International Journal of Gynecology and Obstetrics 114 (2011) 29–32

Contents lists available at ScienceDirect

International Journal of Gynecology and Obstetrics

journal homepage: www.elsevier.com/locate/ijgo

CLINICAL ARTICLE

Improving maternal mortality reporting at the community level with a 4-question modified reproductive age mortality survey (RAMOS)

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ARTICLE INFO

Article history:
Received 26 October 2010
Received in revised form 19 January 2011
Accepted 16 March 2011

Keywords:
Ghana
International health
Maternal mortality
Reproductive age mortality survey (RAMOS)

ABSTRACT

Objective: To investigate the identification of maternal deaths at the community level using the reproductive age mortality survey (RAMOS) in all households in which a women of reproductive age (WRA) died and to determine the most concise subset of questions for identifying a pregnancy-related death for further investigation. *Methods:* A full RAMOS survey was conducted with the families of 46 deceased WRA who died between 2005 and July 2009 and was compared with the cause of death confirmed by the maternal mortality review committee to establish the number of maternal mortalities. The positive predictive value (PPV) of each RAMOS question for identifying a maternal death was determined. *Results:* Compared with years of voluntary reporting, active surveillance for maternal deaths doubled their identification. In addition, 4 questions from the full RAMOS have the highest PPV for a maternal death including the question: "Was she pregnant within the last 6 weeks?" which had a 100% PPV and a 100% negative predictive value. *Conclusion:* Active identification of maternal mortality at the community level by using a 4-question modified RAMOS that is systematically administered in the local language by health workers can increase understanding of the extent of maternal mortality in rural Ghana.

1. Introduction

Investigative studies routinely uncover significant underreporting of maternal mortality in low-resource countries; in rural areas, and at the community level, maternal mortality is notoriously difficult to identify [1–3]. National birth and death certification processes are variably implemented, and data collection frequently does not extend into the rural communities where many maternal deaths occur. Methods based on national surveys are used infrequently, and hospital-based studies include only deaths to women with access to health facilities. Other deaths are missed when social norms repress open dialogue about reproductive health, or when a deceased woman was already marginalized by her community. Despite the barriers, it is crucial to find consistently effective ways to identify, report, and investigate maternal deaths at the community level. Acknowledging and studying the factors related to the death can serve as witness to these women's deaths, and possibly can be mined for answers to the underlying causes of these deaths and be incorporated into solutions and policies [4].

Examining deaths to all women of reproductive age (WRA) is one strategic method for identifying maternal deaths because they will always be a subset of this group. The reproductive age mortality survey (RAMOS) is a 39-question survey, administered to the surviving spouse or next of kin, that assesses signs and symptoms related to the death, which include general and reproductive health questions to determine whether the decedent was pregnant at the time of death, the outcome of the pregnancy, the use of family planning, and symptoms such as vaginal bleeding and abdominal or pelvic pain.

The RAMOS has been used in assessments of maternal mortality in hospitals in several low-resource countries, including Surinam, Tanzania, Gambia, Mozambique, and Taiwan [1,2,5–8]. In all of these studies, the use of the RAMOS increased the identification of maternal deaths compared with hospital records and official government estimates. In Mozambique, use of the RAMOS increased the identification of maternal deaths in hospital, but it did not include the outcomes of the 60% of deliveries that occurred outside the healthcare facilities [6]. Likewise, in Surinam, use of the RAMOS into deaths in 5 hospitals over 9 years found that the number of maternal deaths identified was 30 percent higher than the officially reported number of maternal deaths for the whole country [8].

The RAMOS was used in Ghana in 2002 by the Ghana Health Service (GHS) in an extensive maternal mortality review in selected areas of Accra; the survey identified almost twice the number of

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0020-7292/$ – see front matter
doi:10.1016/j.ijgo.2011.01.011

maternal deaths as the officially reported number of maternal deaths [9]. In 2007, the GHS coordinated a comprehensive study that compared the ability of sisterhood studies versus the use of RAMOS followed by verbal autopsies to identify maternal deaths in hospital using several metropolitan areas as their study population. The study found that the estimate of the pregnancy-related mortality ratio from the sibling history was 378 per 100 000 live births, whereas the estimate of the maternal mortality ratio for the same time period from RAMOS plus verbal autopsies was 580 per 100 000 live births [10].

The relative success of the use of the RAMOS in hospitals prompted an interest in using this survey to identify maternal deaths in rural Ghana. The Sene district is a rural region in northeast Ghana that covers 8586 square kilometers and has a population of about 100 000. Notification of maternal mortality in the Sene district is by voluntary reporting of maternal deaths by family members, or by public health personnel who make visits to the village and might be notified by a community elder about a death of a pregnant woman. A public health nurse is then dispatched to conduct an investigation, by using a verbal autopsy and medical records to review factors related to the death. Maternal mortality review committees routinely meet in the Sene district to review data from the investigation to establish a final diagnosis and to determine systems and community issues that may have contributed to the death.

The voluntary reporting system in the Sene district was considered to result in underreporting of maternal deaths. In 2008, a pilot program that investigated deaths to WRA using the RAMOS was implemented. Community health workers were actively encouraged and given an incentive to report any deaths of a WRA (10–49 years old) after which hospital staff members were dispatched to complete a full RAMOS with the next of kin. The RAMOS was reviewed by the district medical officer and any answers that suggested a pregnancy-related death (for example vaginal bleeding, seizures, or abdominal pain) triggered the hospital staff to conduct a verbal autopsy and to determine whether this was a maternal death.

The use of the full RAMOS at the community level is limited by the baseline educational level of the rural population and the implicit requirement of the survey for some literacy and understanding of the physiological and temporal details of a death. The aim of the present study was to review the experience of the Sene district with the RAMOS to determine whether it identified more maternal deaths and whether it could be shortened to a simpler subset of questions that can identify a community level pregnancy-related death for further investigation.

2. Materials and methods

The present study consisted of a review of cases of known maternal deaths and deaths to WRA from non-obstetric causes reported in the Sene district between January 2005 and July 2009. The record reviews were conducted between July 1 and August 15, 2009. The records from all maternal mortality reviews from 2005 to 2009 were examined, in addition to data from the RAMOS conducted in 2008. For maternal deaths in years other than 2008 and for all other confirmed maternal deaths that did not have an accompanying RAMOS survey, the project staff arranged to meet with the families of the deceased woman, traditional birthing attendant, or the local health worker; verbal consent was obtained and the RAMOS was administered. The questionnaire was administered in a home or clinic and was translated into the local dialect. The study was approved by the University of Michigan Institutional Review Board and the Ghana Health Service Ethical Review Board; no incentives were given to participants.

RAMOS results and those of maternal mortality reviews were available for 46 WRA who died during the period of review. Thirty deaths were confirmed as maternal deaths and 16 were non-maternal deaths as determined by RAMOS. Non-maternal deaths served as negative controls.

The RAMOS questionnaire was reviewed, and the 28 non-reproductive health questions were excluded from the analysis. The remaining 11 questions represented information that could potentially correlate with a maternal death (Table 1).

The results of the maternal mortality review were used as the gold standard for the diagnosis of a maternal death and were used to calculate the positive predictive values (PPVs) and negative predictive values (NPVs) of each selected RAMOS question. The PPVs were calculated by dividing the positive responses for that question among maternal death cases by all positive answers (true positives/[true positives + false positives]). The NPVs were calculated by dividing the number of negative responses to each question from non-maternal death cases by all negative answers (true negatives/[true negatives + false negatives]). Indefinite answers were not counted as positive or negative answers.

3. Results

In 2005, 2006 and 2007, 7, 3, and 7 maternal deaths were identified, respectively. In 2008, the year of active surveillance of deaths of WRA, 13 maternal deaths were identified. In 2009, when the district reverted back to voluntary reporting, only 7 maternal deaths were reported (2 of which occurred in the study period). Active surveillance with RAMOS in 2008 also identified 16 non-maternal deaths of WRA, which serve as negative controls. Of the 32 maternal mortalities that occurred during this time, 2 families could not be located; therefore, the remainder of the data addresses 30 maternal mortalities that were investigated during the period studied. Of the 30 women who died, 22 women died of direct maternal deaths and 8 women died of indirect maternal deaths. The most common causes of direct maternal death, as determined by the maternal mortality review process, were postpartum hemorrhage (50%) followed

Table 1
Positive predictive value of 11 questions from the RAMOS.

Question from the full RAMOS	Positive responses out of all maternal deaths (n = 30) (true positives)	Negative responses out of all confirmed non-maternal deaths (n = 16) (true negatives)	PPV (%)	NPV (%)
Did she have pain in her stomach or abdomen?	6	14	75.0	37.8
Was she bleeding from the vagina?	15	14	88.2	51.9
Is her last child less than 1 year old?	3	4	42.9	12.5
Has she been pregnant since her last child was born?	20	1	95.2	56.2
Has she ever had an induced abortion?	4	1	80.0	38.4
Did she stop using family planning?	28	13	69.0	100
During her illness, did she ever collapse, and if so, was it within 7 days of her death?	3	0	100	37.0
Did she ever lose consciousness, and if so, was it within 7 days of her death?	2	1	66.0	34.8
Was she pregnant when she died?	21	0	100	68.0
Was she recently pregnant (within the last 6 weeks)?	30	0	100	100
Did she live less than a year after her last pregnancy ended?	30	3	91.0	100

Abbreviations: NPV, true negatives divided by all negative answers; PPV, true positives divided by all positive answers; RAMOS, reproductive age mortality survey.