Verbal autopsy to ascertain causes of neonatal deaths in a community setting: A study from Morang, Nepal

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ABSTRACT

Introduction: Clinical registration of the cause of death is available for less than one-third of the global newborn deaths, but the need for good quality data on causes of death for public health planning has renewed the interest in the Verbal Autopsy (VA). We aimed to determine the cause of neonatal deaths by VA in Morang district of Nepal.

Methods: Caretakers of the deceased were interviewed using a semi-structured VA questionnaire by female community health volunteers. The cause of death was assigned by two senior pediatricians independently and disagreements in ascertaining the proximate cause of death were resolved by consensus.

Results: The proximate causes of deaths were infections (41 %), birth asphyxia (37.2 %), prematurity (11.5 %), and low birth weight related causes (6.9 %). There was no significant statistical difference in deaths due to infection seen in non-institutional deliveries (43.5 %) than institutional deliveries (34.6 %). More than half of the deaths (58.5 %) occurred within the first three days of life where the predominant cause of death was birth asphyxia (60.7 %).

Conclusions: Analysis of verbal autopsies demonstrates that the major causes of death still are infections and birth asphyxia. The timing of deaths suggests that neonatal interventions should be aimed at the first week of life. There is no comparative advantage between institutional deliveries at below district level institutions and non-institutional deliveries to prevent neonatal infection. Thus, further study on the quality of care at institutes below the district level should be conducted. Disparities still occur in deaths, with most deaths in Morang occurring in non-institutional deliveries and in disadvantaged groups.

Keywords: *neonatal deaths, Nepal, newborn, verbal autopsy*

INTRODUCTION

Over the last few decades, there has been a declining trend, globally, in rates of mortality for infants and children aged less than five years, but this declining trend is less among neonates. The major causes of neonatal death are infections, birth asphyxia, prematurity and low birth-weight related causes. Most deliveries occur at home without skilled attendants, and most neonates may not receive appropriate care through the existing medical systems.[1-3] Clinical registration of the cause of death is available for less than a third of the global newborn deaths [4] but the need for good quality data on the causes of death for public health planning and

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resource allocation has renewed interest in Verbal Autopsy (VA), a method known and used for many decades. [5]

The 2001 and 2006 Nepal Demographic and Health Surveys reported a 33 % reduction in under-five mortality from 91 to 61 deaths per 1,000 live-births but the neonatal mortality declined by 15 % only, from 39 to 33 deaths per 1,000 live-births.[6, 7] Interventions to address neonatal deaths are challenging in Nepal as skilled attendants conduct only 19 % of deliveries and only 18 % of deliveries are conducted at health facilities.[8] Furthermore, birth and death registration are very limited. It is thus important to identify the major causes of neonatal deaths in Nepal to adequately design interventions.

Verbal Autopsy is a method of ascribing causes of death on the basis of information on events, signs and symptoms supplied by the caretakers of the deceased.[9-11] Procedures for examining infant and child deaths have been developed over the last twenty years [12-18] and the verbal autopsy has been used in studies at the community level [19-21], in sample registration systems in India and as part of the INDEPTH network of demographic surveillance sites.[22] There are several possible approaches to data collection and deriving the causes of deaths. The trained interviewer may use an open-ended form to discuss the events which preceded the death of the child with the caretaker or may use structured closed questionnaires designed specifically to establish the presence or absence of particular signs and symptoms or any related health care actions.[23, 24] To derive the cause of death, various methods may be used including physicians' review, pre-defined algorithm or a data-defined algorithm using computer analysis. The physician's review is the most common methodology used internationally. [5, 25, 26]

METHODS

Setting

The Morang Innovative Neonatal Intervention (MINI) is the first programmatic model in Nepal to introduce community-based identification and management of infections in newborns .[27] Verbal autopsies were done as part of this program. Morang district is located in the eastern part of Nepal, has primarily flat agricultural land with some adjoining hills and has an area of 1,855 sq km. It has a population of 914,799, 80 % of whom live in rural areas.[28] The human development and other indices of Morang are comparable to the national figures.[29, 30] Morang has 65 Village Development Committees, each of which is divided into 9 administrative units called wards. Wards are the lowest administrative units in Nepal. Since 1988, in every ward, the Female Community Health Volunteers (FCHVs) have been given responsibility by the Ministry of Health and Population for health promotion and preventive services in her community. The FCHVs reside in the communities they serve, are likely to know about pregnancies and deliveries, and are thus able to record births and deaths. Each FCHV in Morang serves an average population of 1,580.

Study design

The study is a descriptive prospective study nested within the MINI program and designed to identify the causes of neonatal deaths by VA. Adapted verbal autopsy questionnaires [5] were administered to all mothers whose outcome of the last pregnancy was a live birth followed by death of the baby within 28 days of birth for the time period May 2005 to August 2006 in all the 65 VDCs in Morang district.

Study tool

The verbal autopsy questionnaire was a combined open-ended narrative with closed questions and was developed from the experience of other available tools.[31] The questionnaires were administered to the caretaker of deceased by trained field workers, usually within 30 weeks, after the deaths were reported by the FCHVs. The event was verified and the VA questionnaire administered to the caretaker of the deceased after taking a verbal consent. Confidentiality was maintained, by separately interviewing the caretakers and in record keeping. Data quality control measures were taken by cross verifying 10 % of the VAs by a supervisor and by keeping checks in the data entry system.

Data Analysis

The VA questionnaires were reviewed by one of six trained field supervisors and collected in the MINI field office. All the forms were checked for completeness and consistency by the field coordinator. Two copies of the filled questionnaires were made and provided independently to two senior pediatricians for assigning the causes of death. Concurrence of both pediatricians was required to label a cause of death and in case of a difference, a joint meeting was held to agree on the cause of death.

The entire data was entered in SPSS 15 (SPSS Inc., Chicago, IL) and further analysis was carried out.

Ethical issues

The study was conducted in full accordance with the ethical principles and with free and informed verbal consent of the caretakers. The Ministry of Health and Population, Nepal approved the investigation. Ethical approval to conduct the study was obtained from the

Western Institutional Review Board in the USA.

RESULTS

Verbal autopsies for neonatal deaths were done over a period of 16 months, from May 2005 to August 2006. Verbal autopsies were conducted for 183 neonatal deaths; 92 % of the respondents were mothers and the remaining were other close relatives or fathers. The mean recall period after death was 22 weeks. The proximate cause of death could be assigned in all 183 cases as shown in Table 1. The major proximate causes of deaths were categorized as infections (41 %), birth asphyxia (37.2 %), prematurity (11.5 %), and low birth weight related causes (6.9 %) as per the National Neonatal Health Strategy 2004.

Table 2 shows the timing of death as per the different causes of deaths. More than half of the deaths (58.5 %) occurred within the first three days of life where the dominant cause of death was birth asphyxia (60.7 %).

Table 3 shows the causes of death in different delivery settings. As expected, more deaths were seen in non-institutional deliveries (71 % Vs 29 %). In non-institutional deliveries, 43 % of the deaths were due to infections compared to 35 % of deaths among institutional deliveries.

Table 1: Proximate cause of death in newborns as ascertained from verbal autopsy

Proximate cause of death	N	%	95% CI
Infection	75	41.0 %	34.1 to 48.2 %
Birth asphyxia	68	37.1 %	30.5 to 44.4 %
Prematurity related	21	11.5 %	7.6 to 16.9 %
Low Birth Weight (LBW) related	8	4.4 %	2.2 to 8.4 %
Congenital anomaly	4	2.2 %	0.9 to 5.5 %
Hypothermia	3	1.6 %	0.6 to 4.7 %
Hemorrhagic disease of newborn	2	1.1 %	0.3 to 3.9 %
Others	2	1.1 %	0.3 to 3.9 %
Total	183	100.0 %	

Almost 63 % of mothers who had a neonatal death were not able to read, 15 % were able to read with difficulty and 22 % were able to read and write easily Table 4. Also, most deaths were seen in disadvantaged indigenous groups (50.3%) followed by 13 % in Dalits (marginalized groups).

It was also interesting to observe that more deaths in the first three days of life were seen in male children (62.6 %) than in female children (37.4 %)[Data not shown].

Table 2: Age at death of newborn and subsequent cause of death at the age

Proximate cause	Total	Age at death					
		0-3 days		4-7 days		8-28 days	
		n	%	n	%	n	%
Infection	75	16	15.0 %	27	69.2 %	32	86.5 %
Birth asphyxia	68	65	60.7 %	2	5.1 %	1	2.7 %
Prematurity related	21	16	15.0 %	5	12.8 %	0	0.0 %
LBW related	8	6	5.6 %	0	0.0 %	2	5.4 %
Congenital anomaly	4	1	0.9 %	2	5.1 %	1	2.7 %
Hypothermia	3	2	1.9 %	1	2.6 %	0	0.0 %
Hemorrhagic disease of newborn	2	0	0.0 %	1	2.6 %	1	2.7 %
Others	2	1	0.9 %	1	2.60 %	0	0.0 %
Total	183	107	58.5 %	39	21.3 %	37	20.2 %

Table 3: Cause of death by place of delivery: Institutional Vs Home delivery

Proximate cause	Place of delivery				P value
	Home		Institutional		
	Frequency	(%)	Frequency	(%)	
Infection	57	43.5 %	18	34.6 %	0.270
Birth asphyxia	47	35.9 %	21	40.4 %	0.569
Prematurity related	13	9.9 %	8	15.4 %	0.296
LBW related	7	5.3 %	1	1.9 %	0.307
Hypothermia	3	2.3 %	0	0.0 %	0.271
Others	4	3.1 %	4	7.7 %	0.166
Total	131	71.6 %	52	28.4 %	

Table 4: Neonatal deaths as ascertained in various ethnic groups in the verbal autopsy

Ethnic groups *	Neonatal Deaths		Morang Population - 65 VDCs **	
	N	%	N	%
Disadvantaged indigenous (Janjati) groups	92	50.3 %	299476	44.1 %
Marginalized (Dalit) groups	24	13.1 %	69757	10.3 %
Upper caste groups	23	12.6 %	175807	25.9 %
Religious minorities	18	9.8 %	21285	3.1 %
Disadvantaged non marginalized (non-dalit) terai castes	13	7.1 %	83811	12.3 %
Relatively advantaged indigenous (Janjati) groups	4	2.2 %	28674	4.2 %
Others	9	4.9 %	-	-
Total	183	100 %	678810	

*Revised Integrated Health Information Management System – Recording and Reporting Guidelines. Kathmandu: Management Division, Department of Health Services, Ministry of Health and Population, 2007 (2064).

**Central Bureau of Statistics (CBS). Population Census 2001, National Report, Kathmandu, Nepal: National Planning Commission, 2002

DISCUSSION

Establishing accurate estimates of neonatal deaths in low middle–income countries like Nepal is a key priority to guide public health programming. This study labeled the primary causes of death as infection, birth asphyxia, and prematurity to be consistent with the National Neonatal Health Strategy 2004 of Nepal.

Current standards for classification of causes of death support the assignment of a single as opposed to multiple causes of death to calculate cause-specific mortality fractions.[32, 33] However, multiple disease processes may contribute to the complex pathophysiology leading to a newborn's death. A significant synergistic relationship between prematurity and maternal infections in the risk for birth asphyxia mortality was also reported in some studies. [34] By classifying only a single cause of death, this interaction would not have been recognized. Furthermore, the overlapping clinical presentation of neonatal conditions presents challenges in discriminating the cause of death with VA methods, which often uses nonspecific symptoms and relies on subtle differences that may not be discernable to caregivers. For example, a preterm or septic infant may be neurologically depressed at birth and may also meet the criteria for birth asphyxia by "failing to cry at birth," "failing to breathe," or being "unable to suck" or may present with hypothermia. In many cases, a newborn may experience several comorbidities that are, furthermore, challenging to differentiate by VA; and thus, classifying only a single cause of death fails to acknowledge complex disease processes and accurately influence estimates of the true disease burden. To identify a single underlying cause of death, various hierarchical classification schemes have been devised. The fixed disease categories and hierarchy

tested in some studies were developed by the Child Health Epidemiology Reference Group (CHERG)[36] to standardize approaches in classifying causes of neonatal death and produce disease estimates for programmatic relevance. Some hierarchical systems assign deaths on the basis of categories that indicate the timing of the events leading to death (eg, antenatal, intrapartum, postnatal). The Office of National Statistics in England uses such a hierarchal classification system in the International Classification of Diseases, which assigns neonatal deaths to congenital anomalies, antepartum infections, and immaturity-related conditions before assigning deaths to asphyxia.[35,36] However, in another classification system used in Sweden by Winbo et al,[32] asphyxia is instead placed ahead of preterm birth. The Neonatal and Intrauterine Cause of Death by Etiology classification system is used to identify the underlying etiology of death, and places specific conditions, including fetal infections, above most causes of birth asphyxia.

For the purpose of simplicity and to be in line with the National Neonatal Health Strategy 2004, we categorize all neonatal deaths into four broader groups as outlined in the strategy.

A similar study from Sarlahi district found that birth asphyxia (33 %), serious infections (30 %) and prematurity (29 %) were the commonest causes of neonatal deaths. [34] Similarly, in a study in rural Pakistan, the main causes of neonatal deaths were asphyxia, neonatal infections and prematurity.[16] Environmental factors including poor hygienic practices and proximity to livestock, as well as newborn care practices such as wrapping of infants with unclean cloths, cutting the cord with unsterilized equipment at home, and limited

use of clean delivery kits could contribute to the high rate of infection.[8, 37]

More than 70 % of the neonatal deaths occurred in the first week of life, with birth asphyxia accounting for 61 % of deaths in the first three days. Deaths from birth asphyxia occurred for both home deliveries (36 %) and institutional deliveries (40 %), suggesting that management of this condition needs to be improved for both home and institutional delivery.

Prematurity accounted for 12 % of death and there is no significant difference between home and institutional deliveries. This may reflect the lack of skills and or infrastructure to tackle this problem at institutes at district and below level.

In this study, the majority (72 %) of neonatal deaths were among those delivered at home, where delivery was usually conducted by an untrained birth attendant. While this reflects the distribution of births at home, the rate of infection was not statistically significantly higher among home deliveries ($p > 0.05$). This is again pointing to the fact that institutional deliveries are not a guarantee of decreasing the incidence of neonatal deaths due to infections. There could be multiple reasons to this finding. The infection prevention practice in the health institutes needs to be looked into comparing them with those in home deliveries. This also points to the need of more data on infection practice in health institutes.

The majority of neonatal deaths (71 %) were among disadvantaged ethnic groups, those with the higher mortality were the traditional groups, which consistently are low for all demographic and health indicators.[8] These findings suggest the importance of having an equity-lens when planning for safe-motherhood-newborn programs, targeting interventions toward these vulnerable groups.

Limitations

The time delay between the event and the interview is the main drawback of this study. Not using both open and close ended questionnaire for VA van be taken as another limitation of the study

The cause of death was assigned but the corresponding ICD-10 codes were not given, which offered the pediatrician a maximum flexibility to assign the cause of death. Though standardization cannot be assured by this technique, the published levels of inter-observer reliability is generally higher and reflects the expectations of the individual reviewers, who are aware of the epidemiological pattern and characteristics of diseases in their area. Alternatives are needed as the physicians' review is relatively cost-ineffective and not feasible if a very large number of questionnaires have to be assessed. [5]

Some births may have gone unrecorded if the infant died within the first few hours of birth or if the mother delivered outside the catchment area and/or stayed outside the area for more than two months after delivery.

Misclassification of causes of deaths is possible because there is no gold standard with which to compare the findings. [38]

CONCLUSIONS

There are not many verbal autopsies done in Nepal at the community level. These verbal autopsies show that the major causes of death are infections and birth asphyxia - similar to those in other countries of the region. There was no statistically significant difference in the cause of deaths in Morang occurring in non-institutional deliveries pointing to a need to have further research to evaluate the quality of care in institutional deliveries below district level.

The timing of deaths suggests that neonatal interventions should be aimed at the first week of life and during the intra-partum period. Thus, further work is needed to address birth asphyxia both at the community-level and among skilled and well -equipped attendants in health facilities. Future studies are required to validate and use a standard community-level case definition of various primary causes of neonatal deaths to generate consistent global estimates.

ACKNOWLEDGEMENTS

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