Validation of the verbal autopsy questionnaire for identifying maternal deaths in Pakistan

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Introduction

Maternal mortality represents the largest and the most persistent gap between developed and developing countries. The maternal mortality ratio (MMR), which measures the risk of death at each pregnancy, is up to 40 times higher in some African countries than the countries of Northern Europe [1]. MMR is believed to be the most sensitive indicator of women's status in the society and of the quality and accessibility of maternal health services available to women. A maternal death is not merely a result of lack of care or treatment failure; rather it is the final outcome of a complex interplay between a myriad of social, cultural and economical factors. Therefore, maternal mortality is widely recognized as a key human rights issue [2]. A maternal death is a sign of gross social injustice to women. It implies that the society has failed to look after the life and health of its mothers.

It was for these reasons that the Millennium Declaration adopted MMR as an indicator of maternal health, and set the goal of reducing maternal mortality by 75% (from the 1990 level) by 2015. To achieve this target is possible only if a majority of births are attended by skilled birth attendants and if the accessibility and quality of emergency obstetric care is improved significantly [3].

Unfortunately, maternal health is an area where the least progress has been made since the Millennium Declaration in 2000. All projections, using the trends in reduction of maternal mortality since 1990, suggest that MDG-5 will not be achieved in many countries and not in the majority of countries in Sub-Saharan Africa. An added complexity is that it is hard to measure the MMR, which requires a well-developed births and deaths registration system, or overly expensive field surveys. Indeed, this is the most important reason noted for a failure to address this MDG in the developing nations of the world [4].

In the absence of a vital registration system, the levels, medical causes and risk factors of maternal mortality can only be determined through population-based studies. To determine the MMR (and the causes of maternal mortality) at the national level, large scale surveys are needed. An important goal of Pakistan's recently completed

Demographic and Health Survey[1] (PDHS) was to estimate the MMR and the medical causes and risk factors of maternal mortality from a nationally representative sample. The key to identification of maternal deaths in the sample was the verbal autopsy (VA) technique: All births and deaths occurring during three years preceding the survey were identified in a sample of approximately 95,000 households, which were selected through cluster random sampling from the four provinces of the country. The causes of the female deaths in the reproductive age (15-49 years) were investigated using a VA questionnaire.

The VA interviews were conducted by specially trained interviewers with the deceased woman's family members who were present at the time of death. The primary purpose of the VA interview

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[1] Demographic and Health Survey (DHS) is a standardized study of national indicators of population and health. These surveys have been completed in over 50 countries of the world. In most countries, multiple rounds of DHS have been conducted over the past two decades.

was to determine the cause of death and to classify the death a maternal or non-maternal. The VA questionnaire also elicited information on the health seeking behavior during pregnancy and the fatal illness.

Clearly, the validity and reliability of the estimates of the levels and causes of maternal mortality in Pakistan depends upon the validity of the VA questionnaire. The VA techniques for identifying maternal deaths have evolved over last two decades. In Pakistan, different types of VA questionnaires have been used in small-scale studies. The recent PDHS used a refined version that was developed in consultation with national and international experts, and which was rigorously pre-tested in a variety of urban and rural settings.

This paper presents the main findings from a study to evaluate the sensitivity and specificity of the VA questionnaire that was later used by the PDHS to identify maternal deaths. The study included 110 VA interviews conducted on the deaths of females in the reproductive age, occurring during the last one year in two major hospitals of Pakistan.

Methodology

The validation study was conducted during July-September 2006 by the National Institute of Population Studies (NIPS), which is also the executing agency for PDHS. The primary objective of the study was to test the sensitivity and specificity of the VA questionnaire developed for PDHS.

The minimum sample size[2] for this study was estimated to be 128, which was based upon the assumption that at least 25% of female deaths in the 15-49 years age bracket are due to maternal complications. This assumption was derived from the following information: 1) MMR was believed to be around 500 per 100,000 live births [5]; 2) the crude birth rate (CBR) was estimated at 30 per 1000 population; and 3) the age-specific death rate (ASDR) for females 15-49 years was 3 per 1000 [6].

The first step of the study was to identify 128 female deaths in the age-bracket of 15-49 years occurring in the hospitals selected for this study. Only the deaths occurring during the last one year were included in the study. The deaths were identified by two methods:

1. Backward tracking (identifying all female deaths occurring in the hospital in the stipulated time period and ascertaining the cause of death, as well as the home address of the deceased woman, through hospital records). Due to incomplete information in hospital records, this method was not very successful.

2. Forward tracking (identifying female deaths in communities residing in the vicinity of the hospital and then finding the hospital records pertaining to those deaths). This was the

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[2] A margin of error of +/- 7.5% was used to arrive at the sample size, using the formula: $Z^2{}_\alpha \times p\,(1-p) / d_2$, where $Z_\alpha = 1.96$; p=0.25 and d=0.075.

more commonly used method. Female deaths in communities were identified through the Lady Health Workers' records.

The information collected on each death was as follows: a certificate of cause of death from the hospital authenticated by a staff doctor; home address of the deceased woman, in order to conduct the VA interview with the family members of the deceased woman; and the completed VA questionnaire.

Identification of female deaths was the responsibility of two male Field Supervisors, who also filled out a 'certification of death' form with the help of the hospital staff from the hospital records (electronic records or case files). The information on the form included the name, age, address and date of death of the deceased woman; the name and address of the hospital where the death occurred; categorization of death (maternal, non-maternal and unknown); and the immediate and underlying causes of death. These records were kept strictly confidential and the VA interviewers did not have access to them. Once the address of the deceased woman was confirmed, a team comprising two VA interviewers was dispatched there, who filled out the VA questionnaire.

The VA questionnaire included the following sections: 1) personal information of the respondents included in the VA interview (name, age, sex, relationship with the deceased woman and whether he or she was present during the fatal illness, at the time when the woman was taken to hospital, and at the time of death); 2) personal information of the deceased woman, including a short pregnancy history; 3) a detailed verbatim report of the events surrounding the death, as narrated by the respondents; 4) a check-list of signs and symptoms occurring during fatal illness; 5) details of a few selected signs and symptoms identified through the check-list (duration, intensity, persistence, prognosis); and 6) details of health services utilization during fatal illness.

The VA interviews were conducted by two female interviewers in each team (Rawalpindi-Islamabad and Hyderabad, respectively); these interviewers had extensive experience in conducting verbal autopsy interviews; they were also a part of the VA questionnaires pre-testing team previously, and were trained by the first author.

The completed VA questionnaires were sent to NIPS where these were edited and entered into a computer database. Each completed VA questionnaire was then forwarded to a panel of obstetricians at the Pakistan Institute of Medical Sciences, Islamabad, after removing the deceased woman's name and other personal information. The reviewing obstetricians carefully read the completed questionnaire and then filled out a 'certification of death' form, which was exactly similar to the one filled at the hospital where the death had occurred. Like the VA interviewers, the reviewing obstetricians were not privy to the information contained in the hospital's certification of death form.

A maternal death was defined as "the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes" [7]. A "pregnancy-related death", on the other hand, was defined as "the death

of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the cause of death or duration and site of pregnancy".

The primary purpose of the study was to determine the level of agreement in the cause and the category of death assigned by the hospital and the obstetrician who reviewed the completed VA questionnaire. Using hospital diagnosis as the 'gold standard' and regarding the VA interview as a screening test, the sensitivity, specificity and the positive and negative predictive values were computed.

The causes of death assigned by the hospital and the reviewer were compared through contingency tables. The degree of agreement was estimated, using Kappa statistic.

Results

Only 120 female deaths could be identified and successfully tracked in the two sites (Rawalpindi -Islamabad and Hyderabad) and VA questionnaires were completed on all of these deaths. However, ten questionnaires had to be discarded due to incomplete information.

Out of the 110 deaths included in the analysis, 39 were classified as 'pregnancy-related', as it was established through the VA interview that these deaths occurred either during pregnancy or childbirth, or within 42 days of a delivery, miscarriage or abortion.

Table 1 presents the cross-classification of the deaths into maternal and non-maternal categories (using the ICD-10 maternal death definition), assigned respectively by the hospital and the review panel.

Table 1 Classification of female deaths into maternal and non-maternal categories, using hospital diagnosis as gold standard

Category of death assigned by the VA review panel	Category of death assigned by the hospital where death occurred (Gold Standard)		Total
	Maternal	Non-maternal	
Maternal	25	7	32
Non-maternal	4	74	78
Total	29	81	110

Accordingly, the sensitivity, specificity, positive predictive value and negative predictive value were estimated as follows:

Sensitivity	86.2%
Specificity	91.4%
Positive predictive value	78.1%
Negative predictive value	94.9%

Moreover, the hospital's and reviewer's certificates of the deaths meeting the 'pregnancy-related death' definition (ICD-10) were examined to ascertain the categories of death assigned by them. While the hospital regarded only 67% of these deaths as 'maternal', the reviewers assigned 82% of them to the maternal death category.

The hospital's certification of death classified 25 deaths as maternal. The immediate causes of maternal deaths assigned by the hospital were: postpartum hemorrhage (8); septicemia (6); hepatitis (3); and eclampsia (2); unknown (6).

The reviewers classified 32 deaths as maternal. The immediate causes of maternal deaths assigned by the reviewers were: shock due to excessive blood loss (6); postpartum hemorrhage (4); hypertension (4); post-operative complications (3); septicemia (2); other indirect (12); unknown (1).

All deaths were classified into five major cause categories, as follows: direct maternal deaths; indirect maternal deaths; deaths due to infectious disorders; deaths due to cancers; and deaths due to diabetes and/or hypertension. The deaths where a cause was assigned that did not belong to any of these five classes were classified as the "deaths due to all other causes". The deaths where no cause was assigned were classified as "deaths due to unknown causes".

Table 2 presents the distribution of deaths according to the above categories, for causes assigned by the reviewers and the hospital, respectively.

Table 2 Distribution of deaths by cause assigned by reviewers and hospital*

Cause of death	Number (%) of deaths assigned by reviewers	Number (%) of deaths assigned by hospital
Direct maternal deaths	11 (10.0%)	11 (10.0%)
Indirect maternal deaths	16 (14.5%)	10 (9.1%)
Infectious disorders	31 (28.2%)	23 (20.9%)
Cancers	15 (13.6%)	13 (11.8%)
Hypertension/diabetes	28 (25.5%)	12 (10.9%)
All other causes	6 (5.5%)	20 (18.2%)
Unknown causes	3 (2.7%)	21 (19.1%)
Total	110 (100.0%)	110 (100.0%)

Kappa statistic for agreement = 0.378 (P = 0.055).

There was good agreement between hospital and reviewers with regard to direct maternal deaths. However, the agreement was weak in all other cause categories.

Discussion

In the absence of reliable vital registration systems, a population-based study of maternal mortality is the only remaining option to estimate MMR with reasonable accuracy. The idea of using verbal autopsies to identify maternal deaths in the population is not new [8, 9]. However, there are very few studies that validated a VA questionnaire with the aim of identifying maternal deaths through a household survey [10]. Moreover, the inherent qualitative element of the VA interview and the need to interview multiple respondents make it even more difficult to evaluate the reliability and validity of the VA techniques.

Finally, completed VA questionnaires must be reviewed by a panel of experts before a cause of death can be assigned. Each of these steps adds some degree of variation and bias, compromising the quality of information. Nonetheless, estimation of MMR derived from population-based studies using VA is superior to those derived from indirect methods, e.g. sisterhood method and mathematical modeling [11, 12]. The 1983 RAMOS study in Menoufia, India, found 3.7 times as many maternal deaths as in the officially certified maternal deaths [13].

We may conclude from this study that the VA questionnaire used by the Demographic and Health Survey in Pakistan is reasonably sensitive and specific. Even so, it may be noted that the VA questionnaire in its current form will miss approximately 13% of maternal deaths, resulting

into significant under-estimation of MMR[3]. Moreover, maternal deaths occurring early in pregnancy might be missed altogether, as noted by other studies [1].

As an aside to the study, a qualitative examination of the completed VA questionnaires, as well as the comments and notes recorded by the hospital physicians and the review panelists on the certification of death forms, was also conducted. It was found that the causes of death reported by the hospital do not follow any standard guidelines, and a wide variety of medical terms are used to describe the same cause in different ways.

Unfortunately, the review panelists were no different in this regard. At times, it was difficult to decipher the actual cause of death from the extensive notes on the certification of death forms. Moreover, it seems that the reviewers relied largely upon the verbatim part of the VA questionnaire to arrive at a decision regarding the cause of death, and even for deciding upon the category of death (maternal or non-maternal). There was quite valuable objective information in other parts of the pre-coded questionnaire, such as the check-list of signs and symptoms during fatal illness, which the reviewer did not rigorously consult.

An important lesson learnt from this study is that the sensitivity of the VA technique can be further enhanced by rigorous training of the review panelists in utilization of the information contained in the coded parts of the questionnaire. A computer-generated summary of the details of the signs and symptoms of the fatal illness, elicited through objective questioning of respondents by specially trained interviewers, would help the reviewers decipher and understand this information more clearly.

The ideal way to monitor maternal mortality is through a functioning national vital registration system. Until this happens, the only way to reliably estimate MMR will be through verbal autopsies.

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[3] Although the VA questionnaire was further improved in the light of this study, under-estimation of MMR in the PDHS 2007 cannot be ruled out.

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