapartum deaths will help to identify the sources of delay in access to essential obstetric care.

The BABIES model suggests further clusters of underlying causes with the birthweight by age-at-death cells. For example, for antepartum deaths of babies with birthweights of 1500 g or greater, the major causes of death are likely to be maternal infections (including syphilis), hypertension, and diabetes.<sup>6,13</sup> In this setting, strategies focusing on prevention, antenatal screening, and treatment of sexually transmitted diseases are likely to be an effective intervention for reducing mortality in this group. Causes of late neonatal deaths of babies with birthweights of 1500 g or greater are likely to be neonatal infections, such as tetanus, sepsis, and acute diarrheal illnesses.<sup>6,13</sup> Potentially successful interventions include increasing the tetanus immunization coverage among pregnant women, ensuring clean delivery practices, and encouraging exclusive breastfeeding. This study population had a

relatively low rate of adequate tetanus immunization; however, these coverage rates do not fully capture vaccinations that women received during the index pregnancy, and this aspect of the surveillance system is being improved.

Preventing deaths of very low birthweight babies requires the use of technologically advanced treatment methods associated with neonatal intensive care. This level of care is clearly not feasible for this population, and interventions therefore could focus on decreasing low birthweight by improving maternal nutrition, presumptively treating malaria in holoendemic areas, increasing the use of family planning, and extending birth spacing.<sup>6,15,16</sup>

Further analyses of surveillance system data are planned to examine pregnancy outcomes for subpopulations (e.g., by geographic cluster or sociodemographic risk) to target interventions more precisely. Comparing project outcomes with a reference population will clarify gaps in achievable mortality reductions. In addition, CARE is implementing multiple strategies to reduce fetoinfant and maternal mortality, including development of emergency obstetric protocols, neonatal resuscitation training, training in total quality management to improve quality of clinical care, and significant work mobilizing communities around emergency transportation.<sup>17</sup> Ongoing surveillance data will provide some of the outcome indicators for evaluation of interventions. Process evaluation, detailing the implementation steps, also will be conducted.

The simple surveillance system described here can be implemented and used at the community and district health management levels to determine trends in reproductive

health outcomes and prioritize interventions in a setting of scarce resources. However, sustainability of the system will depend on the value that community members, mothers, and community leaders attribute to it and on the incentives and supportive supervision that community members provide to village health workers. The very act of recording and accounting for all pregnancy outcomes in a community is a powerful tool for focusing attention on maternal and neonatal health. ■

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#### Contributors

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