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EVALUATION OF A POPULATION BASED INTERVENTION TO IMPROVE THE VIETNAMESE MORTALITY REPORTING SYSTEM

Nguyen Van Thuong[1], **Le Quang Minh**[2]
Mark Stevenson[3], **Le Thuy Linh**[4]
and **Le Tran Ngoan**[*,4,5]

[1] *Nghe An Health Department, Viet Nam;*

[2] *Ha Nam Health Department, Hanam, Vietnam*

[3] *The University of Melbourne, Australia;*

[4] *Hanoi Medical University, Viet Nam;*

[5] *International University of Health and Welfare, Japan*
e-mail: letngoan@hmu.edu.vn

Abstract

Background Objectives were to examine the benefits of a population-based intervention to improve mortality reporting system for NCDs in Central Viet Nam.

Methods An intervention was performed at Dien Chau district Health Center for 85 health officers in applying Verbal Autopsy (VA) to determine the causes of death and ICD-10 coding. Data were repeatedly obtained by three times (before, after the intervention, and final VA) for all deaths occurred in 2014. Verbal autopsy was the reference group to estimate diagnostic tests for all NCDs and its sub-groups. We compared these indicators between the second and first obtained data to see the improvements.

Results Among 1,581 deaths, 1,572 cases were determined by VAs. Sensitivity, specificity, positive predictive value, and negative predictive value was 0.95, 0.54, 0.83, and 0.80, respectively for before and 0.93, 0.76,

* Corresponding author.
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0.90, and 0.81, respectively for after the intervention. The significant changes for all NCDs were not seen for sensitivity and negative predictive value, $P > 0.05$, but that were observed improving for specificity and positive predictive value, $P < 0.05$. After the intervention, sensitivity was increased from 0.28 to 0.76 for chronic respiratory disease, from 0.23 to 0.50 for diabetes, from 0.79 to 0.87 for cancer; and 0.87 (not changed) for cardiovascular disease.

Conclusions Data quality for NCDs and its sub-groups was improved after the intervention, which would be suggested to perform nationwide to enhance mortality data for identifying and planning preventive strategy's targeting the leading-causes of deaths in Viet Nam.

Background

Non communicable diseases (NCD's) are the leading cause of mortality globally [1] and account for 28 million deaths each year in low and middle-income countries [1,2]. Given the public health challenge of NCD's in low and middle-income countries, there is an urgency for accurate mortality data upon which to identify and plan preventive strategies; this is particularly important for the four leading causes of NCDs namely, cardiovascular disease, cancer, diabetes, and chronic respiratory diseases (included chronic obstructive pulmonary diseases and asthma).

In high-income countries, accurate mortality data is derived from vital registration systems namely, death certificates signed by a trained health professional. However for many low- and middle-income countries, identifying deaths from vital registration systems is limited either because such registration systems do not exist or the completeness of death registration is poor [3]; the latter is the situation in Viet Nam where the current system has limitations with respect to the legal framework for registration of early neonatal deaths and deaths of temporary residents or migrants. Further, the registration system does not conform to international standards for reporting causes of death or for recording detailed statistics by age, sex and cause of death [3].

A civil registration and vital statistics system as a national health information system was established by the Ministry of Health of the Socialist Republic of Viet Nam in 1992. The A6 mortality reporting system is a national mandatory mortality registration system which relies on commune-level health officials providing basic demographic data and information on the cause of death, age, sex, and date of death for each deceased case. A record of the death is recorded in an official book referred to as the A6. The data from the A6 are collated by the district-level health service, and the information is forwarded to the provincial and central-level governments. The commune-level officials play a significant role in maintaining the current mortality reporting system and, in

turn, are able to actively use the information gained to plan commune-level health services. The A6 mortality reporting system has been evaluated and the results confirmed that the sensitivity of the A6 system varied depending on the cause of death, with the sensitivity of the system being excellent for injury (sensitivity = 75.4%), cancer (sensitivity = 66.9%), and cardiovascular diseases (sensitivity = 63.1%)[4]. The A6 mortality reporting system performs well in relation to its completeness and classification of 3 leading causes of death-namely, cardiovascular disease, cancer, and injury.

There is a need to improve the accuracy of the A6 mortality statistics in order to implement timely policies and population-based interventions to respond to the growing burden of NCD's in Viet Nam. The aims of the present study therefore, were to examine the outputs of a population-based intervention which involved the comprehensive training of health workers involved in mortality reporting to improve the A6 mortality reporting system for all non-communicable diseases particularly the sub-groups of diabetes and chronic respiratory diseases.

Methods

The study was conducted at Dien Chau District of Nghe An Province in the central area of Viet Nam (Fig. 1). The local health network included 39 commune health stations, one district health center and one general hospital; the health stations and health center provide primary health care for the district. The population of Dien Chau in 2014 was 308,135. A total of 27 commune health stations have medical doctors who are responsible for maintaining the A6 mortality registration.

A comprehensive 1-day training workshop was hosted at the Dien Chau Health Center for 85 health officers invited from 39 commune health stations (78 health workers, and 7 medical doctors) and Dien Chau District Health Center (7 health workers). The workshop involved training on the i) definition of causes of death (underlying cause of death, immediate cause of death, and contributing cause of death; ii) ICD-10 coding for 54 main group causes and specific causes of deaths and iii) methods of data collection and the practice of Verbal Autopsy (VA) to determine a cause of death when undertaking a household visit [4,5].

Prior to the implementation of the workshop, health workers provided mortality data from the A6 book in the commune health centres and the district health centre comprising the name, age and sex of the deceased, the date of death and the cause of death. Data was obtained by using the the government's data collection form which includes the five variables with a guideline on how

to report the underlying cause of death and the relevant ICD-10 coding. This form has been used to register deaths from over 10,769 commune health centres across Viet Nam since 2005,[6]. On the completion of training, all participants reviewed the commune and district health records and reported all-cause mortality to the researchers and finally, a list of all-cause mortality was derived from undertaking verbal autopsy (VA) across the same communes and district (see Figure 2). To administer the VA a team of commune health workers who participated in the training ($n = 78$) visited the deceased's household and administered one of three verbal autopsy questionnaires; separate questionnaires were used for deaths in each of three age groups (0-28 day old infant, 29 days to < 5 years old child and 5 years onwards). The instruments included a series of questions relating to various signs and symptoms of different diseases and injury along with an open narrative section that was completed with the aid of the field worker. Cause of death assignment for the VA's was undertaken, independently, by 2 experienced physicians, each of whom had more than 15 years clinical experience and who had previously worked in allocating causes of death from surveillance systems. An *underlying* cause of death (the disease or injury which initiated the events directly leading to death) for all cases was assigned wherever possible. An *immediate* (the disease, condition or complication that occurred closest to the time of death) and *contributory* (a condition originated in the underlying cause and terminated in the immediate cause) causes of death was also assigned. The cause of death was assigned from the 10^{th} version of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) [7] and comprised approximately 54 groups of causes of death that could be confidently assigned by the experienced physicians based on the information typically provided in a verbal autopsy. Assigning the cause of death was enhanced by utilizing a previously developed series of algorithms [4,5,8]. The third database determined the causes of death by VA and this was the reference group or "Gold Standard" to estimate sensitivity, specificity, positive predictive value, and negative predictive value 9,10 for the first and second obtained databases for all NCDs, the sub-groups of cardiovascular disease, cancer, diabetes, and chronic respiratory diseases.

Statistical analysis: we compared these indicators of sensitivity, specificity, positive predictive value, and negative predictive values between the second and first obtained databases using a two-sample test of proportions to observe increasing values of those indicators indicated the benefits of intervention [11]. After analysis for the whole populations, we analyzed for the sub-group of admitted hospitals for both the first and second databases.

The research protocol was approved the Ethic Committee of Hanoi Medical University on Nov. 25, 2008.

Figure 1. Location of Nghe An province in Central Viet Nam (Source: http://ontheworldmap.com/vietnam/)

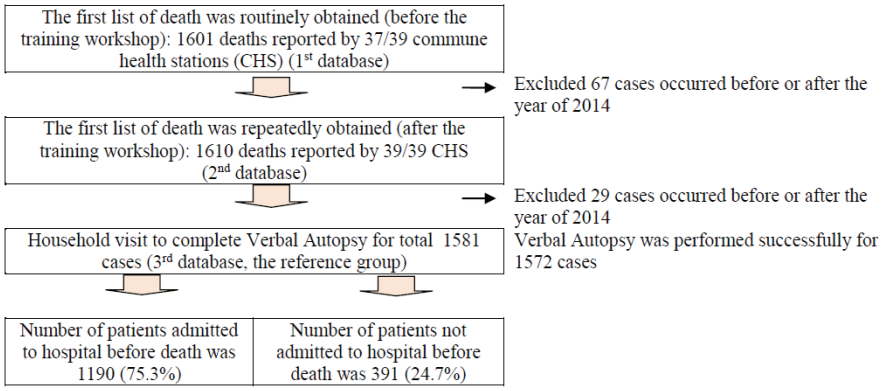

Figure 2. Flow chart of the three times repeated database developments

Results

Among a total 1,581 reported deaths, 1,122 cases were classified as NCDs (71%); specifically, deaths due to cardiovascular diseases (CVD, 576 cases, 36%), cancer (440 cases, 28%), diabetes (26 cases, 2%), and chronic respiratory diseases (included chronic obstructive pulmonary diseases and asthma, CRD, 80 cases, 5%). For the final data analysis, we excluded 9 cases due to unsuccessfully performed VA due to a deceased person's family migrating to another region outside of the study area.

A total of 1,572 cases (included 1,114 NCD deaths) were determined by VA. We compared the first enumeration of mortality (before the training workshop)

to the third database (mortality determined using the VA approach). The estimated sensitivity, specificity, positive predictive value, and negative predictive value was 0.95, 0.54, 0.83, and 0.80, respectively for the total NCDs; 0.23, 1.00, 0.67, and 0.99, respectively for diabetes; 0.28, 0.98, 0.38, and 0.97, respectively for chronic respiratory diseases (CRD); 079, 0.90, 0.75, and 0.92, respectively for cancer; 0.87, 0.76, 0.68, and 0.91, respectively for cardiovascular disease. Table 1.

Table 1. Accuracy of mortality report before the training workshop of the first database

	Not disease	Disease	Total	Indicator	Mean, 95% CI
Total NCDs					
				Sensitivity	0.95 (0.93, 0.96)
Not disease	241	59	300	Specificity	0.54 (0.52, 0.57)
Disease	204	1,020	1,224	Positive predictive value	0.83 (0.81, 0.85)
Total	445	1,079	1,524	Negative predictive value	0.80 (0.78, 0.82)
Diabetes					
				Sensitivity	0.23 (0.21, 0.25)
Not disease	1,495	20	1,515	Specificity	0.99 (0.99, 1.00)
Disease	3	6	9	Positive predictive value	0.67 (0.64, 0.69)
Total	1,498	26	1,524	Negative predictive value	0.99 (0.98, 0.99)
Chronic respiratory diseases					
				Sensitivity	0.28 (0.26, 0.30)
Not disease	1,430	46	1,476	Specificity	0.98 (0.97, 0.99)
Disease	30	18	48	Positive predictive value	0.38 (0.35, 0.40)
Total	1,460	64	1,524	Negative predictive value	0.97 (0.96, 0.98)
Cancer					
				Sensitivity	0.79 (0.77, 0.81)
Not disease	989	87	1,076	Specificity	0.90 (0.88, 0.91)
Disease	113	335	448	Positive predictive value	0.75 (0.73, 0.77)
Total	1,102	422	1,524	Negative predictive value	0.92 (0.91, 0.93)
Cardiovascular disease					
				Sensitivity	0.87 (0.85, 0.88)
Not disease	729	76	805	Specificity	0.76 (0.74, 0.78)
Disease	228	491	719	Positive predictive value	0.68 (0.66, 0.71)
Total	957	567	1524	Negative predictive value	0.91 (0.89, 0.92)

NCDs: Non-communicable diseases; CI: Confident interval;

After the training workshop, the sensitivity, specificity, positive predictive value, and negative predictive value was 0.93, 0.76, 0.90, and 0.81, respectively for total NCDs; 0.50, 1.00, 0.87, and 0.99, respectively for diabetes; 0.76, 0.98, 0.68, and 0.99, respectively for CRDs; 0.87, 0.95, 0.88, and 0.95, respectively for cancer; 0.87, 0.89, 0.82, and 0.92, respectively for cardiovascular disease, Table 2.

Table 2. Accuracy of mortality report after the training workshop of the second database

	Not disease	Disease	Total	Indicator	Mean, 95% CI
Total NCDs					
				Sensitivity	0.93 (0.92, 0.94)
Not disease	349	80	429	Specificity	0.76 (0.74, 0.78)
Disease	109	1,034	1,143	Positive predictive value	0.90 (0.89, 0.92)
Total	458	1,114	1,572	Negative predictive value	0.81 (0.79, 0.83)
Diabetes					
				Sensitivity	0.50 (0.48, 0.52)
Not disease	1,544	13	1,557	Specificity	0.99 (0.99, 1.00)
Disease	2	13	15	Positive predictive value	0.87 (0.85, 0.88)
Total	1,546	26	1,572	Negative predictive value	0.99 (0.99, 1.00)
Chronic respiratory diseases					
				Sensitivity	0.76 (0.74, 0.78)
Not disease	1,466	19	1,485	Specificity	0.98 (0.97, 0.99)
Disease	28	59	87	Positive predictive value	0.68 (0.66, 0.70)
Total	1,494	78	1,572	Negative predictive value	0.99 (0.98, 0.99)
Cancer					
				Sensitivity	0.87 (0.85, 0.89)
Not disease	1,085	57	1,142	Specificity	0.95 (0.94, 0.96)
Disease	52	378	430	Positive predictive value	0.88 (0.86, 0.90)
Total	1,137	435	1,572	Negative predictive value	0.95 (0.94, 0.96)
Cardiovascular disease					
				Sensitivity	0.87 (0.85, 0.89)
Not disease	886	75	961	Specificity	0.89 (0.87, 0.90)
Disease	111	500	611	Positive predictive value	0.82 (0.80, 0.84)
Total	997	575	1572	Negative predictive value	0.92 (0.91, 0.94)

NCDs: Non-communicable diseases; CI: Confident interval;

The significant changes for all NCDs were not seen for the sensitivity (difference -0.02, 95%CI: -0.04, 0.00), P=0.10; and the negative predictive value (difference 0.01, 95%CI: -0.02, 0.04), P=0.73; but that were observed improving for the specificity (difference 0.22, 95%CI: 0.18, 0.26), P<0.01; and the positive predictive value (difference 0.07, 95%CI: 0.04, 0.10), P<0.01. For the sub-groups, the estimated sensitivity was significantly increased for CRDs (difference 0.48, 95%CI: 0.33, 0.62), P<0.01; for diabetes (difference 0.27, 95%CI: 0.02, 0.52), P=0.04; for cancer (difference 0.08, 95%CI: 0.03, 0.13), P<0.01; but it was no change of 0.87 for cardiovascular disease, Table 3.

Table 3. Improve quality of mortality registration after the training workshop

		NCDS		Chronic respiratory disease		Diabetes		Cancer		Cardiovascular disease	
Indicators	**Variable**	**Mean, 95% CI**	***P***	**Mean, 95% CI**	***P***	**Mean, 95% CI**	***P***	**Mean, 95% CI**	***P***	**Mean, 95% CI**	***P***
Sensitivity	After	0.93 (0.91, 0.94)		0.76 (0.66, 0.85)		0.50 (0.31, 0.69)		0.87 (0.84, 0.90)		0.87 (0.84, 0.90)	
	Before	0.95 (0.93, 0.96)		0.28 (0.17, 0.39)		0.23 (0.07, 0.39)		0.79 (0.75, 0.83)		0.87 (0.84, 0.90)	
	Difference	-0.02 (-0.04, 0.00)	0.10	0.48 (0.33, 0.62)	0.00	0.27 (0.02, 0.52)	0.04	0.08 (0.03, 0.13)	0.00	0.00 (-0.04, 0.04)	1.00
Specificity	After	0.76 (0.74, 0.79)		0.98 (0.95, 1.01)				0.95 (0.93, 0.97)		0.89 (0.86, 0.92)	
	Before	0.54 (0.51, 0.57)		0.98 (0.94, 1.01)				0.90 (0.87, 0.93)		0.76 (0.72, 0.80)	
	Difference	0.22 (0.18, 0.26)	0.00	0 (-0.04, 0.05)	0.72			0.05 (0.01, 0.09)	0.01	0.13 (0.09, 0.17)	0.00
Positive predictive value	After	0.90 (0.89, 0.92)		0.68 (0.57, 0.78)		0.87 (0.74, 1.00)		0.88 (0.85, 0.91)		0.82 (0.79, 0.85)	
	Before	0.83 (0.81, 0.86)		0.38 (0.26, 0.49)		0.67 (0.49, 0.85)		0.75 (0.71, 0.79)		0.68 (0.64, 0.72)	
	Difference	0.07 (0.04, 0.10)	0.00	0.30 (0.15, 0.46)	0.00	0.2 (-0.02, 0.42)	0.24	0.13 (0.08, 0.18)	0.00	0.14 (0.09, 0.19)	0.00
Negative predictive value	After	0.81 (0.79, 0.84)		0.99 (0.96, 1.01)		0.99 (0.95, 1.03)		0.95 (0.93, 0.97)		0.92 (0.90, 0.94)	
	Before	0.80 (0.78, 0.83)		0.97 (0.93, 1.01)		0.99 (0.95, 1.03)		0.92 (0.89, 0.95)		0.91 (0.89, 0.93)	
	Difference	0.01 (-0.02, 0.04)	0.73	0.02 (-0.03, 0.07)	0.01	0.00 (-0.05, 0.05)	1.00	0.03 (0.00, 0.06)	0.00	0.01 (-0.02, 0.04)	0.45

The significant increased specificity and positive predictive value for both cancer ((difference 0.05, 95%CI: 0.01, 0.09), P=0.01 and (difference 0.13, 95%CI: 0.08, 0.18), P<0.01, respectively) and cardiovascular diseases ((difference 0.13, 95%CI: 0.09, 0.17), P<0.01 and (difference 0.14, 95%CI: 0.09, 0.19), P<0.01, respectively) were observed, Table 3.

Discussion

The main findings were successfully evaluated data quality NCDs of the current mortality reporting system of Dien Chau district of Nghe An province located in Central Area of Viet Nam for all deaths occurred in 2014. The estimated sensitivities of databases for total NCDs for both before and after the intervention was ranked between 93% and 95%. It means that the current mortality reporting system might be missed diagnosing of about 5%-7% of NCD cases among total 1,581 registered deaths for the whole population of Dien Chau district indicating excellence accuracy of reported mortality data at the study population. The other important findings include the significant benefits of improving data quality of total NCDs for specificity and positive predictive value; and for sub-groups of cardiovascular diseases, cancer, diabetes, and chronic respiratory diseases. The present findings are consisted with the previous results to evaluate the data quality of the current mortality reporting system at three provinces represented three regions of Viet Nam for deaths occurred during 2008-2009. That is, the A6 mortality reporting system is embedded within the commune health system and is the lead mortality reporting system for the Ministry of Health. The system performs well in relation to its completeness and classification of three leading causes of death namely, circulatory disease, cancer and injury. With further enhancements and ongoing support from government and donor agencies, the A6 system will be a valuable resource for identifying and planning preventive strategy's targeting the leading-causes of deaths in Viet Nam [4,8].

Among four groups of NCDs, two groups of cardiovascular diseases and cancer were responsible for 64% of total deaths (1,016 cases) and the estimated sensitivities for before and after the intervention for these two groups were also being excellence and ranked between 79.0% and 87.0% (data for 2014). These findings are consisted with data quality (data for 2008-2009) that was previously validated being excellence for cancer (sensitivity= 66.9%), and cardiovascular diseases (sensitivity= 63.1%) [4]. The present indicator of sensitivity is better than previous results that would be explained by progressing mortality registration experiences of the local health workers at the commune health stations by yearly performing data reported from 2008 to 2014.

Because diabetes and chronic respiratory diseases were responsible for a

small proportion of deaths of 2% and 5%, respectively (Whole study populations), the estimated sensitivities before the intervention were relatively as low as 23% and 28%, respectively. These indicators were significantly improved after the intervention as high as 50% and 76% for diabetes and chronic respiratory diseases, respectively, pointing out the important benefits of the intervention by the training workshop.

Because the four groups of NCDs of cardiovascular diseases, cancer, diabetes, and chronic respiratory diseases have their four shared risk factors of tobacco smoking, unhealthy diet, physical inactivity and harmful use of alcohol [1,12], each patient might be suffered from one or more specific diseases, for example, diabetes, lung cancer, chronic respiratory diseases that related to tobacco smoking. By these conditions, cause of death might be missed reporting (within NCDs) depend on time of registration and available data and medical records. Therefore, the intervention by a training workshop at communities to determine the underlying cause of death, immediate cause and contribute cause of death is important and useful.

Viet Nam has 761 district Health Centers of 63 provinces/cities nationwide. From 2005 to date, 95% of these districts and of 10,769 Commune Health Stations has been routinely registered mandatory mortality registration and cause of deaths occurred at their communities and yearly completed mortality data collection in using the designed from of "Mortality registration" [4,6,8,13]. This national local health care network would be working well to providing a training workshop to improve mortality reporting system in applying the present findings and achievements.

Vital statistics are routinely collected in many countries to report on specific causes of death and its trends are reviewed in relating with socioeconomic and lifestyle factors. However, vital registration systems are expensive to set up and require close collaboration between Ministry of Health, and sectors responsible for registration of persons, immigration, and the judiciary. Misclassification of cause of death is a major problem for this system that have been reviewed elsewhere [3,14]. Verbal autopsy has been recommended using to determine cause of death and developing database of mortality for health planning, priority setting, monitoring, and evaluation in countries with incomplete or no vital registration system [14]. The A6 mortality reporting system is the lead mortality reporting system for the Ministry of Health in Viet Nam and it was evaluated being excellence data source for three leading causes of injury, circulation and cancer [4,8]. The present approach using Verbal autopsy to address the significant benefits of population-based intervention was performed in strengthening the A6 mortality reporting system focused on NCDs in the participated population in Central Viet Nam. NCDs caused about 28 million deaths (74% of 38 million deaths worldwide) 15 per year now at developing

countries and the present work is making a change improving data quality supporting NCDs control.

The present study certainly has a limitation because there have not been available incident data of these non-communicable diseases to estimate an important data of disability-adjusted life year (DALY) for total NCDs and four groups of cardiovascular diseases, cancer, diabetes, and chronic respiratory diseases as recommended by WHO [1,2]. The present study is an initial contribution to NCDs control and further research in Viet Nam as well as worldwide.

Comclusion

Data quality for total NCDs and its sub-groups of diabetes and chronic respiratory diseases, was improved after the intervention, which would be suggested to perform nationwide to enhance mortality data for identifying and planning preventive strategy's targeting the leading-causes of deaths in Viet Nam.

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