

Validity of Verbal Autopsy for Assessment of Causes of Death in Bangladesh

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Abstract:

Background: *Causes of death are less commonly known in developing countries. Due to religious considerations, autopsy is not possible in many countries, so alternative procedures like verbal autopsy may be an important tool to determine causes of death in these countries. **Subjects and Methods:** This was a cross-sectional study, carried out in the Department of Medicine of Rangpur Medical College*

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*from July, 2014 to December, 2014. The patients who died during the study period were included in our study. We have been able to find about 405 death records with complete addresses of the family members/spouse. Of these family members, 304 agreed to take part in this study by answering our questions, based on the Singh, s questionnaire. **Results:** Mean age of the victims at the time of death was 56.4 years and males were more common than female (71.7% vs 28.3%, P value 000). Overall mortality due to communicable diseases by verbal autopsy and medical records were; 9.86% vs 6.90% and non-communicable disease were; 83.6% vs 85.48%. In majority of the victims, the causes of deaths by verbal autopsy and medical records, respectively were; stroke (48.7% vs 51.3%) and the second commonest cause was kidney failure 40 (13.2% vs 13.2%). Coronary artery disease (CAD) was the cause of death among 6.9% of the victims. The causes of death by verbal autopsy compared to medical records revealed no significant differences. Overall the sensitivity of diagnosis of non-communicable disease(NCD) was higher than communicable disease, using the verbal autopsy questionnaire (sensitivity 100% vs 76.92%) but specificity of diagnosis was higher in communicable disease than NCD (100% vs 87.72%). Among the communicable diseases, sensitivity was high in tuberculosis but specificity was similar in central nervous system infections, pneumonia and tuberculosis. Sensitivity and specificity was maximum (100%) in CAD. Sensitivity and specificity was also very high in diagnosis of malignancy (100% and 99.66%). **Conclusion:** In our study, sensitivity and specificity of diagnosis of causes of death by the verbal autopsy questionnaire was high. It is possible that verbal autopsy to determine causes of death may be a better substitute for medical certification of cause of death.*

Key words: Verbal autopsy, validity, specificity, sensitivity, positive predictive value, diagnostic testing

INTRODUCTION

Causes of death are not widely known in developing countries.¹ Many developing countries with the highest burden of poverty

and disease continue to lack routine, representative and high quality information on the levels and causes of death.^{2,3} This is crucial for health and development policies, health programs, program monitoring and evaluation purposes.⁴ In this regard, mortality surveillance systems and demographic surveillance sites (DSS) using validated verbal autopsy procedures suggested this as being a cost-effective alternative method for ascertaining cause of death and sustainable medium-term solutions.^{5,6} Due to religious considerations, autopsy is not possible in many countries, therefore WHO experts and the International College of Nutrition, International College of Cardiology, and the Tsim Tsoom Institute have developed a verbal autopsy questionnaire to find out the causes of deaths in these countries subject to validation.^{7,8} The verbal autopsy is based on interviewing relatives or caregivers about the signs, symptoms, lifestyle behaviors and other characteristics experienced by the deceased before their death and the circumstances surrounding their death.⁶ It is based on the assumption that most causes of deaths can be distinguished by their signs and symptoms and that these can be accurately recognized, recalled and reported by lay respondents.⁹ In Bangladesh there were a few studies which were carried out on verbal autopsy. One such study was to determine causes of childhood deaths in Bangladesh.¹⁰ Another verbal autopsy report was for hypertensive patients of Rangpur, Bangladesh, in 2014. However, as yet no study had been carried out to check the validity of the verbal autopsy.¹¹ In the procedure, several factors may influence the validity and reliability of verbal autopsies; such as the 'true' underlying distribution of cause of death in the population, the age and sex of the deceased, quality and standardization of verbal autopsy tool (verbal autopsy questionnaire, diagnostic procedure and mortality classification) and the data collection process.^{6,12}

Regardless of its importance, there were few studies which validated the verbal autopsy methods. There is a growing national and international concern regarding the validation of verbal autopsy for its sustainability and usefulness in tracking the epidemiological transition which can be done either by available cause of death in the medical records or cause of the death obtained by autopsy.

Therefore, this study was carried out to find out the validity and accuracy of verbal autopsy by measuring its sensitivity and specificity compared with causes of death mentioned in the hospital medical records, which are considered to be the “gold standard”.

MATERIALS AND METHODS

This study was carried out in the Department of Medicine, Rangpur Medical College, Bangladesh from July, 2014 to December, 2014. The study sample was based on available hospital records which were examined during the first 3 months of the study. Of 405 records of deaths which were available, only 304 families volunteered to take part in our study. The rest, 101 families, were excluded from the study, as they did not consent to interview. A health worker was trained in understanding the questionnaire used for data collection by interviewing relatives of the victims by the structured validated Singh,s questionnaire(13).This training was translated into practice by using the instrument for collection of data for this study by the health worker. The addresses of the decedents were obtained from the available records along with telephone/mobile numbers.

The health worker contacted the family to find out information about a close family member/spouse who was present besides the deceased during treatment and the time of

death. The family members, for motivation, were given to understand that inquiry about the cause of death aims to possibly prevent illness and improve longevity in their remaining family which can be advised after interview and, if appropriate, by changing their health behavior. The interview consisted of a modified Singh's verbal autopsy questionnaire¹³ to record the clinical manifestations at the time of illness. Each interview took about 20 minutes, sometimes in two sittings. The socio-demographic and clinical data obtained in the medical records were reconfirmed during interview and examination of the socioeconomic status of the family. Clinical data of the victims, based on questionnaires, present before the death, were confirmed over telephone, and recorded. A board consisting of internist, cardiologist, neurologist, nephrologist, endocrinologist, pulmonologist was appointed to review all the available clinical data to finalize the cause of death. The cause of death obtained by interview was based on verbal autopsy questionnaire. The exact causes of the death of the corresponding victim were collected from the medical record of the medicine department by another expert blind to the diagnosis made by the board of experts, based on questionnaire. The two methods for finding out the causes of death were compared and sensitivity, specificity and positive predicted value of the verbal autopsy questionnaire were calculated.

DATA COLLECTION

Data regarding attributes of social classes; education of the victim, occupation and family income, as well as per capita income, were collected by interview of a close relative, preferably spouse of the decedents. Medical records of the victims were examined from the register of medical records of the Medical College Hospital by an expert physician (RM) to

find out clinical data as well as exact cause of death given in the case records. The diagnosis of the causes of deaths were verified based on given investigation reports and data were stored in confidence with this expert.

STATISTICAL ANALYSIS

The data were analyzed by SPSS windows version 17.0. The socio-demographic data of the study population were expressed either as parametric variables or as frequencies and their observed difference was tested mainly by Student's one sample-test and the 'chi-square' test. A P-value of <0.05 (two tailed t-test and chi-square were considered statistically significant.

RESULTS

During the study period, we have studied over 304 patients of both sexes. Mean age of the victims at the time of death was 56.39 years and males were more common than female (71.7% vs 28.3% (Table 1).

Variables	Frequency/percentage (n=304)
Mean age (SD)years	56.39 ±15.001 years
Sex	
Male	218 (71.7%)
Female	86 (28.3%)
Level of education	
Illiterate	123 (40.5)
5 or less class	61 (20.1%)
>5-10 class	91 (29.9%)
>10-12 class	16 (5.3%)
Graduate and above	13 (4.3%)
Occupation	
Housewife	84 (27.6%)
Agriculture	115 (37.8%)
Business	68 (22.4%)
Service	23 (7.6%)

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Retired	5 (1.6%)
Others	9 (3%)
Monthly income	
<62.5 USD	143 (47%)
62.5-125 USD	126 (41.4%)
125-187.5 USD	29 (9.5%)
>187.5 USD	6 (2%)

In this study, 90.4% of the victims were from rural areas. Majority of the victims 50.5% (152) were educated from the 5th to 10th class, a significant proportion of them were illiterate 40.5% (123) and higher education (graduation and above) was least common 4.3% (13). Majority of the victims were farmers among males 52.3% (114) and house wives among females 97.7% (84). Monthly income was <125 USD in 89.37%.

The frequency distribution of causes of death by major diseases has shown in Table II. Causes of death were broadly classified as communicable, non-communicable and acute poisoning. Among the communicable disease category, we were able to show three causes of death CNS infection, pneumonia and tuberculosis. Likewise, from the non-communicable disease category; we were able to classify six causes of death e.g. stroke, CKD, chronic respiratory diseases (asthma and COPD), CAD, liver disease and malignancy. Overall mortality from communicable disease was 11.18% and from non-communicable disease was 81.57% (p-value 000). Majority of the cause of death was stroke (cerebrovascular diseases) 48.7% and least cause of death was acute poisoning with organophosphorous compounds (0.65%). Death due to chronic lower respiratory diseases was 5.26% and 6.9% of the patients died due to CAD. 9.86% of the patients died due to infectious diseases, among them CNS infection was the leading infection (6.25%); pneumonia (0.98%) and TB (2.63%) was the very minimum.

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Table II: Frequency distribution of causes of death from medical records and verbal autopsy

Cause of death	ICD disease coding	Cause of death from death certificate	Cause of death from verbal autopsy
Cerebrovascular	G40-G47	148 (48.7%)	156 (51.3%)
Renal failure	N17-N19	46 (15.1%)	40 (13.2%)
Chronic lower respiratory diseases	J40-J47	16 (5.26%)	18 (5.9%)
CAD	I20-I25	21 (6.9%)	21 (6.9%)
Infection		30 (9.86%)	21 (6.90%)
Central nervous system infection	G00-G09	19 (6.25%)	13(4.27%)
Pneumonia	J09-J18	3(0.98%)	2(0.65%)
TB	A15-A19	8 (2.63%)	6 (1.97%)
Malignancy		11 (3.61%)	12 (3.94%)
HCC	C15-126	3 (0.98%)	4(1.31%)
Brain tumor	C69-C72	1 (0.32%)	3(0.98%)
Leukemia	C81-C96	2 (0.65%)	2(0.65%)
Ca stomach	C15-126	2(0.65%)	2(0.65%)
Ca larynx	C30-C39	1(0.32%)	1(0.32%)
Liver disease		10 (3.28%)	12 (3.94%)
Hepatic failure	K72	4(1.31%)	4(1.31%)
Cirrhosis of liver	K74	6(1.97%)	8 (2.63%)
Drug and biological agents	T36-T50	2(0.65%)	1 (0.3%)
Codes for special purposes	U00-U99	15 (4.93%)	10 (3.28%)
Undiagnosed cases		5 (1.64%)	13 (4.3%)

Overall the sensitivity of diagnosis of non-communicable disease was higher than communicable disease with verbal autopsy questionnaire (sensitivity 100% vs 76.92%) but specificity of diagnosis was higher in communicable disease than non-communicable disease (100% vs 87.72%). Among the communicable disease sensitivity was high in TB but specificity was similar in CNS infection, pneumonia and TB. Sensitivity and specificity was maximum (100%) in CAD. Sensitivity and specificity was also very high in diagnosis of malignancy (100% and 99.66%). The sensitivity, specificity and positive predictive values were given in Table III.

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Table III: Showing sensitivity, specificity and positive predictive value of different diseases

Disease	Sensitivity	Specificity	Positive predictive value
Non-communicable disease	100%	87.72%	97.30%
Stroke	100%	95.06%	94.87%
CKD	86.46%	100%	100%
CAD	100%	100%	100%
Obstructive airway disease	100%	99.31%	88.89%
Liver disease	100%	99.32%	83.33%
Malignancy	100%	99.66%	91.67%
Communicable disease	76.92%	100%	100%
CNS infection	76%	100%	100%
Pneumonia	75%	100%	100%
TB	80%	100%	100%
Acute poisoning	66.67%	100%	100%

Table IV: showing the modifiable factors of NCD of the study population

Modifiable factors	Frequency/percentage
Physical inactivity	5.3% (16)
Sedentary life style	1.6% (5)
Lack of regular exercise (30 minutes walking)	94.7% (288)
Smoker	57.94% (175)
Duration of smoking	10.16 pack year
SLT consumption	17.8% (54)
Diabetes mellitus	16.57%
Hypertension	60.19%

Among the study population 60.19% (183) had hypertension. Among the hypertensives 69.4% (127) of them were male and 30.6% (56) were female and mean age at the time of death was 58.87 years. At the time of the death, duration (mean) of hypertension was 6.81 years. Diabetes mellitus was associated in 16.57% (30) cases. Among the hypertensive patients only 35.9% (65) used to take antihypertensive drug regularly and 31.1% (57) used to come in for regular follow up. Only 8.8% (16) hypertensive patients used to take life-style modifications regularly. Only 20.2% (37) had control of blood pressure at the time of admission to the hospital. Majority 75.7% (137) of the

hypertensive patients died due to stroke (cause of death taken from medical records of the hospital) followed by chronic renal failure 10.9% (20) and CAD 5% (9). Causes of death unrelated to the complications of hypertension were 8.74% (16).

Table 5. Major causes of deaths by verbal autopsy versus medical records.

Causes of death among hypertensive patients	Medical records	Verbal autopsy
Stroke	75.7% (137)	78.77% (144)
CRF	10.9% (20)	10.4% (19)
CAD	5% (9)	5% (9)

DISCUSSION

This study shows that the causes of death obtained by verbal autopsy were similar with the causes of death given in the medical records. The predictive value of these results appears to be significant.

In our study, verbal autopsy diagnosis was near accurate (Table III) with the diagnosis from 'medical records' which was taken as 'gold standard'. We have found false positive diagnosis with verbal autopsy in stroke, chronic lower respiratory diseases, malignancy and liver diseases. However, the percentage of false positive result was very minimum (4.30%). More than half of the false positive result occurred in stroke, which was confused with CNS infection. Most of the false negative result occurred in CNS infection. This result may be due to almost similar presentations of stroke and CNS infection. These two diseases present with similar characteristics, only there are differences in clinical investigation. Although, verbal autopsy process has several stages and many factors can influence the level of its accuracy¹⁴, validation of verbal autopsy is considered to have an acceptable level of diagnostic accuracy at the population level, if

sensitivity is at least 50% and specificity at least 90%.¹⁵In our study both sensitivity and specificity of verbal autopsy diagnosis was more than the acceptable level. Overall sensitivity of diagnosis of non-communicable diseases was 100% and specificity was 87.72%. Among the non-communicable diseases highest sensitivity and specificity (100%) was in CAD, and lowest sensitivity was observed in CKD 86.46%. Sensitivity of diagnosis of stroke was 100% but specificity was 95.06%. High sensitivity and specificity of diagnosis of CAD was due to specific and unique symptoms and signs of CAD diseases. Sensitivity and specificity of diagnosis of malignancy was also near about 100%. This was due to patient relative's direct statement about the diagnosis of the name of the disease. Sensitivity of diagnosis of overall communicable diseases was 76.92% with a specificity of 100%. Among the communicable disease sensitivity was higher in TB (80%) and lowest in pneumonia, but specificity of diagnosis of each disease was 100%. There were very few studies done to test the validity of the verbal autopsy. Misganaw et al has shown the sensitivity of the verbal autopsy diagnoses was 69%, specificity 78% for non-communicable diseases and for communicable diseases, the values of sensitivity and specificity were 79% and 78% respectively.¹⁶

Bangladesh has an epidemiological transition from burden of acute infectious and nutritional deficiency diseases to chronic non-communicable diseases (NCDs).¹⁷The country is under transition from poverty to affluence with a decrease in communicable diseases and emergence of NCDs; CVDs and other chronic diseases as leading causes of death similar to other low- and middle-income countries.¹⁸According to WHO, NCDs were estimated to have contributed to almost 60% of deaths in the world and among them about 80% occurred in the developing countries. However, in Bangladesh, 51% of deaths

occur due to NCDs and other chronic health conditions.¹⁹ According to the mortality profile of Bangladesh, 2014 highest mortality from circulatory system disease (33.20%), followed by certain conditions originating in the perinatal period (15.93%), respiratory system disease (13.90%), nervous system disease (3.89%) and digestive system disease (0.53%).²⁰ Our study represents data from the Department of Medicine of a tertiary medical college of northern part of Bangladesh. Stroke was the leading causes of death (51.3%), followed by chronic kidney disease (13.2%). Death from infectious disease and malignant disease was 6.90% and 3.94% respectively. Death due to coronary artery disease was 6.9%, which is much less than the recent trend of increase of CAD, but because of the study site (Department of Medicine) CAD patients were less in this study. Hypertension was common among the study population (60.19%), among them 90.7% died due to complications of hypertension (stroke, CRF and CAD). Ratindra et al has shown that majority (71.2%) of the hypertensive patients died due to hypertension related complications (detected from verbal autopsy); 33.3% due to stroke, 20.3% CAD and 17.8% chronic kidney disease.¹¹ Knowledge of causes of death, at least as it relates to major available interventions, is important for health sector planning. Little is known from conventional sources about the causes of deaths in Bangladesh, partly because of deficiencies in the registration of deaths, and partly because relatively few deaths are attended by qualified physicians.²¹ Our validation study is of paramount important to make a verbal autopsy determine causes of death a better substitute of medical certification of cause of death.

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CONCLUSION

In our study sensitivity and specificity of diagnosis of cause of death with verbal autopsy questionnaire was high. Therefore, verbal autopsy determined causes of death may be a better substitute for medical certification of causes of death.

Limitation

Sample size was small and data was collected over telephone from the relatives of the patient.

Future direction

A cohort study with large sample size will be needed to clarify the causes of death in hypertensive patients.

Conflict of interest

There was no conflict of interest.

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Contributions by the authors

Dr. Ratindra Nath Mondal planned and supervised the study. Dr. Md. Ashraful Haque, Dr. Abul Kalam Azad analysed the data. Dr. Shah Md.Sarwer Jahan, Dr. Md. Mahfuzer Rahman, Dr. Md. Kumruzzaman Sarker, Dr. Moni Rani, AKM Shaeheduzzaman, Md. Shafiul Alam, Devendra Nath Sarkar, helped to collect the data. Dr. B. D. Bidhu, Professor Dr. Md. Zakir Hossain, Professor Dr. Amaresh Chandra Shaha,

Professor Ram B. Singh, DW Wilson, Professor Dr. Md. Noor Islam helped in writing of the manuscript and presentation of the data.

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