การสอบสวนสาเหตุการตายโดยการสัมภาษณ์ในเวียดนาม: ความสอดคล้องของสาเหตุการตายกับข้อมูลการตายจากโรงพยาบาลและข้อมูลการตายของผู้ป่วย

นางสาวตู มาย ดีพ

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาศิลปศาสตรดุษฎีบัณฑิต
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VERBAL AUTOPSY IN VIETNAM: THE DEGREE OF AGREEMENT ON SPECIFIC CAUSE OF DEATH WITH MEDICAL RECORD AND FAMILIES-GIVEN CAUSE OF DEATH

Miss Tu My Diep

A Dissertation Submitted in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy Program in Demography
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Field of Study	Demography
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ความเป็นมา: ประเทศเวียดนามเหมือนกับหลายประเทศที่ประชากรมีรายได้ต่ำถึงปานกลางที่ข้อมูลสถิติเกี่ยวกับการตายในประเทศไม่มีความแม่นยำและน่าเชื่อถือเนื่องจากระบบการจดทะเบียนการตายยังไม่สมบูรณ์ ปัจจุบันมีความพยายามแก้ไขปัญหานี้โดยใช้วิธีการสอบสวนสาเหตุการตายโดยการสัมภาษณ์ (VA) ซึ่งเป็นกระบวนการสัมภาษณ์ผู้ดูแลผู้ป่วยเกี่ยวกับสถานการณ์ก่อนการตายเพื่อบ่งชี้สาเหตุการตาย (CoD) การศึกษาสาเหตุการตายเป็นเรื่องที่ค่อนข้างใหม่และมีจำนวนงานวิจัยค่อนข้างน้อยในเวียดนามเนื่องจากระบบการจดทะเบียนดังกล่าวยังไม่สมบูรณ์ ดังนั้น การวิจัยเกี่ยวกับข้อมูลการตายด้วยวิธีการสอบสวนสาเหตุการตายโดยการสัมภาษณ์จึงมีสำคัญในกระบวนการพัฒนาและปรับปรุงคุณภาพของข้อมูลสาเหตุการตายในประเทศเวียดนาม งานวิจัยชิ้นนี้มีจุดประสงค์เพื่อประเมินความสอดคล้องของสาเหตุการตายจากการสอบสวนสาเหตุการตายโดยการสัมภาษณ์ (VACoD) และสาเหตุการตายจากข้อมูลการตายจากโรงพยาบาล (MCoD) และข้อมูลการตายที่แจ้งโดยครอบครัวผู้ตาย (FGCoD) ในสามจังหวัดในประเทศเวียดนาม

ระเบียบวิธีวิจัย: งานวิจัยนี้มีจุดประสงค์เพื่อศึกษาความสอดคล้องของสาเหตุการตายจากวิธีการสอบสวนสาเหตุการตายโดยการสัมภาษณ์ใน 3 จังหวัดของเวียดนาม ได้แก่ โฮจิมินห์ ซิตี้ บินห์ดอง และแลมดอง ข้อมูลจากการสำรวจที่ใช้ในการวิเคราะห์ได้จากข้อมูลการตายระหว่างเดือนมกราคม พ.ศ. 2551 ถึงเดือนธันวาคม พ.ศ. 2552 ที่มีข้อมูลจากการสอบสวนสาเหตุการตายโดยการสัมภาษณ์ ข้อมูลการตายจากโรงพยาบาล และข้อมูลการตายจากมรณบัตร นอกจากนี้ งานวิจัยยังศึกษาปัจจัยที่ส่งผลต่อความสอดคล้องของสาเหตุการตายจากจากการสอบสวนสาเหตุการตายโดยการสัมภาษณ์ (VACoD) และสาเหตุการตายจากข้อมูลการตายที่แจ้งโดยครอบครัวผู้ตาย (FGCoD)

ผลการวิจัย: ระหว่างปี พ.ศ.2551 และปี พ.ศ. 2552 มีข้อมูลจากการสอบสวนสาเหตุการตายโดยการสัมภาษณ์ 4,672 รายในสามจังหวัดดังกล่าว ซึ่งมี 252 รายที่มีข้อมูลการตายจากโรงพยาบาล และในจำนวนนี้มี 64 รายที่ตายในโรงพยาบาล และมี 3,166 รายที่มีข้อมูลการตายจากจดทะเบียนการตายที่แจ้งโดยครอบครัวผู้ตาย ผลการวิจัย พบว่า สาเหตุการตายจากการสอบสวนสาเหตุการตายโดยการสัมภาษณ์ (VACoD) มีความสอดคล้องกับข้อมูลการตายจากโรงพยาบาล (MCoD) ประมาณร้อยละ 56 จากตัวอย่างจำนวน 64 ราย โดยพบว่า โรคหัวใจและหลอดเลือดมีความสอดคล้องกันมากที่สุด (ร้อยละ 90) สำหรับความสอดคล้องระหว่างการสอบสวนสาเหตุการตายโดยการสัมภาษณ์ (VACoD) และข้อมูลการตายที่แจ้งโดยครอบครัวผู้ตาย (FGCoD) พบว่า สาเหตุการตายที่สอดคล้องกันมากที่สุดคือ อุบัติเหตุจากการจราจรและความชรา (92.6%) โดยจากข้อมูล 3,166 ราย พบว่า เกือบครึ่งหนึ่ง (47.2%) มีความสอดคล้องระหว่างสาเหตุการตายจากการสอบสวนสาเหตุการตายโดยการสัมภาษณ์และสาเหตุการตายที่แจ้งโดยครอบครัวผู้ตาย นอกจากนี้ พบว่า ความสอดคล้องของข้อมูลการตายนี้ไม่แปรเปลี่ยนตามปัจจัยระยะเวลาในการสอบสวนหลังการตาย ซึ่งข้อมูลที่ใช้ในการวิเคราะห์มีระยะเวลาในการสอบสวนสาเหตุการตายจากการสัมภาษณ์หลังการตายระหว่าง 9 - 24 เดือน

สรุป: สาเหตุการตายจากการสอบสวนสาเหตุการตายโดยการสัมภาษณ์มีความสอดคล้องในระดับปานกลางกับสาเหตุการตายจากข้อมูลการตายจากโรงพยาบาลและสาเหตุการตายที่แจ้งโดยครอบครัวผู้ตาย ทั้งนี้ ควรมีการศึกษาเพิ่มเติมถึงผลกระทบของลักษณะของผู้ให้ข้อมูลต่อความความสอดคล้องของข้อมูลในกรณีที่มีข้อมูลเชิงลึกที่สมบูรณ์มากกว่าที่มีอยู่ ผู้วิจัยหวังว่างานวิจัยชิ้นนี้แม้มีขอบเขตไม่กว้างมากนักจะมีประโยชน์เบื้องต้นในการพัฒนาระบบสถิติแห่งชาติเกี่ยวกับสาเหตุการตายในเวียดนามและประเทศกำลังพัฒนาอื่นๆ

คำสำคัญ: สาเหตุการตาย, การสอบสวนสาเหตุการตายโดยการสัมภาษณ์, ความสอดคล้องของสาเหตุการตาย ข้อมูลการตายจากโรงพยาบาล, ข้อมูลการตายโดยครอบครัวผู้ตาย, เวียดนาม

สาขาวิชา ประชากรศาสตร์ ลายมือชื่อนิสิต .....

ปีการศึกษา 2558 ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

5686961251 : MAJOR DEMOGRAPHY
KEYWORDS: CAUSE OF DEATH, VERBAL AUTOPSY, CONSISTENCY, AGREEMENT, MEDICAL RECORD, FAMILIES-GIVEN CAUSE OF DEATH, VIETNAM.

TU MY DIEP: VERBAL AUTOPSY IN VIETNAM: THE DEGREE OF AGREEMENT ON SPECIFIC CAUSE OF DEATH WITH MEDICAL RECORD AND FAMILIES-GIVEN CAUSE OF DEATH. ADVISOR: ASSOC. PROF. PUNGPOND RUKUMNUAYKIT, Ph.D., 116 pp.

Background: Similar to middle and low-income countries, the accurate of the nationally representative statistics on mortality in Vietnam are deficient because of inadequate routine information systems. There is an effort to solve this problem by introducing the verbal autopsy (VA) method, which is the process of interviewing caregivers on the circumstances leading to death to assess the cause of death (CoD). Studies on CoD are relatively new and scarce in the Vietnamese context given its mortality registration system. In this regard, the reliability study on the VA mortality data is essential for the improvement of data quality on CoDs. This study is designed to evaluate the consistency of the VA derived CoD (VACoD) with the medical record (MCoD) and Families-Given CoD (FGCoD) in three provinces in Vietnam.

Methods: This study assesses the consistency of the VACoD in three provinces of Vietnam (Hochiminh City, Binhduong Province and Lamdong Province). The data include all of death cases occurring between 1st January 2008 and 31st December 2009 in selected areas which had verbal autopsy (VA) records together with medical records or death certificates. Furthermore, the study investigates factors that relate to the agreement between these approaches by applying multivariate estimations.

Results: Between 2008 and 2009, there were 4,672 VA interview records in these provinces, in which 252 cases had medical records, where 64 cases of these deaths occurred in hospital. There were 3,166 cases that had death certificates. We found that VACoD agreed with MCoD about 56% of 64 deaths. For specific causes of cardiovascular diseases occupied the highest proportion of agreement (90%). With regards to the agreement between VACoD and FGCoD, transport accident and senility represent the highest proportion of agreement (92.6%). In total, nearly a half of 3,166 death cases (47.2%) from VA agreed with those derived from death certificates in terms of causes of death. Moreover, our findings suggest that VA is robust to time after death. We found that the recall period had no effect on the agreement given the duration of the recall period in our study ranged from 9 to 24 months.

Conclusion: VA agreed moderately with MCoD and FGCoD in determining the underlying causes of death. We recommend further investigations of the effect of characteristics of respondents on the level of agreement given better data in the future. We hope that our study, albeit small, provide useful results that will stimulate further works for strengthening the national cause-specific mortality statistics in Vietnam and other developing countries alike.

Keywords: Cause of death, verbal autopsy, consistency, agreement, medical record, Families-Given cause of death, Vietnam.

Field of Study: Demography Student's Signature .....

Academic Year: 2015 Advisor's Signature .....

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1. INTRODUCTION

Birth and death are the two most important events in a human life. A person's legal existence is measured between the recorded timings of his or her birth and death. Apart from this definitive legal confirmation of identity, registration of births and deaths creates vital basic data about a population. Registration of not only the occurrence of death, but also its cause is essential. The information which is reliable, timely and relevant plays an undeniable role in improving the population's health. Accurate information about cause-specific mortality not only is needed for addressing the health needs of the community people, identifying the magnitude and distribution of major disease problems, but also is important for the country in prioritizing, planning of various health care interventions (Khademi et al., 2010; A. D. Lopez, C. D. Mathers, M. Ezzati, D. T. Jamison, & C. J. Murray, 2006; Soleman, Chandramohan, & Shibuya, 2006). If the number and the causes of deaths are not being recorded, governments could not achieve good public health policies or evaluate their impact (WHO, 2014).

In general, data on causes of death (CoDs) are usually obtained through routine vital registration. In point of fact, there will not be universal vital registration data throughout the world, regardless of useful such information might be. Of the entire global population, only 26 percent of people live in countries with a complete vital registration system where at least 90 percent of births and deaths are registered; these are mostly high-income countries (Koyanagi & Shibuya, 2010). In contrast, this system is seldom fully functional, or even does not exist in most of the developing countries. That lead to the information on CoDs is often incomplete or nonexistent. Globally, more than two-thirds of 56 million annual deaths (representing 38 million deaths) pass by undocumented as to cause (WHO, 2014).

Moreover, when a death occurs in developed countries, the attending physician, who in charge of the patient's care for the condition that resulted in death, is responsible for certifying the CoD (NCHS, 2003). Death certificate with physician diagnoses is a compulsory pre-requisite for funeral procedures (NCHS, 2003). This however is not the case in most developing countries, where access to medical care is limited and where a significant proportion of the deaths occur at home. In such

settings, a new technique has been developed in order to establish the probable COD by interviewing relatives or a caregiver who can provide the specific circumstances, signs, symptoms, care-seeking and other events related to the deceased person and his or her illness in the period before death. This procedure is referred to "verbal autopsy" (Fauveau, 2006).

The term “verbal autopsy” (VA) was first used by Arnold Kielman and coworkers in their publication in 1983 (Fauveau, 2006). VAs have been used previously to investigate infectious disease outbreaks, such as cholera, meningitis, or shigellosis (Etard et al., 2004), and evaluate the effects of public health interventions (Soleman et al., 2006). Since then, VA has become a widely used technique for assessing causes of childhood death (Martha Anker et al., 1999). The application of the VA method for assessing causes of adult deaths and across all ages was extended globally during the following decade and has become a routine technique. In recent years, China, India and more than 18 other countries regularly use VA primarily to assess the CoD structure of a defined population (Setel et al., 2005; Soleman et al., 2006).

Vietnam, the third populous nation in Southeast Asia with over 90 million people (GSO, 2014) whose population structure has been changed rapidly due to the declining in fertility and mortality and a transition in morbidity and mortality (D.L Huong, 2006). Thus, knowledge about the distribution of CoDs is essential for assessing the country's demographic and epidemiological transition, and for effective health care strategic planning. However, as in many middle- and low-income countries, the most accurate nationally representative statistics on mortality in Vietnam are still deficient because of inadequate routine information systems. In the assessment of the global CoDs data, Vietnam is one of 10 countries in the Western Pacific region that has never provided mortality data to WHO (C. D. Mathers, Fat, Inoue, Rao, & Lopez, 2005). One of the major weaknesses of death registration system in Vietnam is the existence of too many parallel systems. “Juridical system” which operated by the Ministry of Justice has the formal responsibility to issue death certificate. The death certificate includes CoD, which is granted at the request of family of a deceased person; henceforth it is referred to as the Families-Given CoD

(FGCoD). In parallel with “Juridical system”, the Ministry of Health and the National Committee for Population, Family and Children also collect mortality data in the country. The different data are obtained from these systems due to their different interests. Hence, source of data in Vietnam are still inadequate and need to be improved. In an effort to solve this problem, a research project was begun from 2007 that was aimed at improving the completeness of death reports, introducing the VA method for accessing CoDs and expanding the use of this tool in the national mortality data collection system in Vietnam (Ngo, Rao, Hoa, Adair, & Chuc, 2010). Studies on CoD are scarce in the Vietnamese context, and studies on the mortality data from the VA system are relatively new in Vietnam. In this process, the reliabilities study on the VA mortality data is essential for acceleration in the improvement of data quality on CoDs.

The proposed thesis attempts to compare CoDs assigned by VA with other sources of the same death case. It divides into two parts: (i) assess the consistency of the VA derived CoD (VACoD) by comparing them against medical records, and (ii) investigate the agreement between Families-Given CoD (FGCoD) and VACoD. The findings of the study are expected to provide some evidence which would be helpful for improving not only the performance and utility of VA methods specific to the Vietnamese context, but also the system of collecting data on cause-specific mortality in the country.

2. BACKGROUND

2.1. The importance of mortality data

Apart from this definitive legal confirmation of identity, registration of births and deaths creates vital basic data about a population. Deaths registration of not only enumeration, but also its cause is essential. The causes of death (CoDs) registration have attracted little attention from a medical history perspective. The determination of CoDs is not considered as an important medical activity (Alter & Carmichael, 1996). Medical professionals are primarily concerned with the diagnosis, and treatment. In addition, from a clinical point of view, the fatal infectious diseases often left little opportunity for intervention, while chronic conditions cause a great deal of sickness but few deaths (D.L Huong, 2006). Death registration was often a response to public fears of epidemics, and early registration systems sometimes targeted epidemic disease for special attention. Since the middle of the eighteenth century, CoDs data were used to control the environmental sources of disease and to draw attention to infectious diseases (Jamison et al., 2006).

The reliable mortality statistics, the cornerstone of national health information systems, are necessary for population health assessments, for formulating health policy and planning health services, evaluating programs and conducting epidemiological research (Khademi et al., 2010). Information on CoDs is crucial for reducing deaths in communities. The pattern of mortality in the community represents an essential pre-requisite for guiding public health action, planning and evaluating the effective of health care interventions (Soleman et al., 2006). Mortality statistics provide a baseline indicator from which health profiles can be constructed and health policy can be formulated. In case of absence of resources for disease surveillance, mortality statistics can also be used as a replacement of morbidity statistics. Studying trends in mortality over time helps to understand the change in health status of the population, to measure the burden of disease, and to evaluate the quality of medical care and health system (Tabeau, Jeths, & Heathcote, 2001). Thus, if the number and the CoDs are not being recorded, governments could not achieve good public health policies or evaluate their impact (WHO, 2014).

There are different health managers and policy makers at every level of administration from local to global, at which data on mortality patterns are needed, as indicated in Table 1 (Byass, 2007). National and international organizations concerned with standardizing and comparing the health profiles throughout the world require consistent and reliable cause-specific mortality data from a wide range of settings. For local public health managers, the leading CoDs are needed for identifying priorities and appropriate interventions for avoidable CoDs and evaluating of various public health interventions. Epidemiologists and health services researchers need a consistent assessment of cause-specific mortality relating to a specific population to determine trends in CoDs that enable evaluations of the effectiveness of interventions across time and regions. The patterns of deaths within health care systems are used for reallocating resources based on the mortality trends over time. Health care professionals could follow up consequences of individual deaths for particular cases through CoDs data.

Table.1. Cause of death data (CoDD): who, what, and why

Who Needs CoDD?	What Kinds of CoDD Are Needed?	Why Are These CoDD Needed?
WHO and national/international bodies	Global and national cause-specific mortality estimates; ICD coding	Standardised, comparable estimates over time and place
Local public health managers	Top-ranking causes of death and public health priorities	Monitoring trends over time and evaluating public health interventions
Epidemiologists and health services researchers	Relating to specific populations and subgroups	Interpreting particular situations in terms of mortality patterns
Institutional managers and clinical auditors	Patterns of deaths within institutions and health care systems	Monitoring trends over time and within departments
Medical and legal practitioners	Individual causes for particular cases	Following up consequences of individual deaths

Source: Byass, P. (2007). "Who needs cause-of-death data?" PLoS Med 4(11): e333.

Mortality data could also be used by various commercial companies to anticipate demand for services (e.g. funeral directors) or to calculate risk (e.g. life insurance companies) (Dahl, 2005). It is also one of the components of the Human Development Index which developed by the United Nation. In addition, mortality was shown in two out of eight targets of the Millennium Development Goals include reducing child and maternal mortality, and mortality from HIV/AIDS, tuberculosis and malaria.

2.2. Certifying cause of death

There are some points of view that the death certificate is unimportant and just another part of documents that must be completed when a death occurs. The importance of accurate information about CoDs to mortality statistics and program prioritization has been discussed in section 2.1. On the individual level, death certificate is used to provide prima facie evidence of the fact of death, which can be require for settle estates, to claim on a person's life insurance, and may also be used in legal proceedings (Dahl, 2005).

A certifier of CoD is person authorized by law who issues a death certificate, on the prescribed form. Depending on local circumstances, this may be the doctor who attended the deceased in his/her last illness, or the coroner for deaths of persons who were not attended during the last illness or for unnatural deaths due to violence or accident, or some other designated official. Each country has its own rules about the formalities to be followed when someone dies. In most countries, there is a legal requirement to notify the relevant authority of any death case (CDC, 1986).

In developed countries, a medical certificate stating the CoDs is needed in order to register a death. When a death occurs, the attending physician, who in charge of the patient's care for the condition that resulted in death, fills out a death registration form, lists the conditions or diseases leading to the death and assigns one condition as the underlying CoD (NCHS, 2003). Death certificate with physician diagnoses is a compulsory pre-requisite for funeral procedures (NCHS, 2003). This however is not the case in most developing countries, where access to medical care is limited and where a significant proportion of the deaths take place outside the health facilities.

A full explanation of the CoDs includes four items: (i) the immediate cause is the disease, injury, or complication directly causing death, (ii) the intermediate causes, which triggered the immediate cause, (iii) the underlying cause is the disease or injury that initiated the chain of events that led directly and inevitably to death, and (iv) contributory conditions which have adversely affected the development of the condition leading to death and hence contributed to the underlying CoD (NCHS, 2003).

The above-mentioned details about CoDs are entered in the International Form of Medical Certificate for CoDs (Fig.1) that recommended by WHO. As can be seen, the statement of CoDs consists of two parts. Part I is for reporting the sequence of events leading to death, proceeding backwards from the direct CoD at line I(a). These causes are linked to a sequential cause-and-effect relationship when read from the bottom to the top of the certificate. So each condition in Part I should cause the condition above it. Part II is for reporting other significant contributory conditions (NCHS, 2003).

Fig.1. International Form of Medical Certificate of CoDs

Cause of death		Approximate interval between onset and death
I Disease or condition directly leading to death*	(a)	.....
	due to (or as a consequence of)	
Antecedent causes Morbid conditions, if any, giving rise to the above cause, stating the underlying condition last	(b)	.....
	due to (or as a consequence of)	
	(c)	.....
	due to (or as a consequence of)	
	(d)	.....
II Other significant conditions contributing to the death, but not related to the disease or condition causing it	.....	.....
	.....	.....
**This does not mean the mode of dying, e.g. heart failure, respiratory failure. It means the disease, injury, or complication that caused death.*		

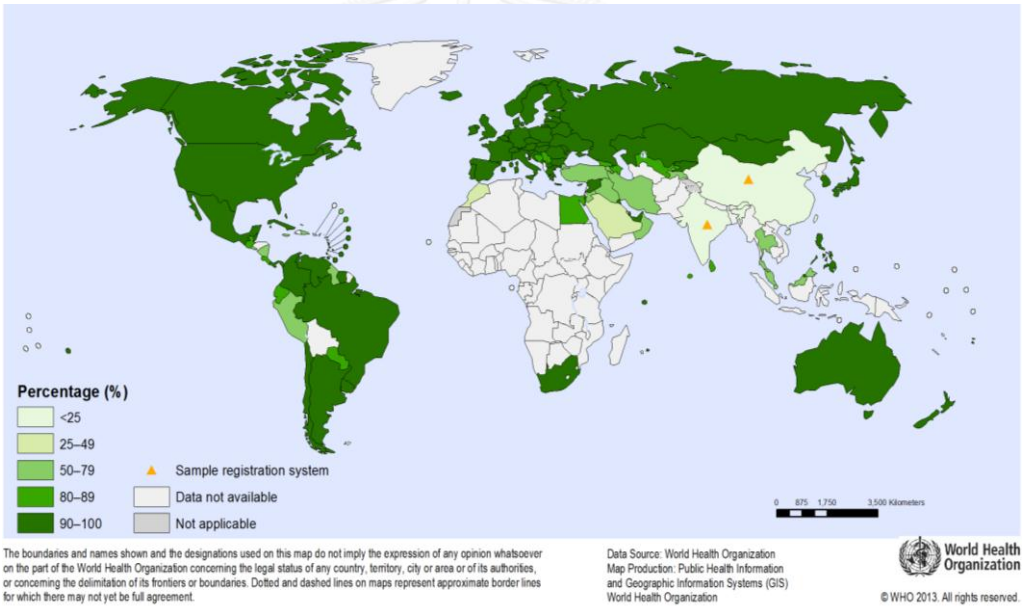
Source: WHO, ICD-10 Volume 2 Instruction Manual (Second Edition - 2003)

2.3. Mortality data collecting situation in developing countries

In general, data on CoDs are usually obtained through routine vital registration. In point of fact, there will not be universal vital registration data throughout the world, regardless of useful such information might be. Of the entire global population, only 26 percent of people live in countries with a complete vital registration system where at least 90 percent of births and deaths are registered; these are mainly high-income countries (Koyanagi & Shibuya, 2010). In contrast, this system is seldom fully functional, or even does not exist in most of the developing countries. The coverage of the resident population by death registration data varies

from nearly 25% in the developing world as a whole to less than 10% in the African Region. In the poorest countries, this figure is closer to 5%–10% (Murray, Lopez, Barofsky, Bryson-Cahn, & Lozano, 2007). That lead to the information on CoDs is often incomplete or nonexistent despite the critical importance of such data. According to WHO, only about one in three deaths worldwide are currently registered by death notification systems, including information on CoDs. It means that more than two-thirds of 56 million annual deaths (representing 38 million deaths) pass by undocumented as to cause (WHO, 2014). The vast majority of unregistered deaths occur in developing countries. In 75 WHO Member States, including more than 90% of African countries, no information on CoDs is available (WHO, 2014).

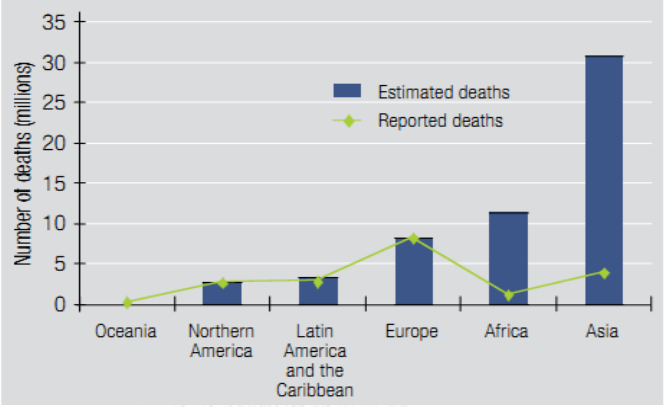
Fig.2. Civil registration coverage of CoDs (%), 2005 – 2011



In developing countries, most deaths occur outside of medical institutions where personnel would be required to report them (Maine & McGinn, 2000). Many people die at home, so that; the certifications and registrations of CoDs are still scarce. One of the example is India, the second populous nation on the world, has about 75 percent of the 9.5 million annual deaths occur at home, and are not recorded (Chadha, 2014). Up to 80 percent of childhood deaths occur outside of health facilities in rural Africa and are not registered in any mortality reporting system (Mung'ala & Snow, 1994). Fig.3. shows the total number of deaths reported for a UN regions in 2007 and the total number of deaths occurring among the resident

population as estimated for that year by WHO. It can be seen that the number of estimated deaths far exceed the reported deaths for Asia and Africa regions. Improvements in producing high quality CoDs data are crucial for improving health and reducing preventable deaths in these countries. The situation is even worse when it comes to the quality of cause-specific mortality data.

Fig.3. Reported deaths versus estimated deaths UN regions, 2007



Source: Department of Health Statistics and Informatics, WHO.

2.4. Mortality surveillance with verbal autopsy (VA)

Mortality surveillance with VA is designed to provide communities-based information on the deaths soon after they happen (WHO, 2007). The interviewers visit households and interview care givers or family members of a deceased using the standard VA questionnaire. Once completed, these forms are used to determine cause-specific mortality.

In 17th century, in London, the death searchers visited household of a deceased persons to hold inquiry about the death, especially about communicable diseases. In the 1950s and 60s in Asia (Khanna and Narragwal in India, Companiganj in Bangladesh) and in Africa (Keneba in The Gambia), Pioneer projects used systematic interviews by well-trained physicians to assess CoDs (Garenne & Fauveau, 2006). This new technique was called “Verbal Autopsy”.

The term “verbal autopsy” (VA) was first used by Arnold Kielman and coworkers in their publication in 1983 (Fauveau, 2006). VAs have been used to previously investigate infectious disease outbreaks, such as cholera, meningitis, or shigellosis (Etard et al., 2004), and evaluate the effects of public health interventions

(Soleman et al., 2006). Since then, VA has become a widely used technique for assessing causes of childhood death (Martha Anker et al., 1999). The application of the VA method for assessing causes of adult deaths and across all ages was extended globally during the following decade and has become a routine technique. From 1992 to 2004, WHO supported a project that implemented and validated the process of verbal autopsy first in Tanzania and then in China, India, Malawi, Ethiopia, and Cameroon (Conway, 2008). The final conclusion of this project was "Experiences from India, China, and Tanzania have shown how, in just a few steps, information generated through community-based mortality surveillance using verbal autopsy can generate statistics that influence policy, practice, monitoring, and evaluation" (Martha Anker et al., 1999). In recent years, there are increasing numbers of countries regularly use VA in the national mortality surveillance systems, principally in India, China, and Tanzania to assess the CoDs structure of a defined population (Setel et al., 2005; Soleman et al., 2006). However, it only exists in a limited number of countries could due to an expensive to set up and maintain.

2.5. Verbal Autopsy

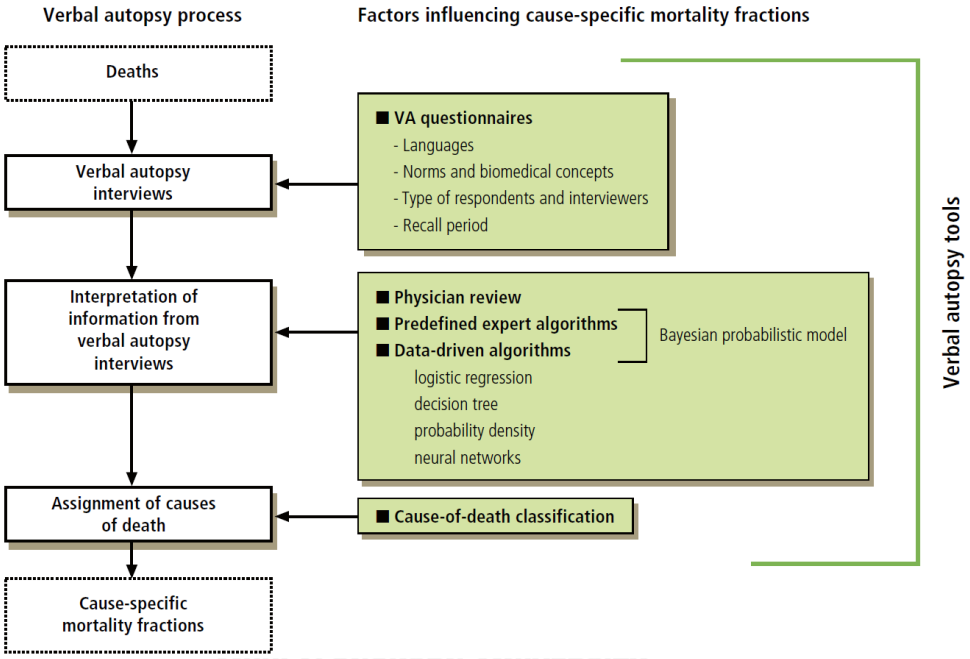
To address the growing need for acquiring accurate vital statistics in the global world, the technique of verbal autopsy has been developed and investigated as a reliable method for the "community diagnosis" of major CoD. Verbal autopsy, or VA, is a technique for assigning a probable CoD, which is based on retrospective information collected during interviews with close relatives or caretakers about the specific circumstances, signs, symptoms, care-seeking and other events related to the deceased person and his or her illness in the period before death. VA usually be applied in places, where routine death registration is nonexistent or inadequate and autopsies are rarely available (Fauveau, 2006). This information is summarized and assigned a most likely CoD using a method that conforms to international convention.

VA is not designed for diagnose the CoD at the individual level. Its' purpose is to describe the mortality pattern at the community or population level (Byass, 2007). Filling gaps in population level information is more important for public health planning and monitoring than filling gaps in individual level data. However, there are some limitations to the use of VA that were known and

quantifiable (Garenne & Fauveau, 2006). VA methodologies are still progressing with many fields of action. Important researches are performed including further optimization of questionnaires and statistical methods for interpreting VA interviews to arrive at CoD that are reliable and remove human bias from the process (Soleman et al., 2006).

2.5.1. Process:

Fig.4. VA process and factors influencing cause specific mortality fractions



Source: Soleman, N., D. Chandramohan and K. Shibuya (2006). "Verbal autopsy: current practices and challenges." Bull World Health Organ 84(3): 239-245.

The procedure for VA can be broken down into 4 steps: (1) The event of death is registered using community reporters, (2) Trained interviewers visit households of the deceased conduct VA interviews with family members or care-givers of the deceased, (3) CoD are assigned and coded, and 4) Cause-specific mortality data be tabulated. There are many factors can influence the cause specific mortality fractions estimated during the VA process which has several phases, as shown in Fig.4. (Soleman et al., 2006).

2.5.2. VA data collection instruments:

The standard VA instruments were published by WHO and has been successfully applied in many research settings since its inception (WHO, 2012). The instruments have a common format that includes a socioeconomic and demographic profile of the respondent and the deceased, and two main sections for details of the illness including open-ended and closed section. An open-ended narrative is used for recording a verbatim account of the signs, symptoms, and circumstances surrounding death. In the closed section, structured questions are used to elicit the presence or absence of specific signs and symptoms.

Separate VA questionnaires are used for the different age groups which are perinatal and neonatal mortality (under 28 days), post-neonatal child mortality (28 days to 11 years), and adolescent and adult mortality (12 years and over).

2.5.3. Appropriate respondents and recall period:

The respondent who provides information about the deceased and allows the interviewer to complete the VA questionnaire should be the primary caregiver who was with the deceased in the period prior to death (Soleman et al., 2006). However, the process of identifying an appropriate respondent is not formalized.

Recall period is defined as the duration between death and administration of the VA instruments. VA interviews should be conducted as soon as practically possible after the report of the event is received, but after any culturally prescribed mourning period has passed (Soleman et al., 2006). VA should be done with caution when the recall period was greater one year according to the WHO recommendations (WHO, 2007).

2.5.4. VA interpretations (Deriving CoD from VA questionnaire):

There are several approaches for interpreting VA interviews to arrive CoD (see Fig.4), which are review by a medically qualified person (physician review), use of algorithms, or a probabilistic approach (Soleman et al., 2006). Each method has its advantages and disadvantages in terms of validity, cost effectiveness, complexity of technique and repeatability (Quigley, Chandramohan, & Rodrigues, 1999). The most widely used approach is physician review (Soleman et al., 2006).

A section of physicians studies the reported symptoms and assigns each death to a cause. The expert assessment of the VA questionnaire made by physicians has been shown to produce better result and is considered to be a reliable method for VA interpretation (Byass et al., 2006; Garenne & Fauveau, 2006). Knowledge about the disease pattern of the communities, and thorough grasp of the logic of the case, the abnormal elements and contradictions could help them to provide robust estimates of cause-specific mortality fractions. However, the agreement between physicians on the probable CoD is one of the issues that need to be considered. This method also has some disadvantages such as costly, time-consuming, and incomparable across populations (due to differing views of local physicians) (King, Lu, & Shibuya, 2010).

2.5.5. Cause-of-death classification:

The CoD used in statistics, which is called statistical underlying CoD, is determined according to the selection and application rules of the International Classification of Diseases compiled by the WHO (WHO, 2007). Annual CoD statistics are compiled according to the underlying CoD that is defined by WHO as "the disease or injury which initiated the train of morbid events leading directly to death, or the circumstances of the accident or violence which produced the fatal injury" (WHO, 2015).

The use of uniform coding helps to make CoD data comparable between geographical areas. The International Classification of Diseases (ICD) is the standard tool for epidemiology, health management and clinical purposes. ICD-10 came into effect from 1993 (Table 2.) and is available online. It is currently under revision by WHO; ICD-11 is scheduled for release in 2018. Although only a three-digit code is sufficient to specify any condition, the ICD-10 is vast and requires clinical judgment and or diagnostic tests to reach some of the diagnoses. Few VA systems use the entire list of codes, as it is impossible to define symptoms and signs for diagnostic algorithms for the complete list of causes. VA typically refers to a subset of causes, generally separate lists for adults versus neonates/children. The items and structures of the lists vary widely across countries. A few are free-lists; others categorize causes according to organ system (like the ICD-10 for most diseases) and some according to path physiological mechanism. In order to retain an accurate broad grouping, it is

important to group all infectious diseases and parasitic diseases in one subgroup, so that misclassification (e.g., misclassification of malaria as pneumonia) will not affect the proportions in the broad categories, requiring similar or related public health responses (Martha Anker et al., 1999). The list of causes on the ICD-10 will permit greater standardization and comparability.

Table.2. List of diseases by ICD-10 chapters

Chapter	Title	Range of codes in whole chapters
I	Certain infectious and parasitic diseases	A00–B99
II	Neoplasms	C00–D48
III	Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	D50–D89
IV	Endocrine, nutritional and metabolic diseases	E00–E90
V	Mental and behavioural disorders	F00–F99
VI	Diseases of the nervous system	G00–G99
VII	Diseases of the eye and adnexa	H00–H59
VIII	Diseases of the ear and mastoid process	H60–H95
IX	Diseases of the circulatory system	I00–I99
X	Diseases of the respiratory system	J00–J99
XI	Diseases of the digestive system	K00–K93
XII	Diseases of the skin and subcutaneous tissue	L00–L99
XIII	Diseases of the musculoskeletal system and connective tissue	M00–M99
XIV	Diseases of the genitourinary system	N00–N99
XV	Pregnancy, childbirth and the puerperium	O00–O99
XVI	Certain conditions originating in the perinatal period	P00–P96
XVII	Congenital malformations, deformations and chromosomal abnormalities	Q00–Q99
XVIII	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	R00–R99
XIX	Injury, poisoning and certain other consequences of external causes	S00–T99
XX	External causes of morbidity and mortality	V01–Y98
XXI	Factors influencing health status and contact with health services	Z00–Z99
XXII	Codes for special purposes	U00–U99[a]
[a] Only some categories in this chapter are used in mortality coding.		

Source: WHO (2007). Verbal autopsy standards: ascertaining and attributing cause of death. France.

2.5.6. Underlying assumptions:

There are several assumptions for proper use of the VA. An underlying assumption of the VA method is that the symptoms and signs of different clinical conditions of each CoD can be distinguished from any other CoD. It also relies on the assumption that symptoms and signs can be recalled accurately by care takers and close relatives during a standardized interview by a trained interviewer (Conway, 2008; Morris et al., 2010).

2.6. Situations and death registration in Vietnam

2.6.1. General information:

Vietnam is a long, S-shaped country in Southeast Asia with an area of 331,000 square kilometer. The geography of the country consists of six regions: Red River Delta, Northern midlands and mountain areas, North Central and Central coastal areas, Central Highlands, South East, and Mekong River Delta. The number of population in Vietnam increased to over 90 million in 2014 (50.7% of them are female) with an annual population growth rate of 1.08%. The population density is about 274 people per square kilometer, with about 67% of population living in rural areas. The life expectancy in 2014 is 73.2 years for both sexes (76.0 years for female, and 70.6 years for male) (GSO, 2014).

2.6.2. Death registration systems:

In Vietnam, civil registration and vital statistics systems (vital registration systems) were initiated in North Vietnam in 1956 (Jones, 1982; Rao et al., 2010). The quality and development of this system in South and North Vietnam, the two parts of a divided country between 1954 and 1975, was extremely divergent. During the 1960s, the quality of vital registration has certainly improved in the North even though the rigors of wartime condition (the Vietnam War in 1965 – 1975). The vital registration system in the South has never been very good (Jones, 1982). Since the country's reunification in 1975, many efforts have been made to improve the vital registration system in the South of Vietnam in order to develop an accurate system for the whole country.

Despite 60 years of development, however, not much information from this system has been published (Rao et al., 2010). One of the major weaknesses is the existence of too many parallel systems with a complex network of agencies at different levels in the national administrative structure (D.L Huong, 2006; Rao et al., 2010; M. R. Stevenson et al., 2012). There are three systems responsible for reporting vital events in Vietnam as shows in Fig.5.

The first system is "juridical system". The Ministry of Justice has the formal responsibility to issue certificates for vital events, such as births, deaths, and

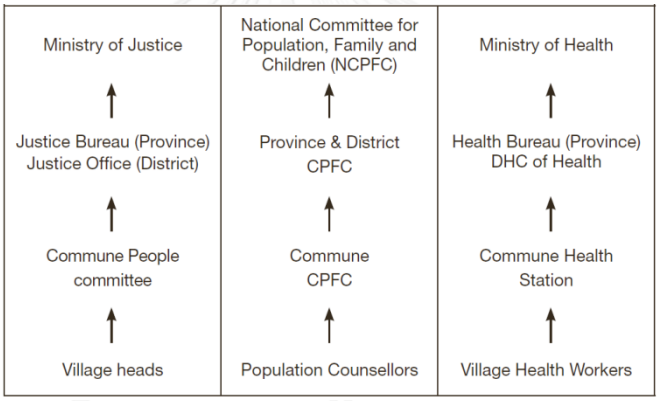
marriages. In each commune, a justice clerk in the People's Committee is responsible for this system. When a death occurs, the deceased's family is obliged by law to report the death to a communal justice clerk and obtain a death certificate. The death registration form is very simple and does not have the medical diagnosis (M. R. Stevenson et al., 2012). The death certificate will be issued to the family of the deceased but it is not obligate for funeral or burial or cremation procedures (D.L Huong, 2006). Death certification also includes CoD, which is granted at the request of family of a deceased person; henceforth it is referred to the Families-Given CoD (FGCoD). There is also regulated that the village head should record and report all vital events in the village to communal justice clerk who is responsible for monthly reporting to the district officer. The district officer checks, summaries and passes on data to the Provincial Justice Bureau every quarter. The provinces in turn send the provincial quarterly report to Ministry of Justice (T. Q Huy, 2007; Jones, 1982).

The second system was established by the National Committee for Population, Family and Children (NCPFC) after the government issued the two child policy in 1988 (N. P. Bang, Hill, Hall, & Rao, 2013). In each commune, this system was set up Communal Population Register System (CPRS) with an active network at the village level. In each village, a population counselor tasks as an advisor in family planning matters, a part-time job with small monthly allowance paid by the NCPFC, who is also responsible for recording all births, deaths and migrations in her/his village. This information is reported monthly to the population officer who is in charge of CPRS. These reports are forwarded to district and province CPFS, and then to NCPFC (T. Q Huy, 2007).

The third system was established by the Ministry of Health (MoH) in 1992, called "A6 mortality reporting system" in commune health stations, which are under the vertical supervision of the health care system (D. L. Huong, Minh, & Byass, 2003; M. Stevenson et al., 2015; M. R. Stevenson et al., 2012). This system also collects data on births and deaths, but does not always obtain information on people dying at home. It does not have a strong network as the CPRS. In some cases, the commune health officials collect demographic information, including deaths, via the CPRS (T. Q Huy, 2007). A record of who has died and why is noted in an official

book that is known as the "A6". From commune health stations, data from the A6 is forwarded monthly to district-level health services. Quarterly summaries are sent to the Provincial Health Bureaus and these reports are collated annually by the central government. Another source of data on deaths is obtained from hospitals with the medical diagnoses, but not covers deaths occurring outside the health facility. The death notice from hospitals has only one line for reporting the CoD, which does not comply with international recommendations to record immediate, antecedent, underlying and contributory causes (Rao et al., 2010). The Health Statistics and Information Division in the MoH are in charge of gathering health information from A6 system and from hospital statistics that forming the basis for compiling the annual Health Statistics Year Book (T. Q Huy, 2007).

Fig.5. Birth and Death Registration Systems in Vietnam



Source: Huy, T. Q. (2007). Mortality in Rural Vietnam: Validity of routine reporting and experiences from a surveillance system. (PhD), Karolinska Institute, Sweden.

However, these sources do not operate adequately because of a lack of coordination and information-sharing between sectors, which leads to overlaps in information collection and processing. Hence, the different data are obtained from these systems due to their different interests. While the Commune People's Committee system is more interested in numbers of births and deaths, the health sector are interested in both numbers and causes, but not cover all deaths, particularly for the majority of deaths which occur at home and without seeking for health care services. Besides, the juridical system is reported of deaths to ensure deceased who were government officers, particularly retired officers, do not continue to receive

financial remuneration, while the NCPFC collect data only for population census and for those in reproductive age (M. R. Stevenson et al., 2012).

2.6.3. Current mortality reporting situations:

Currently, the registration system for vital statistics in Vietnam does not operate effectively and cannot provide accurate data on the number of deaths, CoDs, or the age and sex of people who died (Rao et al., 2010). According to the evaluation on the completeness of vital registration data in Vietnam report of WHO, around 10% for births and 20% for deaths were under-reporting (D.L Huong, 2006). A validation study of the registration system was carried out in FilaBavi, which is a demographic surveillance site, an epidemiological field laboratory in Northern Vietnam, showed that 18.9% of deaths were under-registered (T. Q. Huy, Long, Hoa, Byass, & Ericksson, 2003). By reconciling the information from various sources of mortality data, Hoa and colleagues found widely vary in different reporting sources in different parts of the country. For example, the juridical system in Hochiminh city and Thainguyen province captured 76% and 85% of the death, respectively, whereas the "A6 mortality reporting system" in Hochiminh city captured only 17% of the deaths and this system in Thainguyen captured only 15% (Hoa et al., 2012).

Therefore, to assess trends in mortality pattern it is necessary to rely on mortality data collected in public hospitals. Up to now, hospital statistics still have been considered as the main source of data on morbidity and mortality for the country, forming the basis for the Health Statistics Year Book produced annually by the MoH (T. Q Huy, 2007). However, as many developing countries, most deaths in Vietnam occur at home without medical supervisions. According to MoH, deaths in public hospitals reflect only about 5% of the total annual mortality (MoH, 2006b). The mortality data are not collected systematically and death registration is not routinely undertaken by physicians (Rao et al., 2010). Hence, hospital statistics cannot reflect the general mortality patterns of the population.

Community-based data are largely lacking and cannot provide sufficient evidence for informing health policy-making and planning. In the assessment of the global CoDs data, Vietnam is one of 10 countries in the Western Pacific region that has never provided mortality data to WHO (C. D. Mathers et al., 2005). In some

international studies, CoD patterns in Vietnam were assumed to approximate a combination of estimated patterns for Chinese, Indian and Thailand populations (Alan D Lopez, Colin D Mathers, Majid Ezzati, Dean T Jamison, & Christopher JL Murray, 2006).

The major weaknesses of the Vietnamese health information system were pointed out in WHO evaluation report, which identified underreporting, consisting of many parallel systems, lack of qualified personnel and inadequate monitoring and supervision (D.L Huong, 2006). According to MoH, sources of data in Vietnam are still inadequate and need to be improve for sentinel surveillance systems to generate reliable mortality statistics (MoH, 2006a).

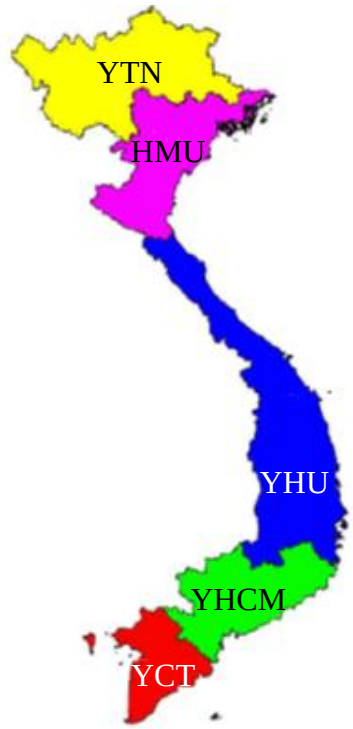
2.6.4. National VA survey in Vietnam

In the first steps towards strengthening the mortality information system in Vietnam, a research project with nationally representative sample of almost 200 communes using VA methods has begun from 2007 to provide a comprehensive account of the descriptive epidemiology of mortality. This nation survey is a part of the Vietnam Evidence for Health Policy Project, ran by School of Population Health, University of Queensland, Australia, the Ministry of Health, and the Health Strategy and Policy Institute of Vietnam. Apart from the main target which is improving the completeness of death report, this project also aimed to expand the use of this tool in the national mortality data collection system in Vietnam and to guide community perceptions of death reporting and CoDs inquiries (Ngo et al., 2010).

2.6.4.1. The sampling procedure

The Mortality Pattern in Vietnam (2007 – 2011), the first national VA survey in Vietnam, has the participation of five major medical universities in the country; include Hanoi Medical University (HMU), Thainguyen Medical University (YTN) in the Northern region, Hue Medical University (YHU) in the Central region, Hochiminh City University of Medicine and Pharmacy (YHCM), and Cantho Medical University (YCT) in the Southern region.

Fig.6. VA interview cluster and the corresponding medical university



Source: Ngo, A. D., C. Rao, N. P. Hoa, T. Adair and N. T. Chuc (2010). "Mortality patterns in Vietnam, 2006: Findings from a national verbal autopsy survey." BMC Res Notes 3: 78.

In the 2007 survey, the first round, information on deaths reported by households in the 2007 population change survey, which was conducted by the General Statistics Office (GSO), were used for VA follow up interviews. A total of 7124 deaths, which covers approximately 2% of the national population, in the 64 provinces of Vietnam were included (Ngo et al., 2010).

Between 2008 and 2011, since the second round of the survey, multi-stage cluster sampling was used to select the surveillance population. The total of 63 cities and provinces in the country were divided into five clusters corresponding to five medical universities in the following list:

- 1st cluster: Thainguyen Medical University (YTN) – 12 provinces: Hagiang, Caobang, Baccan, Tuyenquang, Laocai, Dienbien, Laichau, Sonla, Yenbai, Thainguyen, Langson, Hoabinh.

- 2nd cluster: Hanoi Medical University (HMU) – 16 cities/ provinces: Hanoi, Quangninh, Bacgiang, Phutho, Vinhphuc, Bacninh, Haiduong, Haiphong, Hungyen, Thaibinh, Hanam, Namdinh, Ninhbinh, Thanhhoa, Nghean, Hatinh.
- 3rd cluster: Hue Medical University (YHU) – 13 cities/ provinces: Quangbinh, Quangtri, Thuathienhue, Danang, Quangnam, Quangngai, Binhdinh, Phuyen, Khanhhoa, Kontum, Gialai, Daclak, Dacnong.
- 4th cluster: Hochiminh City University of Medicine and Pharmacy (YHCM) – 12 cities/ provinces: Ninhthuan, Binhthuan, Lamdong, Binhphuoc, Tayninh, Dongnai, Baria – Vungtau, Binhduong, Hochiminh, Longan, Tiengiang, Bentre.
- 5th cluster: Cantho Medical University (YCT) – 10 cities/ provinces: Travinh, Vinhlong, Dongthap, Angiang, Kiengiang, Cantho, Haugiang, Soctrang, Baclieu, Camau.

In each cluster, the numbers of cities or provinces were chosen to representative for all geographical regions of the country by the GSO (see Table 3). In each province, 12 communes were chosen proportionate to the number of households in each commune, which covers about 3% of the national population.

Table.3. List of VA interview provinces/cities

Cluster	Medical University	Provinces/cities
1st	YTN	Sonla, Thainguyen, Hoabinh
2nd	HMU	Hanoi, Quangninh, Haiduong, Thanhhoa
3rd	YHU	Thuathienhue, Binhdinh, Khanhhoa, Daclak
4th	YHCM	Lamdong, Binhduong, Hochiminh
5th	YCT	Kiengiang, Cantho

2.6.4.2. Instruments

The modified WHO Standard VA Questionnaire was adapted to the Vietnamese context and used to collect the data. The VA questionnaire in this research included three forms (see the questionnaire in appendix 1):

Form 1 (questionnaire-based, interview assessment)

- Identification & demographic data of the deceased and respondent
- Information about accidents and injuries
- Open history question
- Treatment and record (if any)

Form 2 (adolescent and adult death)

- Information about the chronic disease that the deceased suffered
- Signs & symptoms of the final illness
- Life style (alcohol drinking, cigarette smoking) for male

Form 3 (neonatal and childhood death)

- General information about the pregnant and delivery process
- Neonatal condition
- Childhood condition

2.6.4.3. Data collection

In each interview cluster, the corresponding medical university took a responsibility for training, fieldwork supervision and data management. Data collectors were local health workers, who were staff of the local health stations, undertook 3 days intensive training on VA interview. The trainings consist of class work as well as field practice. Data were compiled for each calendar year between 2008 and 2011. A list of all deaths for the reference period was collated from different sources of death data at the commune level. For each death on this list, a VA retrospective interview was conducted.

The data collectors would come to household to explain the purpose of the research and to make an oral consent if people are willing to participate. Demographic information of the deceased and household address were used to locate the household. Each interview lasts about 30-45 minutes. Filled questionnaires were double checked the completeness, then, completed VA instruments were submitted for a review by an

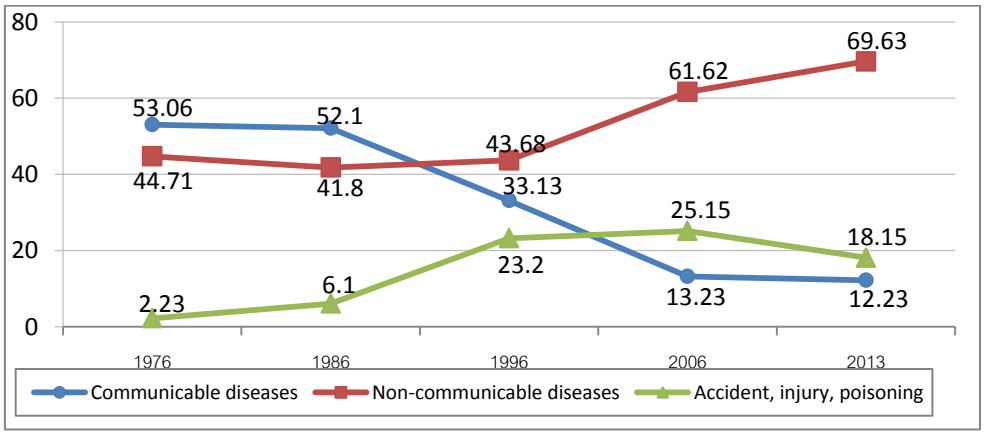
independent section of experienced medical doctors, and most likely CoDs were assigned using diagnostic guidelines (WHO, 2007). The diseases and conditions that led to death are reported on "the International form of the medical certificate for CoD" (see section 1.2).

Finally, the underlying CoD was selected and coded using the tenth revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) by a team of trained coders. The 10 days ICD-10 mortality coding training program aim to ensure that each coder understand and use basic ICD-10 coding conventions, interpret and apply WHO rules for mortality coding, and accurately assign codes for multiple CoDs and underlying CoD.

2.6.5. Mortality patterns in Vietnam:

After the introduction of a market economy in 1986, Vietnam has undergone rapid economic growth (D.L Huong, 2006). The transformation of economic, political and social affairs in Vietnam is reflected on changes in disease patterns. Vietnam is now facing a "double burden" of both existing communicable diseases (CDs) and emerging non-communicable diseases (NCDs) and injuries (D.L Huong, 2006). Hospital data showed that the trends in proportions of mortality arising from injury increased during the period from 1976 to 2013, together with other non-communicable diseases, while the proportions of communicable diseases were decreasing (see Fig.7.) (MoH, 2013).

Fig.7. Mortality pattern in hospitals, Vietnam 1976 – 2013



Data source: Vietnamese Ministry of Health (2013). Health statistics Yearbook.

These mortality figures reflect a pattern typical of developing countries which are in epidemiological transition. In these countries' pattern, there is a decrease in communicable diseases, together with an increase of non-communicable diseases (due to degenerative and man-made conditions), and injuries. It could be related with the increasing of ageing population, reductions in fertility rate, improvement of preventive and control of infectious diseases, and modernization of lifestyle (Agyei-Mensah & de-Graft Aikins, 2010).

A few decades ago, communicable diseases were the leading CoD with epidemics of tuberculosis, malaria and pneumonia. In the results of the VA study in the Epidemiological Field Laboratory of Bavi (FilaBavi) in 1999, infectious diseases were the second leading CoD (D. L. Huong et al., 2003). Currently, with achievements of public health action, Vietnam has to face another health problem. From hospital data, non-communicable diseases have shown a tendency to increase in the last two decades, with total mortality rising from 41.8% in 1986 to 69.6% in 2013 (see Fig.7.) (MoH, 2013). From the estimation of the burden and costs of chronic diseases in 2005, 80% of worldwide deaths from chronic diseases occurred in developing countries, and around 80% of these deaths occurred in the 23 selected countries, which includes Vietnam (Abegunde, Mathers, Adam, Ortegon, & Strong, 2007). Cancer has been more common in Vietnam recently. The proportion of cancer-related death that was reported by the MoH accounts for around 12% of total deaths each year (MoH, 2009). In Vietnam, the injuries tend to increase over the last few years with thousands of deaths each year. Of these, almost 46% of cases were traffic accidents (12,500 persons in 2008) (Hong, 2007). Starting in 2003, the percentage of deaths from accidents, injuries, and poisoning exceeded deaths from communicable disease, making this group the second highest CoD (see Fig.7.). Injury is also a leading CoD of Vietnamese children and teenagers. It is estimated that injury accounted for 75% of child deaths in 2001, and the fatal injury rate for children aged 0-19 years was 83.2 per 100,000 children. According to the estimates by the Ministry of Labour, Invalids and Social Affairs (MOLISA), there are an average of 30 died and 70 disabled for life as the result of an injury in which equivalent to nearly 20 deaths were children and adolescents aged 0-19 years per day in Vietnam (Oxley, Pham, Jamaludin, & Stevenson, 2011).

The results of a national VA survey in Vietnam in 2007 showed the first ever findings on total and cause-specific mortality of the whole country. The findings confirm that the leading CoD across all ages reflected the double burden of mortality in Vietnam. In which, non-communicable diseases such as cerebrovascular diseases, cancer, chronic lower respiratory diseases, hypertensive diseases, and ischemic heart diseases were majorities. Besides, there are some communicable diseases, which are HIV/AIDS, tuberculosis, pneumonia, and diarrhea, need to be pay attention. Perinatal conditions were the leading cause of children deaths. External causes such as accidental drowning, transport accidents were also prominent in group of 0-14 years. For the 15-59 years age group, the leading CoDs were transport accidents, cerebrovascular diseases, HIV/AIDS, and cancer. For deaths above 60 years, the most common CoD was cerebrovascular diseases with nearly one-fourth of cases (Ngo et al., 2010).

In light of the absence of accurate national representative statistics on mortality in Vietnam, national sample mortality surveillance with VA to ascertain the cause of each death that was identified from routine local data sources are urgently needed. In addition, studies on CoD are relatively new and scarce in the Vietnamese context given its mortality registration system. However, mere reports on the overall and cause-specific mortality estimations were generated (Hoa et al., 2012; Ngo et al., 2010). Therefore, this thesis could complement the existing studies by investigating the consistency of the VA-derived CoD (VACoD) as compared to other sources, which are medical records (MCoD) and death certificates (FGCoD), of the same death case. The findings of this study is expected to provide some evidences which is helpful for improving not only the performance and utility of VA methods specific to Vietnamese context, but also the system of collecting data on cause-specific mortality in the country.

3. AIMS OF THE STUDY

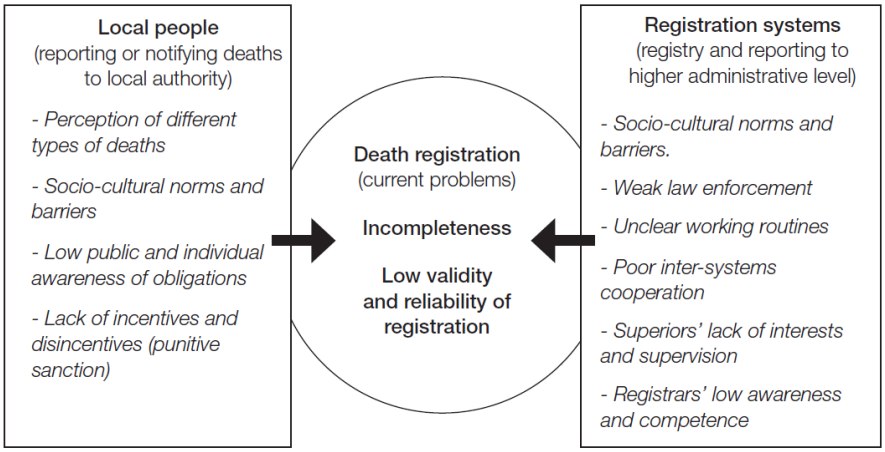
- Investigate the consistency of VA method in Vietnamese data using Medical records and Registered CoD (Families-Given CoD – FGCoD).
- Identify misclassification patterns for medical records and registration causes.
- Investigate the effects of the characteristics of respondents and the deceased on the agreement of VACoD and FGCoD.
- Investigate the proportionate mortality from reassignment of deaths, originally classified to nonspecific categories in the FGCoD, to specific causes upon VA method.

4. LITERATURE REVIEW

4.1. Reasons of incomplete registration of deaths

There are several factors may contributed to the incompleteness of death reporting and registration in Vietnam. Figure 8 summarizes findings from existing studies about influencing factors in local people (who report deaths) and the registration systems on the incompleteness of death reporting. Firstly, it is the willingness to report by the family member of the deceased because there is neither any incentive for reporting nor any legal sanction for not reporting (T. Q. Huy, Johansson, & Long, 2007). The second factor is the public awareness of the purpose of death registration. A study on the civil registration systems in Vietnam reported that the relatives of the deceased do not know what to do with the death certificate which only remind sad memories (Rao et al., 2010). Thirdly, the performance of the personnel in the vital registration system could effect. For example, in the health care system, commune health officials complained that too many reports and too much paper work were requested to do, so they did not pay much attention on reporting death (T. Q Huy, 2007). Finally, reports may be influenced by the cultural tradition and societal factors. In some culture, for example, people do not consider an infant as fully “human” or "not grown enough to be a person". If an infant dies during the first days of life, they would often not report and registered (T. Q. Huy et al., 2007). An elderly death is considered as “a natural phenomenon” which may deter relatives of the deceased from reporting the death (Rao et al., 2010). In the study of reasons for not reporting deaths in rural Vietnam to explore socio-cultural factors that affected on the completeness and quality of death reporting, Huy T.Q and his colleagues also found the under-reported in adult deaths that were seen as "bad deaths". "Bad deaths" were defined as either deaths of persons who had led a "bad life" involving activities such as gambling, drinking, and stealing; or deaths due to stigmatized diseases like HIV/AIDS, tuberculosis and leprosy, for instance. For such deaths, there was a tendency to conceal CoD because of the fear of stigma for family members (T. Q. Huy et al., 2007) that led to poorly recorded of the FGCoD.

Fig.8. Factors influencing death registration



Source: Huy, T. Q. (2007). Mortality in Rural Vietnam: Validity of routine reporting and experiences from a surveillance system. (PhD), Karolinska Institute, Sweden.

4.2. Accuracy of the mortality data from VA

Since VA is not based on clinical or laboratory evidence for determining the CoD, they may be subject to relatively high misclassification errors (Martha Anker et al., 1999). Misclassification means that the death is classified incorrectly to a specific CoD. Misclassification errors for a specific cause, such as "A" arise in two ways: (i) a deceased who did not die from "A" is classified as a "A" death, or (ii) a deceased who did die from "A" is classified as a "non-A" death. This can have a profound effect on the reported specific-cause mortality estimation base on VA (M. Anker, 1997). In addition, there are many factors may influence the validity and reliability of the VA tool (Soleman et al., 2006). Thus, it is essential to validate the VA method before expanding the use of this method as the routine mortality data collection system. Validation studies are key procedure to determining how well a VA questionnaire in identifying a particular CoD. By definition, validation makes a comparison between the two underlying CoDs for the same death: the cause derived from VA and a reference one derived from a pathological autopsy or clinical record (Yang et al., 2006).

From a practical point of view, hospital-based validation studies are the most feasible way to validate a VA questionnaire. Various studies which based on diagnoses from hospital records as the "gold standard" have been conducted to assess

the validity of VA instruments (Bauni et al., 2011; Khademi et al., 2010; Misganaw, Mariam, Araya, & Aneneh, 2012; Yang et al., 2006). Instead of calling hospital records as "gold standard", in some cases VA experts prefer "reference standard" due to the uncertainty in their quality (Chowdhury et al., 2010; Soleman et al., 2006). Diagnostic accuracy refers to the amount of agreement between the results from the diagnostic test under study such as VA tool and those from a reference test (hospital record). The sensitivity and specificity usually be calculated for assessing the accuracy of that method. By definition, sensitivity is the proportion of true positives that are correctly identified by the test, and specificity is the proportion of true negatives correctly identified. In other word, sensitivity relates to the test's ability to correctly detect patients who do have a condition; and specificity relates to the test's ability to correctly detect patients without a condition. The sensitivity of the VA for a specific cause “A”, for example, refers to the proportion of all deaths being correctly assigned as “A” out of all those who truly died from “A”. Specificity is the proportion whose VACoD is identified as “non-A” among those who truly did not die from “A”.

Most of the validation studies have focused on the sensitivity and specificity of the VA which varied by CoD and between countries for the same causes (Soleman et al., 2006). As a rough guide, reliability and diagnostic agreement of the VA method is considered to have an acceptable level of diagnostic accuracy for diseases or conditions at the population level if sensitivity and specificity is at least 60% and 85%, respectively (Bauni et al., 2011). Existing studies have shown reasonable sensitivity and specificity of childhood VA in comparison with a facility assigned CoD, as shown in Table 4.

Table.4. Sensitivity and specificity in previous studies for major causes of childhood death

CoD	Country	Source	Sensitivity (%)	Specificity (%)
Birth asphyxia	Bangladesh	(Chowdhury et al., 2010)	84	93
	Pakistan	(Nausheen et al., 2013)	13	95
	Tanzania	(Setel et al., 2006)	43	90
Diarrhoea	Tanzania	(Setel et al., 2006)	41	94
	Namibia	(Mobley et al., 1996)	89	61
Malaria	Tanzania	(Setel et al., 2006)	50 – 70	70 – 100
	Namibia	(Mobley et al., 1996)	72	85
Meningitis	Bangladesh	(Chowdhury et al., 2010)	50	98
	Tanzania	(Setel et al., 2006)	30	99
Pneumonia	Bangladesh	(Chowdhury et al., 2010)	75	94
	Tanzania	(Setel et al., 2006)	50 – 63	84 – 100

In contrast to the major causes of child mortality, little work has been done on the validation of adult VA questionnaire. Most of the validation studies on adult death have focused on comparison between difference methods in assigning CoDs (Bauni et al., 2011; Khademi et al., 2010; Oti & Kyobutungi, 2010; Tadesse, 2013). Previous validation results of VA for adult deaths suggested that interpreting VA interviews to arrive CoDs by a trained section of physicians yielded consistently higher sensitivity for most of cause-specific mortality outcomes than other approaches. The findings from one VA study in Ethiopia showed sensitivity and specificity of injury category was far larger than the acceptable level, but specificities were lower for communicable and non-communicable diseases. Of the leading CoDs in above study, cardiovascular diseases, HIV/AIDS, tuberculosis and diabetes were identified with sensitivity larger than the acceptable level (Misganaw et al., 2012). One of the interesting findings is that the high sensitivity of the VA instrument to identify cancer-related deaths were reported by several VA validation studies in India and China (Gajalakshmi, Peto, Kanaka, & Balasubramanian, 2002; Yang et al., 2006). The consistency results of these studies have shown that VA seems to be a reasonably valid tool to ascertain CoDs. More validation studies are required in order to improve the accuracy of VA estimations (M. Anker, 1997).

4.3. VA studies on the levels of agreement

In general, agreement assessments are widely used in comparing between observations and their corresponding target values. The observation may refer to a new or generic process, methodology. The target values are usually the gold standard measurements. Another application of agreement assessment is comparing two methods without a designated gold standard method (Lin, Hedayat, & Wu, 2012). Several existing VA studies were conducted in assessing the inter-observers, intra-observer, and inter-method agreement (Bauni et al., 2011; Chowdhury et al., 2010; Khademi et al., 2010; Mpimbaza et al., 2015; Oti & Kyobutungi, 2010; Polprasert et al., 2010; M. Stevenson et al., 2015; M. R. Stevenson et al., 2012; Tadesse, 2013).

Inter-observer agreement

Inter-observer agreement or inter-rater agreement measures the variation in measurements of the same method or instrument when taken by different persons (Viera & Garrett, 2005). Most of the VA studies have focused on the agreement between different approaches to derive CoD from VA, for instance, physicians and the InterVA model, physicians and medical assistants, or between two physicians. Several studies explored how a computer-based probabilistic model (InterVA model) performed in comparison with physician-certified VA in assigning CoDs in different countries. Overall, fair-to-moderate levels of agreement were found between the model and the physician in establishing CoDs, as shown in Table 5.

Table.5. Inter-observer agreement level in previous studies for adult death

Area	Source	Level of agreement
Nairobi, Kenya	(Oti & Kyobutungi, 2010)	Fair
Kilifi, Kenya	(Bauni et al., 2011)	Moderate
Dabat, Ethiopia	(Tadesse, 2013)	Moderate

Chowdhury and colleages carried out a VA study in Matlab, Bangladesh in which medical assitant-assigned CoDs were compared against the corresponding physician-certified CoDs. Base on the findings of a moderate-to-strong agreement, the authors suggested that a well-trained medical assistant could be considered as an alternative to physicians for classifying major causes of neonatal deaths (Chowdhury

et al., 2010). With regard to between-physician reliability that is comparing the diagnoses made by different physicians for the same death, the inter-observer agreement is shown to be high in previous study (Khademi et al., 2010).

Intra-observer agreement

Intra-observer agreement or within-rater agreement measures the variation in measurements of the same method or instrument when taken by the same observer on different occasions. In VA studies, VA questionnaires were reviewed on two occasions by the same physicians. Intra-observer agreements are done with a comparison of the first and subsequent VA diagnoses. However, the findings of the repeatability of CoDs derived by physician review are quite vary from low agreements (Todd, De Francisco, O'Dempsey, & Greenwood, 1994) to high reliabilities (Khademi et al., 2010; Mpimbaza et al., 2015).

Inter-method agreement

Inter-method agreement is the variation in measurements of the same target when taken by different methods or instruments. An example of the application of inter-method agreement to examine reliability of the VA is a study comparing VA diagnoses made by two physicians and the gold standard diagnoses (CoD was identified by using medical documents) in the Golestan Cohort Study in Iran. Agreement between each physician review and the gold standard in this study indicated good reliability (Khademi et al., 2010). Bauni et al. used hospital CoD in adults dying in a district hospital on the coast of Kenya as the gold standard for validating both physician review and InterVA model to VA interpretation. The overall level of agreement across three methods was moderate. The statistic indicator for inter-method agreement between each method and the gold standard was fairly good. Again, the authors confirmed that physicians perform better than the InterVA model in determining the CoDs (Bauni et al., 2011). In addition, inter-method variations are important in evaluating a method for its routine use for assigning CoDs. Existing studies used VA as a gold standard for evaluation of vital registration data for deaths outside hospitals in Thailand (Polprasert et al., 2010), and the A6 mortality reporting system in Vietnam (M. Stevenson et al., 2015; M. R. Stevenson et al., 2012).

4.4. Studies on the role of recall period and characteristics specific to the deceased and the respondent

Recall bias, which is a classic form of information bias, could be particularly concerned in retrospective studies. In VA studies, recall bias could be due to the length of time between death and administering the VA instrument or recall periods. Recall bias leads to uncertainty in the ability of the VA to assign the correct CoD (Yang et al., 2006). There is little or no evidence to inform recall period requirements and the optimal recall period for VA performance. A review of the currently used VA tools from 36 field sites around the world showed the use of a wide range of recall periods, from as soon as possible after death to an indefinite amount of time (Soleman et al., 2006). However, the accuracy of recall in humans significantly depends on the duration time between the event and its assessment. As we known the longer the interval, the higher the probability of incorrect recalls. Existing research of recall for personal events showed that 20% of critical details of an event are irretrievable after only 1 year; and this figure increases to 50% after 5 years (Bradburn, Rips, & Shevell, 1987). A recall period ranging from 1 to 12 months is recommended by WHO (WHO, 2007).

On the other hand, we found recall period quite varies in previous studies. For instance, in the Population Health Metrics Research Consortium gold standard validation study, a three-month recall period was required (Murray et al., 2011). Another validation study in 3 sites in Tanzania, Ethiopia, and Ghana found no significant effect of one to 21 months of recalls on the VA results (Chandramohan, 2001). One study on the role of recall period in affecting VA quality by comparing the VACoDs from two separate interviews that were collected for each death case within 3-52 months of death in India and the Philippines. They found a decrease in the ability of VA diagnostic performance over time, but the association was weak and not statistically significant (Serina et al., 2013). Soleman and colleagues suggest that more studies are needed in order to define the acceptable recall period for VA performance (Soleman et al., 2006).

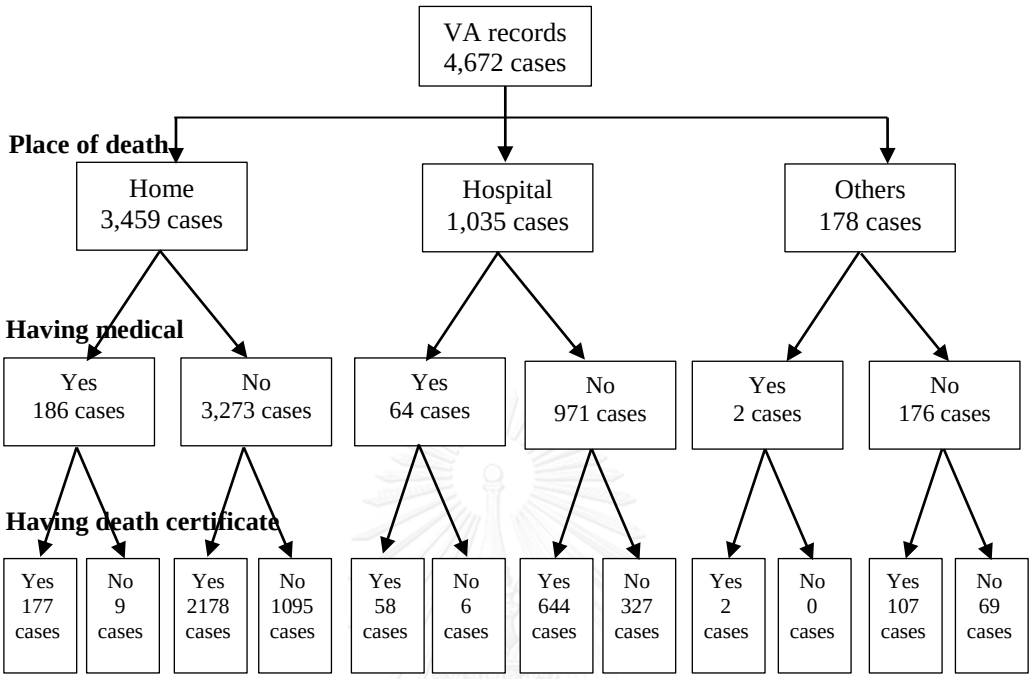
By definition, the respondent or the VA information provider was a person who mostly took care of the deceased person or who knew the most about the

illness led to death or at least had witnessed the death. Soleman and colleagues believed that the accuracy of VA improved if the respondents are primary caregiver who was with the deceased in the period prior to death (Soleman et al., 2006). There is limited information on the effect of respondents' characteristics on the accuracy of VA tools. Existing study that examined the effect of age, sex, relationship and language of the respondents found no significant effect of these variables on the VA results (Soleman et al., 2006). With the regard to gender difference, there are two sides argument. Hoj and colleagues discovered that male respondents are more likely to provide adequate information for a diagnosis than female (Hoj, Stensballe, & Aaby, 1999). In contrast, in the VA study which carried out in South Indian, Gajalakshmi and colleagues concluded that wife was a better responder than husband due to females remembers the circumstances that led to death of her spouse better than males remembering his spouse's death (Gajalakshmi et al., 2002).

In addition, several existing studies also identified characteristics of the deceased which have effect on the performance of VA. With the regard to gender difference, previous study signaled that the higher proportions of deaths classified to non-specific causes is found in female than in male (Hoa et al., 2012; Ngo et al., 2010). Tadesse, S. also discovered that the level of agreement between physicians and the InterVA model (a computer-based probabilistic model) in VA interpretation was low when the deceased was female (Tadesse, 2013). Some studies argued that VA is a less reliable to ascertain causes for elderly death (Gajalakshmi et al., 2002; Hoa et al., 2012; Ngo et al., 2010). For child and adult death, some researchers suggested that VA does not perform adequately for several diseases and conditions, such as tuberculosis, chronic obstructive pulmonary disease, diabetes, hypertensive disease, liver diseases (Yang et al., 2006), and perinatal conditions (Laith, 2012). Furthermore, the findings of recent validation studies suggested that the deceased who had received a treatment for the illness prior to death could be correctly understand and explain their own health conditions to their family. Then, it could substantially affect the information content and the validity of VA (Fottrell, Tollman, Byass, Golooba-Mutebi, & Kahn, 2012; Yang et al., 2006).

5. DATA

Fig.9. Study protocol and data retrieval process



The thesis uses secondary data that retrieves a part of data from research project "Mortality patterns in Vietnam" (see section 2.6.4). Due to data accessibility, only the data from the 4th interview cluster was used. It includes data form 3 provinces, namely Hochiminh City, Binhduong province (South East region) and Lamdong province (Central Highland region). The data includes all of death cases occurring between January 1, 2008 and December 31, 2009 in selected areas which have a VA record together with medical record or death certificate. Figure 9 outlines the selection process of the VA records for inclusion in this study. A total of 4,672 VA interview records were collected in these provinces during the reference period. All these records were classified by place of death which are home, hospital and other places. Then, we divided them into sub-group according to the absent or present of the medical record and the death certificate.

5.1. General information about the study sites

HCMC is Vietnam's center of commerce and the country's largest city in the Southeast of Vietnam with an area of 2,095.5 square kilometer (GSO, 2014),

though not its administrative capital. In 2014, HCMC was estimated to contain about 8 million residents (about 82% of them living in urban areas) (GSO, 2015), with 24 districts and 322 communes (MoH, 2013). As a result of the sweeping economic changes wrought by a market economy in 1986, the economy of this city is rocketed up to one of a thriving metropolis, and the quality of life of people is also improved dramatically.

Located in the Eastern part of the Southern region of Vietnam, Binhduong province is one of the provinces with rapid economic growth rate and dynamic industrial development of Vietnam. Locating at the gateway to HCMC, Binhduong covers an area of 2,694.4 square kilometer (GSO, 2014), with 9 districts and 91 communes. The population of Binhduong, as of the 1 April 2014 Census, was 1,855,788 (of which urban population accounted for 77% of total population) (GSO, 2015). In recent years, with high economic growth rate, the economic structure actively changes, industrial and service sectors rapidly grow and account for high proportion with 63% and 32.6%, respectively (BEGIC, 2010). Binhduong retained the top ranking for highest positive net-migration rate (in-migrants exceeded out-migrants) (GSO, 2015).

Lamdong is the largest plateau province with an area of 9,773.5 square kilometer (GSO, 2014) on the Central Highlands region of Vietnam about 300 kilometer from HCMC. It is also the highest province lying on a plain the average height of which is about 800 – 1,500 meters above sea level. A common characteristic of Lamdong is highland topography with forest coverage accounting for 70 percent of the total area. Lamdong province has 12 district and 147 administrative units of commune level (MoH, 2013) with an estimated population of about 1,26 million persons, of which the urban share of 39.5% total population (GSO, 2015). Lamdong is a multi-cultural area with over 40 ethnic groups living together (LamDongportal, 2016). Vietnamese is considered as an official language for communication among ethnic groups. In the recent years, the economy of Lamdong is increasing, and the quality of life of people is also improved gradually due to investment policies in Highland regions.

5.2. CoD categories

In this study, three-digit ICD-10 codes of all derived CoDs were classified into 31 categories. Some of four-digit ICD-10 codes were included to the grouping procedure. The classification was proposed according to the guide of the Global Burden of Disease study (Alan D Lopez et al., 2006). It was processed separately for the VACoDs and MCoDs. For the VA derived CoDs, the underlying CoDs were classified (see definition of underlying CoD in section 2.5.5). The medical record could be attributed to two or more conditions per case. Where more than one conditions were given, we only refers the first given condition. All categories with their code were presented in table 6.

Table.6. CoD categories and ICD-10 codes

	Categories	**ICD-10 code**	**Cause name**
1	Tuberculosis	A15–A19, B90	Tuberculosis, and sequelae of tuberculosis
2	HIV/AIDS	B20-B24	
3	Diarrheal	A00, A01, A03, A04, A06-A09	
4	Childhood-cluster diseases	A33-A37, A80, B05, B91	Pertussis, poliomyelitis, diphtheria, measles, tetanus
5	Hepatitis	B16-B19	
6	Malaria	B50-B54	
7	Dengue	A90-A91	
8	Other infectious diseases	A02, A05, A20-A32, A38-A79, A81-A99, B00-B09 (minus B05), B25-B99 (minus B90), G00–G04	Sexually transmitted diseases excluding HIV/AIDS, Arthropod-borne viral fevers and viral hemorrhagic fevers, tropical-cluster diseases, leprosy, Japanese encephalitis, Trachoma, intestinal nematode infections, meningitis, Other and unspecified infectious diseases
9	Respiratory infections	J00-J06, J10-J18, J20-J22	
10	Maternal conditions	O00-O99	
11	Perinatal conditions	P00-P96	
12	Nutritional conditions	E00-E02, E40-E46, E50, D50-D53, D64.9	Protein-energy malnutrition, Iodine deficiency, Vitamin A deficiency, Iron-deficiency anemia, and other nutritional disorders

	Categories	ICD-10 code	Cause name
13	Cancer	C00–C97	
14	Other neoplasms	D00-D48	Benign neoplasm
15	Diabetes	E10-E14	
16	Endocrine disorders	D55-D64 (minus D64.9), D65-D89, E03-E07, E10–E16, E20–E34, E65–E88	Haemolytic anaemias, certain disorders involving the immune mechanism, disorders of thyroid gland, disorders of other endocrine glands, metabolic disorders
17	Neuropsychiatric conditions	F01–F99, G06–G98	Unipolar depression, bipolar affective disorder, schizophrenia, epilepsy, alcohol use disorders, Alzheimer, Parkinson, multiple sclerosis, drug use disorders, mental retardation, unspecified mental disorder
18	Cardiovascular diseases	I00–I99	
19	COPD	J40-J44	
20	Asthma	J45-J46	
21	Other respiratory diseases	J30-J39, J47-J98	
22	Liver diseases	K70–K77	
23	Other digestive diseases	K20-K69, K78-K92	
24	Genitourinary diseases	N00–N64, N75–N98	
25	Skin diseases	L00–L98	
26	Musculoskeletal diseases	M00–M99	Rheumatoid arthritis, osteoarthritis, Gout, other disorders of the musculoskeletal system and connective tissue
27	Congenital anomalies	Q00–Q99	
28	Senility	R54	
29	Ill-define	R00-R99 (minus R54)	
30	Transport accidents	V01-V99	
31	Injuries	W01-Y89	

6. PART (I): THE CONSISTENCY OF COD DERIVED FROM VA WITH MEDICAL RECORDS

6.1. Study objectives

- To determine the proportion of agreement between MCoD and VACoD.
- To determine misclassification patterns for medical records.

6.2. Study protocol and data retrieval process

The selection process of the VA records for analyzed in this part of the study was outlined in Figure 9. We only select cases died in hospital and showed sufficient evidence from medical records for determining CoDs. From the original set of 4,672 deaths, only 64 cases were reached these criteria for assessing the agreement between VACoD and MCoD. For VA records, the CoDs have been already assigned by trained physicians, and the ICD-10 coding of underlying CoD (the disease or injury that initiated the events directly leading to death) has been done. For medical records, the first given cause was selected and coded using ICD-10.

In order to investigate whether any differential characteristics between inclusion and exclusion cases, the thesis proposes to conduct regression analyses which will estimate the statistical significance of the relationship between characteristics of the deceased and the having MCoD. The specification is as follow:

$$P(y) = f(x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8)$$

where, y is the variable of "having MCoD" with binary outcomes coded as “0” (no) and “1" (yes), and the predictors which are age (x_1), gender (x_2), marital status (x_3), education status (x_4), occupation (x_5), place of resident (x_6), location of survey (x_7), and year of death (x_8).

Table.7. The association between characteristics of the deceased and having MCoD

Characteristics	***y***	
Age of the deceased (in years)	0.0019***	(0.0005)
Gender of the respondent (male: reference)		
female	-0.0203	(0.0154)
Marital status of the deceased (single: reference)		
married	-0.0081	(0.0230)
separated	-0.0183	(0.0221)
Education of the deceased (no education: reference)		
edu_2nd	0.0029	(0.0215)
highedu	0.0757*	(0.0424)
Occupation of the deceased (agriculture: reference)		
officer	0.0165	(0.0395)
employee	0.0048	(0.0279)
retired	-0.0444***	(0.0150)
housewife	0.0259	(0.0376)
otherjob	0.0070	(0.0277)
Place of resident (rural: reference)		
urban	-0.0027	(0.0177)
Location (HCMC: reference)		
binhduong	-0.0198	(0.0156)
lamdong	-0.0167	(0.0179)
Year of death (2009: reference)		
y08	0.0114	(0.0132)
Observations	959	
Pseudo R2	0.1097	

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 7 exhibits the partial effect of characteristics of the deceased on the probability of MCoD is available. According to the table, the probability of cases that died in hospital and showed sufficient evidence from medical records (selected cases) is not different in different genders and locations. The probability of having MCoD was higher when increased the age of deceased person. Having medical records is not different when the deceased was rural residents as compared to urban dwellers. When the probability of be selected by having medical record was investigated with respect to the education status, it shows that there is not difference when the deceased had achieved primary or secondary education compared to those had no education. The probability of having MCoD was higher when the deceased had achieved high education as compared to those had no education. Regarding occupation, the deceased who were retiree are less likely to have MCoD than those were farmer. But there is no differential effect among people who was officer, employee, housewife, and other

jobs as compared to farmer. Briefly, characteristics of the deceased quite similar between cases are selected and those are discarded due to insufficient evidence from medical records.

6.3. Variables

Creating the outcome variable: The outcome variable of this part is the agreement between VACoD and MCoD. Deaths were aggregated on a case-by-case basis to their respective CoD categories in order to establish binary code indicating for the agreement between VACoD and MCoD

The exposure variables are linked to the characteristics of VA administration, the characteristics of respondent, and the characteristics of the deceased. They are distributed and listed below:

Variables	**Values**	**Operational definitions (if any)**
Characteristics of VA administration		
Site	HCMC Binhduong Lamdong	The location (province) where VA interview was collected.
Module	Neonatal & child death Adult death	Form of the VA questionnaire was used for a given death depend on the age of the deceased at death. An adult module was used for a case of 12 years and older, and neonatal & child modules used for the cases of under 12 years.
Place of resident	Urban Rural	Refers to the deceased's place of residence.
Year of VA be conducted	2009 2010	Refers to the year of VA interviews were conducted.

Variables	**Values**	**Operational definitions**
Characteristics of respondent		
Gender	male female	Refers to the gender of respondent.
Relation	parents/offspring spouse others	The relationship of respondent to the deceased.
Characteristics of the deceased		
Age		The age in years of the deceased at death.
Gender of the deceased	male female	This details the gender of the deceased.
Education	no education up to secondary education higher education	This refers to the highest education level attained by the deceased. This variable was not collected in case of under six-year-old death (preschool).
Marital status	single married separated/divorced/widowed	This describes the marital status of the deceased. This variable was collected on adult death (12 years and older) only.
Occupation	agriculture officer employee retired housewife others	Refers to the primary occupation of the deceased.

6.4. Data analysis

6.4.1. Descriptive statistics

The analyses include descriptive statistics to review the distributions in form of frequency and proportion for categorical variables, and measures of central tendency for continuous variables. Additional descriptive analyses were conducted to understand the patterns of misclassification in the MCoD.

6.4.2. Cause-Specific Mortality Fraction (CSMF)

CSMF was determined as the proportion of all deaths that were attributable to a specific cause across VACoDs. The calculated CSMF for each CoD group was determined separately by applying following formula:

$$CSMF_1 = \frac{n_1}{n}$$

Where $CSMF_1$ refers to the CSMF of the group 1, n_1 refers to the number of death whose VACoD is identified as group 1, and n refers to the total number of death cases in this part of the study.

6.5. Results

6.5.1. The VA administrations

Table.8. Characteristics of VA administrations (n=64)

Characteristics	n	%
Site		
HCMC	38	59.4
Binhduong	15	23.4
Lamdong	11	17.2
Module		
Neonatal & child death	6	9.4
Adult death	58	90.6
Place of resident		
Urban	45	70.3
Rural	19	29.7
The year of VA be conducted		
2009	36	56.3
2010	28	43.7

Table 8 shows the characteristics of 64 VA administrations. About 60% of these VA interviews were conducted in HCMC. Almost all the interviews in this part

of the study (91%) used an adult module of VA questionnaires for those deaths were 12 years and older. The majority of VA interviews were administered in urban area (70%) and in the year of 2009 (56%).

6.5.2. The respondent and the deceased

The characteristics of respondents in this part of the study are described in Table 9. Female respondent represents a lightly higher proportion than male with 52% and 48%, respectively. When asked how they were related to the deceased, about 66% of the respondents stated that the deceased either was their mother/father or was their child, nearly one-fourth (23%) said their spouse, and the remains said other relationship.

Table.9. Characteristics of respondents (n=64)

Characteristics	**n**	**%**
Relation		
Parents/offspring	42	65.6
Spouse	15	23.4
Others	7	11.0
Gender		
Male	31	48.4
Female	33	51.6

Table.10. The general characteristics of the deceased

Characteristics	**n**	**%**
Age in years (n=64)		
Mean ± SD	58.3 ± 26.8	
Min	0	
Max	96	
Gender (n=64)		
Male	42	65.6
Female	22	34.4
Marital status (n=58)		
Single	7	12.1
Married	45	77.6
Separated/divorced/widowed	6	10.3
Education (n=59)		
No education	5	8.5
Up to secondary education	29	49.1
Higher education	25	42.4
Occupation (n=59)		
Agriculture	9	15.3
Officer	9	15.3
Employee	10	17.0
Retired	7	11.9
Housewife	12	20.3
Others	12	20.3

Table 10 shows general characteristics of the deceased in this part of the study. The mean age at death in these provinces is 58.3 ± 26.8 years with range from 0 to 96 years. There were 66% deaths occurred in male. For the marital status, the majorities were married, accounting for about 78%. About half of the deceased in these provinces had completed primary or secondary education (49%), and another 42% of the deceased had higher education. In this part of the study, the main occupations of the deceased were housewife and others, accounting for one fifth of the total.

6.5.3. CoDs derived from VA and medical records

Table.11. CoDs derived from VA and medical records, all ages

		MCoD			VACoD	
	DISEASE	**n**	**(%)**	**DISEASE**	**n**	**(%)**
1	Cardiovascular diseases	20	(31.3)	*1* Cardiovascular diseases	20	(31.3)
2	Injuries	6	(9.4)	*2* Cancer	10	(15.6)
3	Respiratory infections	5	(7.8)	*3* Transport accidents	5	(7.8)
	Cancer	5	(7.8)	*4* Congenital anomalies	4	(6.3)
4	Other digestive diseases	4	(6.3)	*5* HIV/AIDS	3	(4.7)
5	Liver diseases	3	(4.7)	Diabetes	3	(4.7)
6	Tuberculosis	2	(3.1)	Other digestive diseases	3	(4.7)
	HIV/AIDS	2	(3.1)	Injuries	3	(4.7)
	Diabetes	2	(3.1)	*6* Tuberculosis	2	(3.1)
	Other respiratory diseases	2	(3.1)	COPD	2	(3.1)
	Genitourinary diseases	2	(3.1)	Asthma	2	(3.1)
	Congenital anomalies	2	(3.1)	Genitourinary diseases	2	(3.1)
	Transport accidents	2	(3.1)	Musculoskeletal diseases	2	(3.1)
7	Childhood-cluster diseases	1	(1.6)	*7* Childhood-cluster diseases	1	(1.6)
	Other neoplasms	1	(1.6)	Endocrine disorders	1	(1.6)
	Neuropsychiatric conditions	1	(1.6)	Other respiratory diseases	1	(1.6)
	COPD	1	(1.6)			
	Asthma	1	(1.6)			
	ill-defined	2	(3.1)			
	Total	64	(100.0)	Total	64	(100.0)

COPD: Chronic obstructive pulmonary disease

Table 11 presents the VACoDs and MCoDs distributions of all 64 deaths that meet inclusion criteria for this part of the study. Twenty cases of death due to the cardiovascular diseases that made this group become the principal CoD for both approaches, accounting for 31% of total. A number of other causes stood out different for VACoDs and MCoDs. For MCoDs, injuries were the second frequently reported deaths (9%), followed by respiratory infections (8%), and cancer (8%). For VACoDs,

apart from cardiovascular diseases, also prominent were deaths due to cancer (16%), transport accidents (8%), and congenital anomalies (6%). There were 2 cases which given cause as “ill-defined” by medical record that could be classified to specific causes by VA.

In the group of children under 15 years, only 6 cases are selected in this part of the study (see table 12). For both VACoD and MCoD, prominent were deaths due to congenital malformations that accounted for the greatest number of children deaths (66.7% and 33.3%, respectively).

Table.12. CoDs derived from VA and medical records, under 15 years

	MCoD			VACoD	
	DISEASE	**n (%)**		**DISEASE**	**n (%)**
1	Congenital anomalies	2 (33.3)	*1*	Congenital anomalies	4 (66.7)
2	Childhood-cluster diseases	1 (16.7)	*2*	Childhood-cluster diseases	1 (16.7)
	Respiratory infections	1 (16.7)		Other digestive diseases	1 (16.7)
	Other digestive diseases	1 (16.7)			
	Ill-define	1 (16.7)			
	Total	6 (100.0)		Total	6 (100.0)

The cause-specific mortality results for the 15 – 59 years age group in table 13 provides insight into the different causes by different approaches in the adult mortality. From medical records, cardiovascular diseases and injuries were the principal CoDs follow by tuberculosis and HIV/AIDS. While around most of deaths in this age group were assigned the cause as cardiovascular diseases and transport accidents that reach to the most common VACoD.

Table 14 indicates around half of deaths were caused by cardiovascular diseases in the group of aged 60 years and above in both sources. Cancer ranked second, was identified as the CoD for 20% of the VACoD. Other causes were assigned a very small number of cases for each cause by both methods.

Table.13. CoDs derived from VA and medical records, 15 – 59 years

	MCoD			VACoD	
	DISEASE	**n (%)**		**DISEASE**	**n (%)**
1	Cardiovascular diseases	4 (17.4)	*1*	Cardiovascular diseases	4 (17.4)
	Injuries	4 (17.4)		Transport accidents	4 (17.4)
2	Tuberculosis	2 (8.7)	*2*	HIV/AIDS	3 (13.0)
	HIV/AIDS	2 (8.7)		Cancer	3 (13.0)
	Other digestive diseases	2 (8.7)	*3*	Genitourinary diseases	2 (8.7)
	Transport accidents	2 (8.7)		Musculoskeletal diseases	2 (8.7)
3	Cancer	1 (4.3)		Injuries	2 (8.7)
	Neuropsychiatric conditions	1 (4.3)	*4*	Tuberculosis	1 (4.3)
	Asthma	1 (4.3)		COPD	1 (4.3)
	Other respiratory diseases	1 (4.3)		Other digestive diseases	1 (4.3)
	Liver diseases	1 (4.3)			
	Genitourinary diseases	1 (4.3)			
	ill-defined	1 (4.3)			
	Total	23 (100.0)		Total	23 (100.0)

COPD: Chronic obstructive pulmonary disease

Table.14. CoDs derived from VA and medical records, 60+ years

	MCoD			VACoD	
	DISEASE	**n (%)**		**DISEASE**	**n (%)**
1	Cardiovascular diseases	16 (45.7)	*1*	Cardiovascular diseases	16 (45.7)
2	Respiratory infections	4 (11.4)	*2*	Cancer	7 (20.0)
	Cancer	4 (11.4)	*3*	Diabetes	3 (8.6)
3	Diabetes	2 (5.7)	*4*	Asthma	2 (5.7)
	Liver diseases	2 (5.7)	*5*	Tuberculosis	1 (2.9)
	Injuries	2 (5.7)		Endocrine disorders	1 (2.9)
4	Other neoplasms	1 (2.9)		COPD	1 (2.9)
	COPD	1 (2.9)		Other respiratory diseases	1 (2.9)
	Other respiratory diseases	1 (2.9)		Other digestive diseases	1 (2.9)
	Other digestive diseases	1 (2.9)		Transport accidents	1 (2.9)
	Genitourinary diseases	1 (2.9)		Injuries	1 (2.9)
	Total	35 (100.0)		Total	35 (100.0)

COPD: Chronic obstructive pulmonary disease

Table 15 and table 16 show the distribution of cause-specific mortality estimation for male and female across all age group. Deaths as a result of cardiovascular disease among male in these provinces became the first rank across all age group, accounting for 38%. The second frequently reported CoD with 12% of cases was given to injuries by medical records and transport accidents by VA (see Table 15). For female, over one-fourth of the total VA records were assigned the cause as cancer that made this group become the principal VACoD. Another 18% of VA records were determined to cardiovascular disease which ranked second. For

MCoDs, both cancer and cardiovascular disease occupied for the highest proportion of total female deaths (see Table 16).

Table.15. CoDs derived from VA and medical records, all ages, male

		MCoD			VACoD
	DISEASE	**n (%)**		**DISEASE**	**n (%)**
1	Cardiovascular diseases	16 (38.1)	*1*	Cardiovascular diseases	16 (38.1)
2	Injuries	5 (11.9)	*2*	Transport accidents	5 (11.9)
3	Other digestive diseases	3 (7.1)	*3*	Cancer	4 (9.5)
4	Tuberculosis	2 (4.8)	*4*	HIV/AIDS	3 (7.1)
	HIV/AIDS	2 (4.8)	*5*	Congenital anomalies	3 (7.1)
	Respiratory infections	2 (4.8)		Other digestive diseases	2 (4.8)
	Diabetes	2 (4.8)		Musculoskeletal diseases	2 (4.8)
	Liver diseases	2 (4.8)		Tuberculosis	1 (2.4)
	Transport accidents	2 (4.8)	*6*	Diabetes	1 (2.4)
5	Cancer	1 (2.4)		Endocrine disorders	1 (2.4)
	Other neoplasms	1 (2.4)		COPD	1 (2.4)
	Neuropsychiatric conditions	1 (2.4)		Other respiratory diseases	1 (2.4)
	COPD	1 (2.4)		Genitourinary diseases	1 (2.4)
	Genitourinary diseases	1 (2.4)	*7*	Injuries	1 (2.4)
	Congenital anomalies	1 (2.4)			
	Total	42 (100.0)		Total	42 (100.0)

COPD: Chronic obstructive pulmonary disease

Table.16. CoDs derived from VA and medical records, all ages, female

		MCoD			VACoD
	DISEASE	**n (%)**		**DISEASE**	**n (%)**
1	Cancer	4 (18.2)	*1*	Cancer	6 (27.3)
	Cardiovascular diseases	4 (18.2)	*2*	Cardiovascular diseases	4 (18.2)
2	Respiratory infections	3 (13.6)	*3*	Diabetes	2 (9.1)
3	Other respiratory diseases	2 (9.1)		Asthma	2 (9.1)
4	Childhood-cluster diseases	1 (4.5)		Injuries	2 (9.1)
	Asthma	1 (4.5)	*4*	Tuberculosis	1 (4.5)
	Liver diseases	1 (4.5)		Childhood-cluster diseases	1 (4.5)
	Other digestive diseases	1 (4.5)		COPD	1 (4.5)
	Genitourinary diseases	1 (4.5)		Other digestive diseases	1 (4.5)
	Congenital anomalies	1 (4.5)		Genitourinary diseases	1 (4.5)
	Injuries	1 (4.5)		Congenital anomalies	1 (4.5)
	Ill-define	2 (9.1)			
	Total	22 (100.0)		Total	22 (100.0)

COPD: Chronic obstructive pulmonary disease

6.5.4. Agreement between VACoD and MCoD

Table 17 refers the proportions of agreement between causes derived from VA versus those derived from medical records. A lightly more than half of the 64 VA

and medical records reviewed was reached to agreement (56%). Apart from the Childhood-cluster diseases which have only one case, cardiovascular diseases occupied the highest proportion of agreement, reported by 90% of those who VACoD is identified as "cardiovascular diseases", followed by HIV/AIDS and Injuries (about 67%).

Table.17. Agreement between VACoDs and MCoDs

VACoD	Agreed n (%)	No agreement n (%)
Childhood-cluster diseases	1 (100.0)	0 (0.0)
Cardiovascular diseases	18 (90.0)	2 (10.0)
HIV/AIDS	2 (66.7)	1 (33.3)
Injuries	2 (66.7)	1 (33.3)
Cancer	5 (50.0)	5 (50.0)
Congenital anomalies	2 (50.0)	2 (50.0)
Tuberculosis	1 (50.0)	1 (50.0)
COPD	1 (50.0)	1 (50.0)
Genitourinary diseases	1 (50.0)	1 (50.0)
Transport accidents	2 (40.0)	3 (60.0)
Other digestive diseases	1 (33.3)	2 (66.7)
Diabetes	0 (0.0)	3 (100.0)
Asthma	0 (0.0)	2 (100.0)
Musculoskeletal diseases	0 (0.0)	2 (100.0)
Endocrine disorders	0 (0.0)	1 (100.0)
Other respiratory diseases	0 (0.0)	1 (100.0)
Total	**36 (56.3)**	**28 (43.7)**

COPD: Chronic obstructive pulmonary disease

Table.18. Cross tabulation of medical and VA diagnoses

VACoD	MCoD																			Total
	(1)	(2)	(4)	(9)	(13)	(14)	(15)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(27)	(29)	(30)	(31)	
Tuberculosis	**1**	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2
HIV/AIDS	1	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Childhood-cluster diseases	-	-	**1**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Cancer	-	-	-	-	**5**	-	1	-	-	-	-	-	2	1	-	-	-	-	1	10
Diabetes	-	-	-	1	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	3
Endocrine disorders	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CVDs	-	-	-	1	-	-	1	-	**18**	-	-	-	-	-	-	-	-	-	-	20
COPD	-	-	-	-	-	-	-	-	-	**1**	1	-	-	-	-	-	-	-	-	2
Asthma	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Other respiratory diseases	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Other digestive diseases	-	-	-	-	-	-	-	-	-	-	-	-	1	**1**	-	-	1	-	-	3
Genitourinary diseases	-	-	-	-	-	-	-	-	-	-	-	1	-	-	**1**	-	-	-	-	2
Musculoskeletal diseases	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	2
Congenital anomalies	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	**2**	-	-	-	4
Transport accidents	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	**2**	2	5
Injuries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	**2**	3
Total	2	2	1	5	5	1	2	1	20	1	1	2	3	4	2	2	2	2	6	64

CVDs: Cardiovascular diseases; COPD: Chronic obstructive pulmonary disease

* (1)Tuberculosis; (2)HIV/AIDS; (4)Childhood-cluster diseases; (9)Respiratory infections; (13)Cancer; (14)Other neoplasms; (15)Diabetes; (17)Neuropsychiatric conditions; (18)CVDs; (19)COPD; (20)Asthma; (21)Other respiratory diseases; (22)Liver diseases; (23)Other digestive diseases; (24)Genitourinary diseases; (27)Congenital anomalies; (29)Ill-define; (30)Transport accidents; (31)Injuries

Table 18 shows the patterns of MCoD misclassification when compared with the VACoD. The VA re-classified only 2 deaths for which the MCoD was given as "cardiovascular diseases" to Diabetes (1 case), and Transport accidents (1 case). Table 13 shows the rather low agreement between the two data sources for deaths coded to injuries, with only one-third of events (about 33%) reported in the medical records being confirmed by the VA. Rather, the VA classified another one-third of cases to the cause of transport accidents. The remaining 2 injury-related deaths from medical records was classified to cancer (1 case), and other respiratory diseases (1 case) by VA. The VA re-classified 2 deaths for which the MCoD was given as "ill-defined" to other digestive diseases (1 case), and injuries (1 case).

Note that the findings found in the section are from limited data of matched cases. Discussions of this limitation are presented in chapter 8.

7. PART (II): THE DEGREE OF AGREEMENT BETWEEN FAMILY-GIVEN CoD (FGCoD) AND VACoD

7.1. Study objectives

- To determine the proportion of agreement between FGCoD and VACoD.
- To determine misclassification patterns for FGCoD.
- To investigate the proportionate mortality from reassignment of deaths, originally classified to nonspecific categories in the FGCoD, to specific causes upon VA method.
- To investigate factors in affecting the probability of agreement.

7.2. Conceptual framework

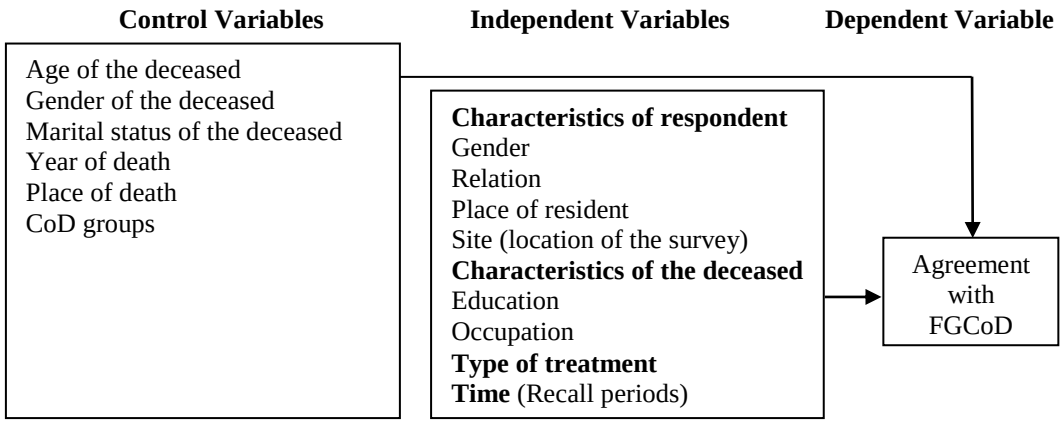
In this part of the study, the role of characteristics of respondents, social-economic characteristics of the deceased, type of treatment that the deceased had received for the illness prior to death, and time of recall in influencing the level of agreement between VACoD and FGCoD will be evaluated. The level of education and occupations of the respondent could be one of the potential factors to enhance the correct report that may affect the agreement. Due to unavailable to analysis, the level of education and occupations of the deceased was employed as an alternative. Hoj and colleagues discovered that male respondents are more likely to provide adequate information for a diagnosis than female (Hoj et al., 1999). Soleman and colleagues believed that the accuracy of VA improved if the respondents are relatives who had taken care of the deceased during the illness prior to death (Soleman et al., 2006). In additions, recent studies showed that contact with health services can substantially affect the information content and the validity of VA (Fottrell et al., 2012; Yang et al., 2006). Recall bias may affect the consistency of the VA instruments. A long recall period is likely to impair a respondent's ability to recollect and report relevant information. In contrast, inadequate time for mourning may cause distress and influence a respondent's willingness and ability to engage in a VA interview. According to WHO recommendation, a recall period should be better not greater than 12 months (WHO, 2007). On the other hand, in the study of the agreement between two different methods in assigning VACoD, Sebsibe Tadesse reported a low level of agreement when the recall period was less than 12 months (Tadesse, 2013). However,

there is little published work on the ideal time to administer the VA. We address the question of the acceptable length of time between death and administering the VA instrument. If the optimal recall period to be defined, it could contribute to ensure quality of data obtained from VA method. Besides, if the time interval between death and VA administration could be lengthened with the valid and reliable information, it could reduce costs of maintaining due to the greater flexibility in administering VA.

Besides, the study uses some characteristics of respondent, characteristics of the deceased, and CoD groups which are potential predictors of the agreement to control for possible confounding effects. Several existing studies identify variables which have effect on the performance of VA. Some studies argued that VA is a less reliable to ascertain cause of death for older age (Gajalakshmi et al., 2002; Hoa et al., 2012; Ngo et al., 2010). With the regard to gender difference, previous study signaled that the higher proportions of deaths classified to non-specific causes is found in female than in male (Hoa et al., 2012; Ngo et al., 2010). Some research suggest that VA does not perform adequately for several causes, for example, tuberculosis, chronic obstructive pulmonary disease, diabetes, hypertensive disease, liver diseases (Yang et al., 2006), and perinatal conditions (Laith, 2012).

On the basis of literature reviews, the CoD groups and following characteristics of the deceased are used as control variables in the analysis. The control characteristics of the deceased include age, gender, marital status, year of death, and place of death. Figure 10 presents the framework which displays outcome variable, explanatory and control variables utilized in this part of the study.

Fig.10. Conceptual framework of factors associated to the agreement with FGCoD



7.3. Study protocol and data retrieval process

Fig.11. Selection process of the VA records in determining agreement with FGCoD

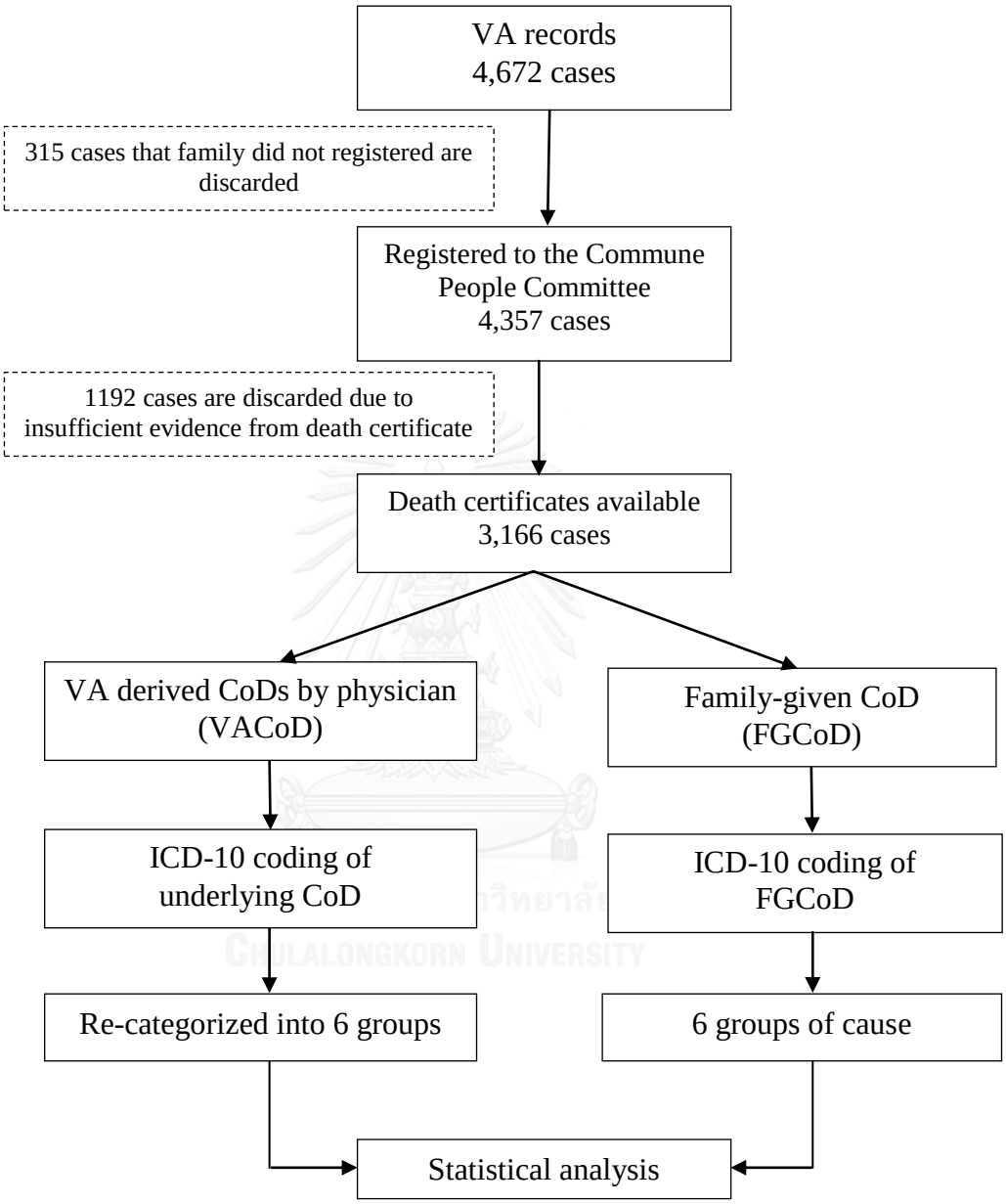


Figure 11 outlines the selection process of the VA records for analyzed in this part of the study. Using question 6.8 in form 1 of the questionnaire (see appendix 1), “Do you have a death certificate for the deceased that issue by the Commune People Committee?”, with the answer of 1 (yes), 2 (no) and 9 (unknown) for the first step of the selection. Records with the answers of 2 and 9 were excluded from the selection process. From the original set of 4,672 deaths, 315 cases were

discarded in the first step. For the remaining 4,357 deaths have been registered to the Commune People Committee by their family, those showed sufficient evidence from death certificate for determining CoDs were included to the analysis (3,166 cases). For VA records, the CoDs have been already assigned by trained physicians, and the ICD-10 coding of underlying CoD (the disease or injury that initiated the events directly leading to death) has been done. ICD-10 codes of VACoDs were then classified into six categories according to FGCoDs for further analysis.

7.4. Grouping VACoD procedure

FGCoDs were already classified into six groups in the data source. The six main categories with their code were the following: “1” (Illness), “2” (Senility), “3” (Cardiovascular diseases), “4” (Transport accident), “5” (Cancer), and “6” (Others). For the purpose of the comparable analysis in this part of the study, the underlying CoDs derived from VA were re-classified into six categories according to CoDs by death certificates.

Group	**Group’s name**	**ICD-10 code**	**CoDs**
1	Illness	A15–A19, B90, B20-B24, A00-A09, A33-A37, A80, B05, B91, B16-B19, B50-B54, A90-A91, A30, A40-A49, A74-A79, A81-A89, A92-A99, B25-B49, B92-B99, G00, G04, J00-J22, D00-D48, E10-E14, D55-D89, E03-E07, E65-E88, F00-F99, G06-G98, J30-J98, K20-K92, N00-N98, L00-L98, M00-M99, Q00-Q99,	Tuberculosis, sequelae of tuberculosis, HIV/AIDS, diarrheal, childhood-cluster diseases, hepatitis, malaria, Dengue, other infectious diseases, Respiratory infection, other neoplasms, diabetes, endocrine disorther, neuropsychiatric conditions, respiratory diseases, digestive diseases, gennitourinary diseases, skin diseases, musculoskeletal diseases, congenital anomalies
2	Senility	R54	
3	Cancer	C00–C97	
4	Cardiovascular diseases	I00–I99	

Group	Group's name	ICD-10 code	CoDs
5	Transport accidents	V01–V99	
6	Other conditions	O00–O99, P00–P96, E40–E46, E50, D50–D53, D64.9, E51–E64, R00–R99 (minus R54), W00– Y89	Maternal conditions, perinatal conditions, nutritional conditions, ill-defined, injuries

7.5. Variables

Creating the outcome variable: Deaths were aggregated on a case-by-case basis to their respective CoD categories in order to establish binary code indicating for the agreement between FGCoD and VACoD. The FGCoD refer to the CoD that the deceased's family have been registered to the Commune People Committee and was recorded on the Death certificate.

Explanatory variables are distributed and listed below:

Variables	Values	Operational definitions
Characteristics of respondent		
Gender	male female	Refers to the gender of respondent.
Relation	parents/offspring spouse others	The relationship of respondent to the deceased.
Place of resident	Urban Rural	Refers to respondent's place of residence.
Site	HCMC Binhduong Lamdong	The location (province) where VA interview was collected.
Treatment		
Type of treatment	no treatment Western treatment Traditional treatment Others	This indicates whether or not the deceased had received any type of treatment for the illness prior to death.

Variables	**Values**	**Operational definitions**
social-economic characteristics of the deceased		
Education	no education up to secondary education higher education	This refers to the highest education level attained by the deceased. This variable was not collected in case of under six-year-old death (preschool).
Occupation	agriculture officer employee retired housewife others	Refers to the primary occupation of the deceased.
Recall periods		
Time		The time in months between death and VA interview is conducted.

Control variables are distributed and listed below:

Variables	**Values**	**Operational definitions**
Age		The age in years of the deceased at death.
Gender of the deceased	male female	This details the gender of the deceased.
Marital status	single married separated/divorced/widowed	This describes the marital status of the deceased. This variable was collected on adult death (12 years and older) only.
Year of death	2008 2009	Refers to the year of death.
Place of death	home hospital others	Hospital deaths refer to the place of death was a public or private hospital or on route to health facility.

7.6. Data analysis

7.6.1. Descriptive statistics

Descriptive statistics were used to describe the distributions in form of frequency and proportion for categorical variables, and measures of central tendency for continuous variables. Additional descriptive analyses were conducted to understand the patterns of misclassification in the FGCoD

7.6.2. Cause-Specific Mortality Fraction (CSMF)

The calculated CSMF for each CoD group was determined separately (see formula in section 6.5.2).

7.6.3. Multivariate estimations

Maximum likelihood estimation of Probit model was applied to predict the probability of agreement between VACoD and FGCoD. Due to we are trying to predict probability of the agreement, a binary outcome variable, the proposed models cannot be estimated by using an ordinary least squares (OLS) because predicted values in OLS can be less than zero or greater than one. Instead, it will be estimated by maximum likelihood estimation method. In order to investigate whether characteristics of respondent and the deceased is likely to affect the probability of agreement, this part of the thesis proposes to conduct regression analyses which will estimate the statistical significance and direction of the relationship between each explanatory variable and the agreement, as well as the marginal effects of each relationship. By doing so, we will employ three following models.

$$P_{(agreed)} = f(female, RELATION, urban, SITE, EDU, OCCUPATION, TREATMENT) \quad (1)$$

$$P_{(agreed)} = f(female, RELATION, urban, SITE, EDU, OCCUPATION, TREATMENT, \boldsymbol{x_n}) \quad (2)$$

$$P_{(agreed)} = f(female, RELATION, urban, SITE, EDU, OCCUPATION, TREATMENT, \boldsymbol{x_n}, time, time^2) \quad (3)$$

In these equations, *female* is a dummy variable refers to the gender of respondent as female; and *urban* is a dummy variable refers to urban area as respondent's place of residence. For the multiple categories variable, we will define dummy variables for each value before putting in the model.

SITE takes on 3 values: HCMC, Binhduong, and Lamdong. "HCMC" is set as the base group. Then, we have two dummy variables, *Binhduong* = 1 if *site* = 2, and *Binhduong* = 0 otherwise; *Lamdong* = 1 if *site* = 3, and *Lamdong* = 0 otherwise.

For three categories of the variable *RELATION*, we let "parents/offspring" be the base group and define the dummy variables *spouse*, and *others*. Thus, let *spouse* = 1 if *relation* = 2, and *spouse* = 0 otherwise; *others* = 1 if *relation* = 3, and *others* = 0 otherwise.

EDU (the deceased's education status) takes on 3 values: no education, up to secondary education, and higher education. "no education " is set as the base group. Then, we have two dummy variables, *edu_2nd* = 1 if *edu* = 2, and *edu_2nd* = 0 otherwise; *highedu* = 1 if *edu* = 3, and *highedu* = 0 otherwise.

For six categories of the variable *OCCUPATION*, we let "agriculture" be the base group and define five dummy variables. Thus, let *officer* = 1 if *occupation* = 2, and *officer* = 0 otherwise; *employee* = 1 if *occupation* = 3, and *employee* = 0 otherwise; *retired* = 1 if *occupation* = 4, and *retired* = 0 otherwise; *housewife* = 1 if *occupation* = 5, and *housewife* = 0 otherwise; and *otherjob* = 1 if *occupation* = 6, and *otherjob* = 0 otherwise.

TREATMENT refers to types of treatment that the deceased had received for the illness prior to death. Three dummy variables could be defined before putting to equations namely *western*, *traditional*, and *otype* (other types). Let "no treatment" be the base group. The details of defining these dummy variables are: *western* = 1 if *treatment* = 2, and *western* = 0 otherwise; *traditional* = 1 if *treatment* = 3, and *traditional* = 0 otherwise; *otype* = 1 if *treatment* = 4, and *otype* = 0 otherwise.

$\boldsymbol{x_n}$ is a vector of control variables as presented in figure 12 (see section 5.2). Before putting in the specification (5) and (6), all of control variables, both binary and multiple categories, should be defined dummy variable(s) for each value. *female_ deceased* is a dummy variable refers to the gender of the deceased as female, *and y09* is a dummy variable refers to 2009 as the year of death. *GCOD* refers to the CoD groups.

For three categories of *MARITAL* that describe the marital status of the deceased, we set "single" as the base group and then define two dummy variables. Let *married* = 1 if *marital* = 2, and *married* = 0 otherwise; *separated* = 1 if *marital* = 3, and *separated* = 0 otherwise.

PLACE refers to the place of death that has 3 values: home, hospital and others. We define two dummy variables and leave the first value as the base group. Thus, let *hospital* = 1 if *place* = 2, and *hospital* = 0 otherwise; *oplace* = 1 if *place* = 3, and *oplace* = 0 otherwise.

Five dummy variables could be defined before putting to equations which are *senility*, *cancer*, *cvd*, *accident*, and *ocond* (other conditions). Let "Illness" be the base group. The details of defining these dummy variables are: *senility* = 1 if *gcod* = 2, and *senility* = 0 otherwise; *cancer* = 1 if *gcod* = 3, and *cancer* = 0 otherwise; *cvd* = 1 if *gcod* = 4, and *cvd* = 0 otherwise; *accident* = 1 if *gcod* = 5, and *accident* = 0 otherwise; and *ocond* = 1 if *gcod* = 6, and *ocond* = 0 otherwise.

Recall periods (*time*) and its' quadratic term ($time^2$) was entered to the specification (6) to estimate the effect of time on the agreement. A quadratic term was entered to the model to capture the decreasing or increasing marginal effects of time for recall on the change in probability of agreement. It is also help to estimate the turning point (maximum or minimum of the function) that can be treated as the optimal time for recall period.

7.7. Results

A total of 4,672 VA interview records were collected in these provinces during the observation period. This part of the study included only 3,166 cases. Of

that total set, 1,506 cases were discarded from the analysis due to insufficient evidence being provided in the death certificates.

7.7.1. The respondents and the deceased

The respondents

Almost respondents in the sample were female (63%) and lived in urban area (67%). When asked how they were related to the deceased, more than half (58%) of the respondents stated that the deceased either was their mother/father or was their child, nearly one-fourth (22%) said their spouse, and one-fifth (20%) said other relationship (see Table 19).

Table.19. Characteristics of respondents (n=3,166)

Characteristics	**n**	**%**
Gender		
Male	1,162	36.7
Female	2,004	63.3
Place of resident		
Urban	2,112	66.7
Rural	1,054	33.3
Relation		
Parents/offspring	1,831	57.8
Spouse	699	22.1
Others	636	20.1
Site		
HCMC	1,598	50.5
Binhduong	1,128	35.6
Lamdong	440	13.9

The deceased

Table 20 shows general characteristics of the deceased in this part of the study. The mean age at death in these provinces is 64.0 ± 21.7 years with range 0 – 108 years. There were 56% deaths occurred in male. For the marital status, the majorities were married. Most the deceased in these provinces had completed primary school or secondary school (67%). The percentage of the deceased who was illiterate is about 17%. In this part of the study, retired was the main occupation with about one-fourths of cases (24%).

Table.20. The general characteristics of the deceased

Characteristics	n	%
Age in years (n=3,166)		
Mean ± SD	64.0 ± 21.7	
Min	0	
Max	108	
Gender (n=3,166)		
Male	1,772	56.0
Female	1,394	44.0
Marital status (n=3,118)		
Single	410	13.2
Married	2,115	67.8
Separated/divorced/widowed	593	19.0
Education (n=3,134)		
No education	523	16.7
Up to secondary education	2,092	66.7
Higher education	519	16.6
Occupation (n=3,134)		
Agriculture	555	17.7
Officer	152	4.8
Employee	495	15.8
Retired	754	24.1
Housewife	524	16.7
Others	654	20.9

7.7.2. Additional information about the deaths

Table.21. Information about recall periods, treatment, year and place of death

Variables	n	%
Recall period in months (n=3,166)		
Mean ± SD	17.1 ± 3.9	
Min	0	
Max	24	
Type of treatment (n=3,166)		
No treatment	803	25.4
Western treatment	2,312	73.0
Traditional treatment	41	1.3
Others	10	0.3
Year of death (n=3,166)		
2008	1,296	40.9
2009	1,870	59.1
Place of death (n=3,166)		
Home	2,355	74.4
In-hospital	702	22.2
Others	109	3.4

The mean duration between death and administration of the VA instruments (recall period) in this study is 17.1 ± 3.9 months within the 0-24 months range. About two thirds of cases indicated that the deceased had received any form of treatment for the illness prior to death, in which, the majority form was western treatment (73%). Over half of all the cases in this part of study (59%) died in the year

of 2009. Regarding the place of death, most of the cases (74%) died at home in these provinces, only one-fifth (22%) died in the hospital (see Table 21).

7.7.3. CoDs derived from VA

Table 22 presents the VACoDs distributions of all 3,166 deaths that meet inclusion criteria for this part of the study. There are similarities in the rank order of five leading causes which are cardiovascular diseases, cancer, transport accidents, injuries and senility between male and female. Around one-fourth of the total deaths due to the cardiovascular diseases that made this group become the principal CoD. Cancer ranks second, accounting for 17% and 18% of male and female deaths, respectively. There is an important highlight of some major causes for the sex differential in the mortality pattern, for instance HIV/AIDS for male, and COPD for female but not in the first ten ranks in other groups. The comprehensive summaries of VACoDs distribution by sex for three broad age groups which are 0-14 years,15-59 years, and 60 years and above were presented in Table 23, 24, and 25.

For children aged under 15 years, deaths due to cardiovascular diseases were the first leading CoD for both gender. External causes such as injuries (for female) and transport accidents (for male) were also prominent in this age group (see table 23).

In table 24, deaths as a result of cardiovascular disease among male became the first rank across age group of 15-59 years, accounting for about 24%. Cancer was the second frequently reported CoD, followed by transport accidents and injuries. For females, there are similarities in the rank order of these leading causes to male, but with clearly fewer deaths from each cause.

There were similarities in the two leading causes among male and female in group of age 60 years and above (table 25). After these two causes, external causes which are transport accidents and injuries became more prevalent in female deaths, while respiratory infections were important in male deaths. However, these causes only have few scattered cases with about 5% for each cause.

Table.22. Distribution of leading VACoDs by gender across all ages

	Male			Female	
	DISEASE	**n (%)**		**DISEASE**	**n (%)**
1	Cardiovascular diseases	437 (24.7)	*1*	Cardiovascular diseases	369 (26.5)
2	Cancer	303 (17.1)	*2*	Cancer	251 (18.0)
3	Transport accidents	114 (6.4)	*3*	Transport accidents	103 (7.4)
4	Injuries	107 (6.0)	*4*	Injuries	90 (6.5)
5	Senility	102 (5.8)	*5*	Senility	73 (5.2)
6	Respiratory infections	77 (4.4)	*6*	Diabetes	64 (4.6)
7	Tuberculosis	76 (4.3)	*7*	Tuberculosis	47 (3.4)
8	HIV/AIDS	66 (3.7)	*8*	Respiratory infections	46 (3.3)
9	Diabetes	62 (3.5)	*9*	COPD	38 (2.7)
10	Liver diseases	58 (3.3)	*10*	Liver diseases	32 (2.3)
	ill-defined	118 (6.7)		ill-defined	95 (6.8)
	All other causes*	252 (14.2)		All other causes*	186 (13.3)
	Total	1772 (100.0)		Total	1394 (100.0)

COPD: Chronic obstructive pulmonary disease
*All other causes: see table C, appendix 2

Table.23. Distribution of VACoDs by gender for under 15 years

	Male			Female	
	DISEASE	**n (%)**		**DISEASE**	**n (%)**
1	Cardiovascular diseases	9 (24.3)	*1*	Cardiovascular diseases	5 (29.4)
	Transport accidents	9 (24.3)		Injuries	5 (29.4)
2	Injuries	3 (8.1)	*2*	Neuropsychiatric conditions	2 (11.8)
3	Tuberculosis	2 (5.4)	*3*	Tuberculosis	1 (5.9)
	Cancer	2 (5.4)		Cancer	1 (5.9)
	Congenital anomalies	2 (5.4)		Genitourinary diseases	1 (5.9)
4	HIV/AIDS	1 (2.7)		Musculoskeletal diseases	1 (5.9)
	Other infectious diseases	1 (2.7)		Congenital anomalies	1 (5.9)
	Respiratory infections	1 (2.7)			
	Perinatal conditions	1 (2.7)			
	Neuropsychiatric conditions	1 (2.7)			
	Liver diseases	1 (2.7)			
	Senility	1 (2.7)			
	ill-defined	3 (8.1)			
	Total	37 (100.0)		Total	17 (100.0)

Table.24. Distribution of leading VACoDs by gender for 15-59 years

	Male			Female	
	DISEASE	**n (%)**		**DISEASE**	**n (%)**
1	Cardiovascular diseases	210 (23.8)	*1*	Cardiovascular diseases	74 (24.7)
2	Cancer	150 (17.0)	*2*	Cancer	48 (16.0)
3	Transport accidents	62 (7.0)	*3*	Transport accidents	34 (11.3)
4	Injuries	60 (6.8)	*4*	Injuries	18 (6.0)
5	Senility	57 (6.5)	*5*	Diabetes	13 (4.3)
6	HIV/AIDS	40 (4.5)	*6*	HIV/AIDS	12 (4.0)
7	Tuberculosis	39 (4.4)		Respiratory infections	12 (4.0)
8	Liver diseases	31 (3.5)	*7*	Senility	11 (3.7)
9	Respiratory infections	29 (3.3)	*8*	Tuberculosis	9 (3.0)
	Diabetes	29 (3.3)	*9*	COPD	8 (2.7)
10	COPD	16 (1.8)	*10*	Neuropsychiatric conditions	6 (2.0)
	Other digestive diseases	16 (1.8)		Liver diseases	6 (2.0)
				Other digestive diseases	6 (2.0)
	ill-defined	61 (6.9)		ill-defined	23 (7.7)
	All other causes*	81 (9.2)		All other causes*	20 (6.7)
	Total	881 (100.0)		Total	300 (100.0)

COPD: Chronic obstructive pulmonary disease
*All other causes: see table D, appendix 2

Table.25. Distribution of leading VACoDs by gender for 60 years and above

	Male			Female	
	DISEASE	**n (%)**		**DISEASE**	**n (%)**
1	Cardiovascular diseases	218 (25.5)	*1*	Cardiovascular diseases	290 (26.9)
2	Cancer	151 (17.7)	*2*	Cancer	202 (18.8)
3	Respiratory infections	47 (5.5)	*3*	Transport accidents	69 (6.4)
4	Senility	44 (5.2)	*4*	Injuries	67 (6.2)
	Injuries	44 (5.2)	*5*	Senility	62 (5.8)
5	Transport accidents	43 (5.0)	*6*	Diabetes	51 (4.7)
6	Tuberculosis	35 (4.1)	*7*	Tuberculosis	37 (3.4)
7	Diabetes	33 (3.9)	*8*	Respiratory infections	34 (3.2)
8	COPD	28 (3.3)	*9*	COPD	30 (2.8)
9	Liver diseases	26 (3.0)	*10*	Liver diseases	26 (2.4)
10	HIV/AIDS	25 (2.9)			
	ill-defined	54 (6.3)		ill-defined	72 (6.7)
	All other causes*	106 (12.4)		All other causes*	137 (12.7)
	Total	854 (100.0)		Total	1077 (100.0)

COPD: Chronic obstructive pulmonary disease
*All other causes: see table E, appendix 2

7.7.4. Cause Specific Mortality Fractions of VA

Table 26 provides details on the percentage of CSMFs obtained using the VA method across six CoD groups in different provinces. Of all deaths in this population group, three specific types of cause (cancer, cardiovascular diseases, and transport accidents) accounted for about half of the overall mortality. There were similar CSMFs for cardiovascular diseases obtained from HCMC and Binhduong Province (about 28%), whereas only 9% of deaths in Lamdong Province were attributed to this cause. It is worth emphasizing that, the CSMF of the transport accidents CoD obtained from Lamdong Province was seven- and three-times higher than the CSMFs for the same group obtained from HCMC and Binh Duong province, respectively.

Table.26. CSMFs of VA across six CoD groups by provinces

Group	HCMC n (%)	Binhduong n (%)	Lamdong n (%)	Total n (%)
Illness	510 (31.9)	317 (28.1)	169 (38.4)	996 (31.5)
Senility	156 (9.8)	13 (1.1)	6 (1.4)	175 (5.5)
Cancer	219 (13.7)	287 (25.4)	48 (10.9)	554 (17.5)
Cardiovascular diseases	446 (27.9)	321 (28.5)	39 (8.9)	806 (25.5)
Transport accidents	51 (3.2)	75 (6.6)	91 (20.7)	217 (6.8)
Other conditions	216 (13.5)	115 (10.2)	87 (19.8)	418 (13.2)
Total	**1,598 (100)**	**1,128 (100)**	**440 (100)**	**3,166 (100)**

7.7.5. Agreement between VACoD and FGCoD:

Table.27. Proportion of FGCoD agreed with VACoD by CoD groups

Group	Agreed n (%)	No agreement n (%)
Illness	527 (52.9)	469 (47.1)
Senility	162 (92.6)	13 (7.4)
Cancer	291 (52.5)	263 (47.5)
Cardiovascular diseases	170 (21.1)	636 (78.9)
Transport accidents	201 (92.6)	16 (7.4)
Other conditions	144 (34.5)	274 (65.5)
Total	**1,495 (47.2)**	**1,671 (52.8)**

Table 27 shows the proportions of agreement across the six different CoD groups. One thousand four hundred and ninety-five cases (47.2%) had agreement between VACoD and FGCoD, giving a total of 3,166 deaths. Regarding specific causes, transport accidents and senility represent the highest proportion of agreement, with 92.6% of total cases in each group. However, of the 806 deaths that VA

attributed to cardiovascular diseases, only 170 cases (21.1%) had cardiovascular diseases listed as the CoD on the death certificate, thus showing the lowest proportion of agreement.

Table 28 presents the misclassification matrix for FGCoD when compared with the VACoD. There is good agreement between two methods for the three specific causes which are cancer, cardiovascular diseases, and transport accidents. The VA re-classified about half of deaths which had been assigned to the category “illness” and "other conditions" in the death certificate. Of the total 1,166 cases for which the FGCoD was given as "senility", less than 14% (162 cases) were still classified as such by VA.

Table.28. Cross tabulation of death certificates and VA diagnoses

VACoD	**FGCoD**						**Total**
	Illness	Senility	Cancer	CVDs	Transport accidents	Other conditions	
Illness	**527**	404	5	8	-	52	**996**
Senility	11	**162**	-	-	-	2	**175**
Cancer	156	94	**291**	1	4	8	**554**
Cardiovascular diseases	276	324	-	**170**	-	36	**806**
Transport accidents	2	-	-	1	**201**	13	**217**
Other conditions	75	182	-	11	6	**144**	**418**
Total	**1,047**	**1,166**	**296**	**191**	**211**	**255**	**3,166**

7.7.6. Misclassification analysis

Table 29 shows the distribution of FGCoDs reassigned to specific causes according to the VA diagnoses. The statistics for some categories seem reliable, such as most cases of cancer (73%), cardiovascular diseases (69%), and transport accidents (72%) being confirmed by the VA enquiry. However, the probable underlying pattern of CoD is considerably different to what the routine death registration system suggests. More than one-quarter of deaths due to cardiovascular diseases (26%) had been assigned to the broad category “illness” in the death registration system. The VA review suggests that a substantial proportion (88%) of senility deaths can be reclassified to specific causes, primarily cardiovascular diseases (28%) and cancer (11%).

Table.29. Proportionate reallocation (%) of FGCoD by VA to specific CoDs

VACoD	FGCoD						
	Illness	Senility	Cancer	CVDs	Transport accidents	Other conditions	**Total**
Tuberculosis	7.3	2.9	1.4	1.0	0.5	2.4	**3.9**
HIV/AIDS	6.4	0.9	1.0	0.5	1.9	3.1	**3.0**
Diarrheal	1.2	1.5	-	-	-	0.4	**1.0**
Childhood-cluster diseases	-	0.1	-	0.5	-	-	**0.1**
Hepatitis	1.1	0.8	-	-	-	0.4	**0.7**
Malaria	0.1	-	-	-	-	-	**0.0**
Dengue	0.3	-	-	-	-	-	**0.1**
Other infectious diseases	1.8	0.9	-	0.5	-	0.4	**1.0**
Respiratory infections	3.2	6.3	1.7	2.1	0.5	2.4	**3.9**
Maternal conditions	0.1	-	-	-	-	-	**0.0**
Perinatal conditions	0.1	0.3	-	-	-	0.4	**0.2**
Nutritional conditions	0.1	0.1	-	-	-	0.4	**0.1**
Cancer	16.1	10.9	**73.0**	7.3	6.2	5.9	**17.5**
Other neoplasms	0.1	0.2	0.7	-	-	-	**0.2**
Diabetes	5.6	4.0	2.4	2.6	0.5	2.7	**4.0**
Endocrine disorders	0.7	0.1	-	0.5	0.5	0.8	**0.4**
Neuropsychiatric conditions	1.3	2.3	0.3	0.5	0.9	1.2	**1.5**
CVDs	25.7	28.2	7.8	**68.6**	6.2	16.1	**25.5**
COPD	2.4	3.9	-	1.6	-	3.1	**2.6**
Asthma	2.1	2.1	0.7	0.5	0.5	0.8	**1.6**
Other respiratory diseases	0.6	1.0	0.3	-	-	-	**0.6**
Liver diseases	5.4	1.3	1.4	1.0	2.4	2.7	**2.8**
Other digestive diseases	1.9	1.7	0.7	-	0.5	0.8	**1.4**
Genitourinary diseases	1.0	1.1	-	0.5	-	0.8	**0.8**
Skin diseases	-	0.2	-	-	-	-	**0.1**
Musculoskeletal diseases	1.0	2.1	1.4	0.5	0.5	0.8	**1.3**
Congenital anomalies	1.0	0.3	-	-	0.5	0.8	**0.5**
Senility	1.7	12.2	2.4	1.6	0.5	1.6	**5.5**
Ill-define	4.6	11.2	2.7	5.2	1.9	4.7	**6.7**
Transport accidents	3.0	0.9	1.4	2.1	**71.6**	6.7	**6.9**
Injuries	4.3	2.6	1.0	2.6	4.7	40.8	**6.2**
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

CVDs: Cardiovascular diseases; COPD: Chronic obstructive pulmonary disease

7.7.7. Predicted of probability of agreement between VACoD and FGCoD

Table 30 reports Probit estimations of specification (1), (2) and (3) for the partial effects of various factors on the agreement between VACoD and FGCoD.

Section A pertains to characteristics of respondent, section B pertains to social-economic characteristics of the deceased, section C pertains to type of treatment that the deceased had received for the illness prior to death, and section D pertains to control variables that presented in Fig.10, section 7.2. There are very similar in magnitude as those in specification (2) and (3). We focus our discussion on the estimates in specification (3) for a more complete model.

Section E in the table reports the estimates of the marginal effects of time period between death and VA interview on agreement between VACoD and FGCoD. We do this by estimating specification (3) with time of recall in term of months and in quadratic term. They show that recall period has no effect on the agreement.

In this part of the study, the role of characteristics of respondents in influencing the level of agreement between VACoD and FGCoD was evaluated and found to be not statistically significant (see Section A of Table 30). Specifically, there is no differential effect among female and male respondents. The levels of agreement between both approaches are not difference when the respondent was rural residents as compared to urban dwellers. When the agreement was investigated with respect to the relation of respondent with the deceased, it shows that the agreements between VACoD and FGCoD are not difference when the respondent was spouse or others relation compared to parents/offspring. In other words, the effect of relationship of respondent to the deceased on the agreement is not statistically significant. That being said the characteristics of respondents have no effect on the agreement of VACoD and FGCoD. However, the location where VA interview was collected has significantly effect on the agreement. Specifically, VA in Lamdong is about 25% more likely to agree with FGCoD than in HCMC. The estimate is statistically significant at 99% confidence level. VA in Binhduong is 7% more likely to agree with FGCoD than in HCMC. The estimate is statistically significant at 90% confidence level.

Section B shows the effects of education and occupation of the deceased on the agreement between VACoD and FGCoD. Occupation of the deceased has significantly effect on the agreement of VA and FGCoD. We find that the probability of agreement is lower for the deceased who was officer, retiree, housewife and others than those was farmer. But the probability of agreement is higher for the deceased

who was employee than those was farmer. However, education levels of the deceased have no effect on the agreement.

To investigate whether the deceased had received any kind of treatment for the illness prior to death has affect the agreement or not, we put 3 dummy variables that defined for each type of treatment as the dependent variable to estimate the change in probability of agreement. The estimates with and without controls are shown in Section C of Table 30. We find that if the deceased had received a western treatment, then the VA results is 9% more consistent with FGCoD. This is statistically significant at 99% confidence level. For other types of treatment, there is no significant effect on the agreement.

When putting some control variables, which are age, gender, marital status of the deceased, year of death, place of death, and group of disease, into specification (2) and (3), the partial effect of some factors on agreement between VACoD and FGCoD has changed. Firstly, the association between education of the deceased and the agreement are becomes no statistically significant. In contrast, with control variables, the effect of western treatment that the deceased had received prior to death on the agreement between VACoD and FGCoD becomes statistically significant.

Table.30. Probit estimations of agreement between VACoD and FGCoD

VARIABLES	(1)	(2)	(3)
A. Characteristics of respondent			
Gender of the respondent (male: reference)			
female	-0.0172	-0.0344	-0.0346
	(0.0193)	(0.0211)	(0.0211)
Relationship of respondent to the deceased (parents/offspring: reference)			
spouse	0.0439	0.0137	0.0137
	(0.0331)	(0.0403)	(0.0403)
o_relation	0.0178	0.0187	0.0185
	(0.0257)	(0.0284)	(0.0284)
Place of resident (rural: reference)			
urban	-0.0059	-0.0078	-0.0079
	(0.0229)	(0.0248)	(0.0248)
Location (HCMC: reference)			
binhduong	0.0114	0.0724*	0.0726*
	(0.0318)	(0.0370)	(0.0370)
lamdong	0.2560***	0.2452***	0.2448***
	(0.0296)	(0.0326)	(0.0327)

Table.30. Probit estimations of agreement between VACoD and FGCoD (cont)

VARIABLES	(1)	(2)	(3)
B. Social-economic characteristics of the deceased			
Education of the deceased (no education: reference)			
2ndedu	-0.0398	0.0173	0.0175
	(0.0260)	(0.0447)	(0.0447)
highedu	-0.1209***	-0.0787	-0.0786
	(0.0318)	(0.0649)	(0.0650)
Occupation of the deceased (agriculture: reference)			
officer	-0.1273***	-0.1030**	-0.1031**
	(0.0436)	(0.0478)	(0.0478)
employee	0.0516	0.0626*	0.0625*
	(0.0326)	(0.0351)	(0.0351)
retired	-0.2340***	-0.2347***	-0.2347***
	(0.0261)	(0.0288)	(0.0288)
housewife	-0.1895***	-0.1773***	-0.1772***
	(0.0287)	(0.0315)	(0.0315)
otherjob	-0.0928***	-0.0823***	-0.0823***
	(0.0291)	(0.0318)	(0.0318)
C. Type of treatment (no treatment: reference)			
western	0.0142	0.0880***	0.0881***
	(0.0214)	(0.0257)	(0.0257)
traditional	-0.0999	-0.0190	-0.0194
	(0.0801)	(0.0877)	(0.0877)
o_type	-0.0598	0.1038	0.1023
	(0.1595)	(0.1600)	(0.1692)
D. Control variables			
Age of deceased		-0.0007	-0.0007
		(0.0010)	(0.0006)
Gender of deceased (male: reference)			
female_deceased		0.0711***	0.0714***
		(0.0218)	(0.0218)
Marital status of the deceased (single: reference)			
married		-0.0743**	-0.0744**
		(0.0354)	(0.0354)
separated		-0.1218***	-0.1219***
		(0.0428)	(0.0428)
Year of death (2008: reference)			
y09		-0.0496**	-0.0485**
		(0.0204)	(0.0212)
Place of death (home: reference)			
hospital		-0.0348	-0.0346
		(0.0249)	(0.0249)
o_place		0.0230	0.0230
		(0.0607)	(0.0607)
Group of disease (illness: reference)			
senility		0.5032***	0.5032***
		(0.0205)	(0.0205)
cancer		-0.0364	-0.0364
		(0.0282)	(0.0282)
cvd		-0.3079***	-0.3078***
		(0.0227)	(0.0227)
accident		0.3842***	0.3840***
		(0.0368)	(0.0368)
ocond		-0.2223***	-0.2222***
		(0.0290)	(0.0290)

Table.30. Probit estimations of agreement between VACoD and FGCoD (cont)

VARIABLES	(1)	(2)	(3)
		E. Recall period	
time			-0.0051
			(0.0177)
$time^2$			0.0001
			(0.0005)
Observations	3,134	3,118	3,118
Pseudo R^2	0.0685	0.2162	0.2162

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

8. CONCLUSIONS AND DISCUSSIONS

This study presents the findings on the consistency of the VA derived CoDs by comparing them against the corresponding CoDs derived from medical records (MCoD) and CoDs derived from death certificates (FGCoD) in 3 provinces of Vietnam (Hochiminh City, Binhduong Province and Lamdong Province). Furthermore, the study investigates factors that relate to the agreement between these approaches by using multivariate estimations.

Due to limited data for assessing the MCoDs which only 64 cases, we could not make conclusions on the comparison between VACoD and MCoD. Our findings confirm that VA agreed moderately with FGCoDs. Besides, in this study, most of the cases died at home that almost were caused by chronic non-communicable diseases although the health care utilization prior to death is quite high. We also find a higher proportion of transport accidents related deaths in Lamdong Province than in HCMC and Binhduong Province. The findings are discussed in this chapter at each category level with further acknowledgment to the associated limitations and suggested future studies.

8.1.1. Agreement between VACoD and MCoD

We would like to emphasize that divergences between the VAs and medical records in our study do not indicate that either one was correct. In countries where mortality patterns still rely on hospital data, we must consider that using VAs would be a good alternative source of CoDs, if they gave information as good as health facility reports (Misganaw et al., 2012) or in the case that the time of recall is long. In this sense, we look at the level of agreement between MCoDs and VACoDs.

Most previous studies suggested that VA seems to be a reasonably valid supplemental method to determine CoDs due to the highly reliable results were generated by this method. (Kahn, Tollman, Garenne, & Gear, 2000; Khademi et al., 2010). On the other hand, assessing the agreement between VA and medical records could also be useful for quantifying the quality of mortality data in health facilities, or the quality of procedure to identify CoDs followed WHO guideline by physicians in hospital.

8.1.2. Agreement between VACoD and FGCoD

The agreement achieved by families, irrespective of a specific CoD, showed a proportion of 47 percent of the total study population (n=3,166). This proportion indicates that a moderate level of agreement was reached by the families. Many factors could contribute to this level of agreement.

First, the availability of information on the CoDs from the household could affect agreement. Our predicted model results also show a greater likelihood of agreement between VACoD and FGCoD when the deceased had received a Western form of medical treatment for illness prior to death. If we assumed that families were linked to earlier professional medical diagnosis that could clarify the cause of illness before death, then we should expect a higher proportion of agreement among those families who received correct medical diagnosis. Recent studies showed that the increase in the agreement in the Western treatment group could be linked to the professional medical diagnosis by approaching and understanding these forms of diseases (Fottrell et al., 2012; Laith, 2012). The findings of a validation study in China also suggested that contact with health services can substantially affect the information content and the validity of VA, at least for some conditions (Yang et al., 2006). In cases of cancer-related death, for example, the diagnosis was more likely to be conveyed to the respondents by health professionals than it would be for cardiovascular diseases. This could be a possible explanation for the lower proportion of agreement in the cardiovascular diseases group than in the cancer group in our results.

Second, the rather low agreement between VACoD and FGCoD could have been due to the process of death registration. In Vietnam, the death registration form is very simple; there is no place to enter a medical diagnosis (M. R. Stevenson et al., 2012). Death certification also includes the CoD; such certificates are granted at the request of the family of a deceased person (D.L Huong, 2006). As demonstrated in a South African study, CoD and other information on death certificates could be inadequate and not always in agreement with clinical records in areas with poor quality mortality data (Moyo et al., 2007).

Finally, the agreement may affected by education status of the deceased. This may be partly explained by the illiterate person's ability to correctly understand and explain his or her own health conditions to the family. Then, the deceased person's family might have little understanding or even misunderstand about the diseases that led to the person's death. As a consequence, they might make incorrect reports about CoDs; a situation which contribute to the low agreement between VACoD and FGCoD.

8.1.3. Recall periods

Recall period is the duration which usually be measured in months between death and the VA interview be conducted. The duration of recall in our study ranges from 0 to 24 months. Our findings suggest that VA is robust to time after death due to recall period has no effect on the agreements between CoDs derived from VA and those from death certificates (FGCoD). This result is consistent with a study in India and the Philippines that collected data within 3-52 months of death (Serina et al., 2013). They found a decrease in the ability of the VA to assign the correct CoDs over time, but the association was weak and not statistically significant. The authors suggested that the maximum recall periods for VA interviews can be lasted up to four years after a person's death. A review paper of the VA method reported a wide range of recall periods is used in existing studies. VA interviews could be conducted as soon as practically possible after the report of the event is received, but after any culturally prescribed mourning period has passed (Soleman et al., 2006). According to WHO's guideline, inadequate time for mourning may cause distress and influence respondents' willingness and ability to engage in VA interview (WHO, 2007). For example, a three-month recall period was required in the Population Health Metrics Research Consortium gold standard validation study (Murray et al., 2011). In another VA study, which carried out in Chennai, South Indian, a six-month recall period was required for limiting distress over the terminal event (Gajalakshmi et al., 2002). While the maximum recall period might be extended to an indefinite amount of time (Soleman et al., 2006). However, WHO recommended that a recall period should be better not greater than 12 months because a long recall period is likely to impair a respondent's ability to recollect and report relevant information (WHO, 2007).

8.1.4. Some specific CoDs

Our findings show a higher proportion of transport accident-related deaths in Lamdong Province than in HCMC and Binhduong Province. In the report on the Vietnam Intercensal Population and Housing Survey in 2014, the Central Highlands was still the region with the highest proportion of deaths due to transport accidents and other accidents, in spite of a strong decline in transport accident deaths compared with those in 2009 (GSO, 2015). Poor weather, such as drizzling rain and fog, in Lamdong Province which cause slippery roads and blurs the vision of drivers, may contribute to such a high proportion. Furthermore, Lamdong is a province with high mountains and many sloping roads that could easily be a cause of accidents among inexperienced drivers or for inattentive drivers compared the situation in HCMC and Binhduong Province, where there is congested traffic that limits speed on the road. Existing studies also show that the number of transportation-related deaths was significantly higher in rural areas than that in urban areas (Q. Liu et al., 2012; Lu-Anne, Hawabibi, Mohamed, & Gantchev, 2012; NHTSA, 2012; Zhang et al., 2014). The higher number of deaths due to transport accidents in Lamdong Province could contribute to the higher agreement of the data from in this province compared with those of the other two provinces.

In our analysis, stroke, hypertension and all other heart conditions were merged together in the cardiovascular diseases category. From the estimation of the burden and costs of chronic diseases, 80% of worldwide deaths from chronic diseases occurred in developing countries, and around 80% of these deaths occurred in the 23 selected countries (which includes Vietnam) (Abegunde et al., 2007). The results of CSMFs obtained using VA method in our study indicated cardiovascular diseases, and cancer accounted for the highest share of all deaths, confirming that deaths from non-communicable conditions are not restricted to high-income countries. The same picture appear in other VA study in Kilifi, one of the poorest districts in Kenya, indicating that cardiovascular diseases were also among the five most common causes of adult death (Bauni et al., 2011).

Vietnam has begun a period in which it has a significant ageing population. The trend of population ageing in Vietnam has increased quite rapidly

over the past three decades with the Ageing Index increased from 18.2% in 1989 to 43.3% in 2014. It was higher than the average rate for the Southeast Asia region (GSO, 2015). The Aging Index is defined as the number of people aged 60 or more per 100 people those under 15 years of age. Increasing numbers of people at old and very old ages will pose major challenges for health-care systems. Present evidence suggests that people today are not only living longer than they did previously, but they are also living longer with less disability and fewer functional limitations (Christensen, Doblhammer, Rau, & Vaupel, 2009). Therefore, increasing the number of elderly deaths are assigned a CoD as “senility”. Basically, senility is not a medical CoD; it can be defined as “showing the feebleness of old age” and representing the physical decline associated with old age. Some studies have suggested that senility be considered an ill-defined classification because of a lack of specific sign and symptom (Ngo et al., 2010; Polprasert et al., 2010); then it should be reallocated Group II (non-communicable diseases) deaths (Alan D Lopez et al., 2006; C. Mathers, Vos, Lopez, Salomon, & Ezzati, 2001). However, in Chinese and Vietnamese cultural views, an elderly death as a result of senility is associated with what it means to be “fully human” or to “age well” or to "normal aging" and is not related to any disease (D. Liu, Hinton, Tran, Hinton, & Barker, 2008). So, in our study as in other studies on Vietnam's mortality patterns and in national mortality reporting system, senility is used as one of the main CoDs (D. L. Huong et al., 2003; Ngo et al., 2010). However, the VA method which is relatively new in the Vietnamese context, need to have further analyses to understand about the quality of VA data. For instance, some deaths in the age groups of under 15 years and 15-59 years were identified as senility deaths by VA in our results. Therefore, for improving the quality of data on CoDs from the VA system, it is necessary to give more training and implementing on WHO guidelines for those who interpret VA interviews.

8.1.5. Other factors

The sample population was more urban than the national population. This may be explained by the fact that our sample population includes 2 of the largest urban centers and industrial zones (HCMC and Binhduong Province) which are attractive destinations for workers throughout the country. In recent years, with high

economic growth rate, Binhduong Province retained the top ranking for highest positive net-migration rate (in-migrants exceeded out-migrants) (GSO, 2015). HCMC and Binhduong Province also have the high share of urban population, accounting for 82% and 77% of total population in each province, respectively. According to the report of the 1 April 2014 Census, the Southeast region still had the highest urban population proportion (62.3% of total regional population) which increased from 57.1% in 2009 (GSO, 2015). In addition, a substantial number of migrants come to the Southeast to pursue their studies, training or obtain to improve their technical skills mainly in HCMC.

This paper investigates the effect of gender and relation of VA information provider with the deceased on the agreement between VACoD and FGCoD. Our findings show that there is no differential effect for different groups. This is a positive aspect of using VA as a substitute tool for collecting mortality data in population level. By definition, the respondent or the VA information provider was a person who mostly took care of the deceased person or who knew the most about the illness led to death or at least had witnessed the death. The accuracy of the VA tool improved if the respondents had taken care of the deceased during the final illness (Soleman et al., 2006). However, the process of identifying an appropriate respondent is not formalized. There is limited information on the effect of respondents' characteristics on the accuracy of VA tools. Existing study that examined the effect of age, sex, relationship and language of the respondents found no significant effect of these variables on the VA results (Soleman et al., 2006).

The proportion of home death in our result was very high (74%) compared with developed countries where are low proportions of home deaths with about 16% in Canada, and 22% in the US (Goodridge, Lawson, Rennie, & Marciniuk, 2010). In contrast, most deaths in developing countries occur outside of medical institution (Maine & McGinn, 2000). One of the example is India, the second populous nation on the world, has about 75 percent of the 9.5 million annual deaths occur at home, and are not recorded (Chadha, 2014). Similar result was also found in other VA study in Iran, about 60% of the deceased in this study died at home (Khademi et al., 2010). Among those living in rural areas these figures are even higher. In rural Africa, more

than 80% of childhood deaths occur at home and are not registered in any routine mortality reporting system (Mung'ala & Snow, 1994). About 83% of adults and elderly in Matlab, a rural area of Bangladesh died at home (Alam, Chowdhury, Bhuiyan, & Streatfield, 2010). These figures could be influenced by the cultural tradition and societal factors which the majority of families in this area prefer their family members to die at home. On the other hand, about 20% of all deaths in this study occurred in the hospital which is fourfold of the data in the Vietnam Health Report in 2006 (MoH, 2006b). This report used the mortality data that were collected in public hospital only so it may lead to under-reporting.

The results of the study highlighted the heartening picture of healthcare seeking during fatal illness. In our study, about 75% of the deceased had received at least one kind of treatment for the illness that led to death. Our finding shows that the deceased had seek a western treatment more than other types of treatment. While this healthcare-seeking patterns quite differ with the other study on CoDs of adults and elderly in rural Bangladesh. Only 26% the deceased in the above study sought treatment from physicians, although the health care utilization prior to death was quite high (88.4%) (Alam et al., 2010). Our result is consistency with the report of the Vietnamese Ministry of Health that in rural particularly in the Central Highland region (which includes Lamdong Province), 22.3% do not seek treatment when they get sick (MoH, 2006b). Many reasons could be explained the non-treatment. The most common is financial problems. Data from a national survey in Vietnam in 2001 – 2002 showed that 32% could not afford for medical care (MoH, 2006b). One research in Boston showed that in the year before death, 27% of the deceased had no health care contacts. It may be largely attributable to barriers in obtaining health care, such as lack of financial resources, health insurance, transportation, or sources of primary care (Hwang et al., 2001). Sommers and Cunningham also found that more than one in five Americans got family financial pressures from medical bills in 2010. The increase in medical bill problems leaded to an increased number of unmet medical needs persons because of cost (Sommers & Cunningham, 2011). Another reason is that people do not think of the need of treatment, particularly in elderly. In most cases, it relates to incurable diseases or non-communicable diseases. In our findings, it may be relates to the large number of elderly who did not have any health problem before

they died. According to the 2000 Mexican Population Census, about 50% of the population aged 65+ years reported to have no health care coverage may cause by a culture of not seeking formal care in case of illness among low socioeconomic status population (Wong & Diaz, 2007).

This study has added to the body of knowledge about the application of VA methods in middle and low income countries where a large proportion of deaths occur outside of health facilities. More importantly, our study has demonstrated the very significant potential of the method to provide information on the consistency of the VA method specific to the Vietnamese context. We hope that our study, albeit small, is an initial effort to provide useful data that will stimulate further works for strengthening the national cause-specific mortality statistics.

8.1.6. Limitations and technical recommendations

Our study also had some limitations. As is known, post-mortem examination is the most accurate way to determine CoDs. However, such data were unavailable in Vietnam. Thus, the absence of such pathology reports which would have provided a gold standard for comparing CoDs was a major limitation of our study. Due to we could not concluded whether VA or medical record would give a more accurate determining CoD so we are not call this is a validation study. Although several previous studies used CoDs based on diagnoses from hospital records as the "gold standard" (Bauni et al., 2011; Khademi et al., 2010; Misganaw et al., 2012; Yang et al., 2006), the quality of this "gold standard" may be affected by insufficient evidence from laboratory investigations or technological diagnostic tests, which would support diagnostic procedures (Misganaw et al., 2012).

In additions, using a single cause of MCoD may have hid multiple causes contributing to death. Multiple CoDs are probably more accurately reflects the interaction of different diseases that lead to death (A. T. Bang & Bang, 1992), particularly among children and elderly in which co-morbidity is common (Soleman et al., 2006). On the other hand, to select only one CoD from a set of causes could led to selection bias that would distort mortality estimates.

The small number of cases available from the medical records for analysis in this study was the next limitation of this study. In our study, we have very few matched cases for MCoD and VA since the number of people died in the hospital is small and a majority of those cases do not seem to have medical records. This suggests low quality of medical record procedure, at least in the three provinces studied. Some special attention should be made to improve the quality of medical record procedure in Vietnam. If we were able to match more MCoD with VA cases, we might be more confident in reporting the overall situation of CSMFs of a population of hospital deaths in comparison to results of CSMFs obtained using the VA method.

Another possible limitation of this study could be that the influence of the level of education of the respondent on the level of agreement was not evaluated. The level of education of the respondent could be one of the factors to enhance the correct report that may affect the agreement between VACoD and FGCoD. In our analysis, we could not include this variable into models due to large number of missing values. Instead, the level of education of the deceased was employed as an alternative. However, this might not present the actual situation. The respondent could have obtained higher or lower education than the deceased hence, different agreement. Therefore, future VA studies should pay more attention on the collecting data procedure to enhance information of backgrounds and social determinants of respondents that can add good value to the study.

The quality of VA study depends on the quality of VA interviews and the approach to derive CoDs from VA. In this study, we chose local health personnel who had experience in recording the history of signs and symptoms of diseases that led to death and were familiar with the local terms for signs and symptoms of these diseases as VA interviewers. This study used physician review in interpreting VA interviews for allocating CoDs. Review by a physician is considered to be a reasonably accurate owing to their experience and knowledge about local morbidity and mortality patterns. However, these process, both VA interview and VA review, requires a considerable amount time which is less likely to be practiced in resource constrained setting as Vietnam. Further researches are required to determine alternative

appropriations that toward a routinely implementing such procedures to improve the quality of data on CoDs in registration data. For examples, the use of medical assistant or local health personnel who has trained to apply these diagnostic guidelines for assigning CoDs from VA as an alternative to physician review for VA data. The choice of interviewer should be adapted to local communities. The non-medical interviewers who underwent training in VA interview techniques from the local area could be able to conduct data collections. However, the process of choosing and training of interviewers should be standardized for the widely applying of VA tool in the national mortality data collection system in Vietnam.

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APPENDIX

APPENDIX 1

VERBAL AUTOPSY QUESTIONNAIRE
GENERAL INFORMATION

FORM 1

ID

1	*Province*	
	District	
	Ward	
	Address and phone number (if possible)	
2	Unit in charge	
3	Intervier's name	
4	Date of Interview	___ ___ / ___ ___ / ___ ___ ___ ___
5	Time	Start: ___ ___ : ___ ___ Finish: ___ ___ : ___ ___
6	Householder's name	
7	Language	1 Vietnamese 2 Others
	PART 1: INFORMATION ABOUT DECEASED PERSON	
1.1	Name of deceased	
1.2	Sex	1 Nam 2 Nữ
1.3	Date of birth	___ ___ / ___ ___ / ___ ___ ___ ___
1.4	Date of death	___ ___ / ___ ___ / ___ ___ ___ ___
1.5	Mother's name (if deceased person < 12 years)	
1.6	Father's name (if deceased person < 12 years)	
	PART 2: INTERVIEW ASSESSMENT	

FOR INTERVIEWER	FOR SUPERVISOR
Comments	Comments
Interviewer's name	Supervisor's name

FOR DOUBLE CHECK	FOR RE-INTERVIEW
Comments	Comments
	Supervisor's name

Instructions to interviewer: Introduce yourself and explain the purpose of your visit. Ask to speak to the caretaker or any other person who was present during the illness that led to death. If this is not possible, arrange a time to revisit the household when caretaker will be home. Before interviewing the person explain to him/her that participation in the interview is voluntary; s/he can refuse to answer any question and s/he can stop the interview at any time. Explain to him/her that the information provided is only for research purposes and will be confidential.

"Hello. My name is ….. and I am working with [AGENCY]. We are collecting information on the causes of death in the community. We would very much appreciate your participation in this effort. We want to ask you about the circumstances leading to the death of the deceased. Whatever information you provide will be kept strictly confidential. No information identifying you or the deceased will ever be released to anyone outside of this information-collection activity.

Participation in this survey is voluntary and you can choose not to answer any individual question or all of the questions. You may also stop the interview completely at any time without any consequences at all. However, we hope that you will participate in this survey since the results will help the government improve services for people."

	PART 3: IDENTIFICATION OF RESPONDENT	
3.1	Sex	1 Male
		2 Female
3.2	Relationship of respondent to the deceased:	1 Father/mother
		2 Grandfather/Grandmother
		3 Wife/Husband
		4 Brother/sister
		5 Son/daughter
		6 Other, specific ↘
	PART 4: IDENTIFICATION & DEMOGRAPHIC DATA OF THE DECEASED	
4.1	Name of deceased	↘
4.2	Date of birth	↘
		Lunar calendar ↘
4.3	Sex	1 Male
		2 Female
4.4	Place of death	1 At home
		2 In public hospital
		3 In private hospital
		4 On route to health facility
		9 Others, specific ↘
4.5	Date of death	↘
		Lunar calendar ↘
	Age of deceased (by calculated)	↘ **If < 12 proceed to 4.7** ↓
4.6	Marital status of the deceased	1 Single
		2 Married
		3 Separated
		4 Divorced
		5 Widowed
4.7	Highest level of education of deceased	1 Pre-school
		2 Illiterate
		3 Primary school
		4 Secondary school
		5 High school
		6 Graduate/Postgraduate

4.8	Occupation of deceased	1 Agricuture	
		2 Government officer	
		3 Worker	
		4 Retired officer	
		5 Housewife	
		6 Student	
		7 Children < 6 years old	
		9 Others, specific ↘	
4.9	**During interview, is there any other people? (*interviewer observe*)**	1 Yes	
		2 No	**proceed to 4.10** ↓
	How many people are there? ↘		

4.10	Relationship of each person to the deceased? *Did you live with the deceased in the period leading to her/his death.*		
	Relationship	Present during illness	on her/his deathbed
	Mother	1 Yes	1 Yes
		2 No	2 No
	Father	1 Yes	1 Yes
		2 No	2 No
	Uncle/Aunt	1 Yes	1 Yes
		2 No	2 No
	Grandfather/Grandmother	1 Yes	1 Yes
		2 No	2 No
	Wife/Husband	1 Yes	1 Yes
		2 No	2 No
	Son/daughter	1 Yes	1 Yes
		2 No	2 No
	Brother	1 Yes	1 Yes
		2 No	2 No
	Sister	1 Yes	1 Yes
		2 No	2 No
	Midwife	1 Yes	1 Yes
		2 No	2 No
	Others, specific ↘	1 Yes	1 Yes
		2 No	2 No

	PART 5: ACCIDENTS AND INJURIES		
5.1	**Did s/he suffer from any injury or accident that led to her/his death?**	1 Yes	
		2 No	**proceed to Part 6** ↓
		9 Unknown	
5.2	What kind of injury or accident? Allow respondent to answer spontaneously	☐ *1 Transport accident*	
		☐ *2 Fall*	
		☐ *3 Drowning*	
		☐ *4 Poinsoning*	
		☐ *5 Animal bite*	
		☐ *6 Burn*	
		☐ *7 Suicide/Self-harm*	
		☐ *8 Homicide/assault*	
		☐ *9 Electrocution*	
		☐ *99 Others* ↘	
		☐ *999 Unknown*	
5.3	**Did s/he drink alcohol before the accident or injury?**	1 Yes	
		2 No	**proceed to 5.5** ↓
		9 Unknown	

5.4	For how long after drinking alcohhol did s/he get the accident or injury?	1 Less than 1 hour	
		2 From 1 - 6 hours	
		3 More than 6 hours	
		9 Unknown	
5.5	**For how long after the accident or injury did s/he survive?**	Hour ☞	
		Day ☞	
		99 Unknown	
	PART 6: TREATMENT AND RECORDS		
6.1	**Did s/he receive any treatment for the illness that led to death?**	1 Yes	
		2 No	**proceed to 6.8** ↓
		9 Unknown	
6.2	Please tell me at which of the following places or facilities s/he received treatment during the illness that led to death:	☐ *1 Traditional healer*	
		☐ *2 Shaman or priest*	
		☐ *3 Commune health center*	
		☐ *4 District hospital*	
		☐ *5 Provincial/central hospital*	
		☐ *6 Maternity hospital*	
		☐ *7 Private clinic*	
		☐ *8 Pharmacy, drug seller, store*	
		☐ *9 Others*	
		☐ *10 Family or friends*	
		☐ *99 Unknown*	
6.3	If s/he received treatment at health facilities, record the name and address	☞	
6.4	Do you still keep her/his hospital documents of the treatment for the illness that led to death?	1 Yes	
		2 No	**proceed to 6.8** ↓
		9 Unknown	
6.5	Can I see these documents?	1 Yes	
		2 No	**proceed to 6.8** ↓
		9 Unknown	
6.6	Copy the date of the treatment during the illness that led to death	☞__ __ /__ __ / __ __ __ __	
6.7	Record from the hospital documents ☞		
	- Medical history		
	- Diagnosis		
	- Laboratory results		
	- Treatmets		
6.8	**Do you have a death certificate for the deceased *that issue by the Commune People Committee?***	1 Yes	
		2 No	**proceed to Part 7** ↓
		9 Unknown	
6.9	Can I see the death certificate?	1 Yes	
		2 No	**proceed to Part 7** ↓
		9 Unknown	

6.10	RECORD THE CAUSE OF DEATH FROM THE DEATH CERTIFICATE: ↘		
	PART 7: OPEN HISTORY QUESTION		
	Could you tell me about the illness/events that led to her/his death? Prompt: Was there anything else? *Instructions to interviewer - Allow the respondent to tell you about the illness in his or her own words. Do not prompt except for asking whether there was anything else after the respondent finishes. Keep prompting until the respondent says there was nothing else. While recording, underline any unfamiliar terms.*		
7.1	*Interviewer confirm:* ***Deceased person is*** :	1. Fatal injury	**proceed to Part 8, then END OF INTERVIEW**
		2. Under 12 years	proceed to FORM 3 ↓
		3. 12 years and over	proceed to FORM 2 ↓
	PART 8: ADDITIONAL INFORMATION ABOUT RESPONDENT		
8.1	Age	↘ ..... years	
8.2	Education level	1 Pre-school	
		2 Illiterate	
		3 Primary school	
		4 Secondary school	
		5 High school	
		6 Graduate/Postgraduate	
	END OF INTERVIEW ***THANK RESPONDENT FOR THEIR COOPERATION***		

VERBAL AUTOPSY QUESTIONNAIRE
ADOLESCENT & ADULT DEATH

FORM 2

ID

	PART 1: INFORMATION ABOUT THE CHRONIC DISEASE THAT THE DECEASED SUFFERED	
1.1	**Please tell me if the deceased suffered from any of the following illnesses and the year of diagnosed:**	
(1)	Asthma	1 Yes, in the year → __ __ __ __ 2 No 9 Unknown
(2)	Arthritis	1 Yes, in the year → __ __ __ __ 2 No 9 Unknown
(3)	Cancer	1 Yes, in the year → __ __ __ __ 2 No 9 Unknown
(4)	Pneumonia, chronic bronchitis, bronchiectasis	1 Yes, in the year → __ __ __ __ 2 No 9 Unknown
(5)	Amnesia	1 Yes, in the year → __ __ __ __ 2 No 9 Unknown
(6)	Depression	1 Yes, in the year → __ __ __ __ 2 No 9 Unknown
(7)	Diabetes	1 Yes, in the year → __ __ __ __ 2 No 9 Unknown
(8)	Epilepsy	1 Yes, in the year → __ __ __ __ 2 No 9 Unknown
(9)	Hypertension	1 Yes, in the year → __ __ __ __ 2 No 9 Unknown
(10)	Obesity	1 Yes, in the year → __ __ __ __ 2 No 9 Unknown
(11)	Cerebral vascular accident	1 Yes, in the year → __ __ __ __ 2 No 9 Unknown
(12)	Tuberculosis	1 Yes, in the year → __ __ __ __ 2 No 9 Unknown
(13)	HIV/AID	1 Yes, in the year → __ __ __ __ 2 No 9 Unknown

	PART 2: SIGNS & SYMPTOMS OF THE FINAL ILLNESS		
2.1	**For how long was s/he ill before s/he died?**	month ↘	
		day ↘	
		99 Unknown	
2.2	**Did s/he have a fever?**	1 Yes	
		2 No	**proceed to 2.7** ↓
		9 Unknown	
2.3	Did s/he have a high fever?	1 Mild	
		2 Medium	
		3 High	__ __.__°C
		9 Unknown	
2.4	For how long did s/he have a fever?	day ↘	
		99 Unknown	
2.5	Was the fever continuous or on and off?	1 Continuous	
		2 On and off	
		3 Other	
		9 Unknown	
2.6	Did s/he have sweat during fever?	1 Yes	
		2 No	
		9 Unknown	
2.7	**During the illness that led to death, did s/he have any skin rash?**	1 Yes	
		2 No	**proceed to 2.10** ↓
		9 Unknown	
2.8	For how long did s/he have the skin rash?	day ↘	
		99 Unknown	
2.9	Where was the rash located?	1 Face	
		2 Trunk	
		3 Arms and legs	
		4 Whole body	
		5 Other, specify ↘	
		9 Unknown	
2.10	**Did s/he have would/ulcerate?**	1 Yes	
		2 No	**proceed to 2.12** ↓
		9 Unknown	
2.11	Was the would/ulcerate have pus?	1 Yes	
		2 No	
		9 Unknown	
2.12	**Did s/he have itching of skin?**	1 Yes	
		2 No	
		9 Unknown	
2.13	**Did s/he have a leg ulcer?**	1 Yes	
		2 No	**proceed to 2.16** ↓
		9 Unknown	
2.14	Was it fester?	1 Yes	
		2 No	**proceed to 2.16** ↓
		9 Unknown	
2.15	For how long dis s/he have the fester?	day ↘	
		99 Unknown	
2.16	**Did s/he have pins and needles in feet?**	1 Yes	
		2 No	
		9 Unknown	
2.17	**During the illness led to death, did her/his lip look pale?**	1 Yes	
		2 No	
		9 Unknown	

2.18	**Within 3 months before death, did s/he have weight loss?**	1 Yes	
		2 No	**proceed to 2.20** ↓
		9 Unknown	
2.19	How many kg did s/he loss?	..... kg	
		99 Unknown	
2.20	**Did s/he look pale (anaemic)?**	1 Yes	
		2 No	
		9 Unknown	
2.21	**Did s/he have yellow discoloration of the eyes?**	1 Yes	
		2 No	**proceed to 2.23** ↓
		9 Unknown	
2.22	For how long did s/he have yellow discoloration of the eyes?	month	
		day	
		99 Unknown	
2.23	**Did s/he have swelling around ankle?**	1 Yes	
		2 No	**proceed to 2.25** ↓
		9 Unknown	
2.24	For how long did s/he have swelling around ankle?	month	
		day	
		99 Unknown	
2.25	**Did s/he have puffiness of the face?**	1 Yes	
		2 No	**proceed to 2.27** ↓
		9 Unknown	
2.26	For how long did s/he have puffiness of the face?	month	
		day	
		99 Unknown	
2.27	**Did s/he have swelling on the whole body?**	1 Yes	
		2 No	**proceed to 2.29** ↓
		9 Unknown	
2.28	For how long did s/he have swelling on the whole body?	month	
		day	
		99 Unknown	
2.29	**Did s/he have lymph node in the neck?**	1 Yes	
		2 No	
		9 Unknown	
2.30	**Did s/he have lymph node in the armpit?**	1 Yes	
		2 No	
		9 Unknown	
2.31	**Did s/he have lymph node in the groin?**	1 Yes	
		2 No	
		9 Unknown	
2.32	**Did s/he have a cough?**	1 Yes	
		2 No	**proceed to 2.36** ↓
		9 Unknown	
2.33	For how long did s/he have a cough?	month	
		day	
		99 Unknown	
2.34	Was the cough productive with sputum?	1 Yes	
		2 No	
		9 Unknown	
2.35	Did s/he cough out blood?	1 Yes	
		2 No	
		9 Unknown	
2.36	**Did s/he have breathlessness?**	1 Yes	
		2 No	**proceed to 2.40** ↓
		9 Unknown	

2.37	For how long did s/he have a breathlessness?	month ↘	
		day ↘	
		99 Unknown	
2.38	Was the breathlessness continuous or on and off?	1 Continuous	
		2 On and off	
		9 Unknown	
2.39	S/he breathless in which posture?	□ *1 Lying*	
		□ *2 Sitting*	
		□ *3 Moving or exertion*	
		□ *4 No special posture*	
		9 Unknown	
2.40	**Did s/he have breathe in short pants?**	1 Yes	
		2 No	**proceed to 2.42** ↓
		9 Unknown	
2.41	For how long did s/he have breathe in short pants?	month ↘	
		day ↘	
		99 Unknown	
2.42	**Did s/he have wheezing?**	1 Yes	
		2 No	
		9 Unknown	
2.43	**Did s/he have chest pain?**	1 Yes	
		2 No	**proceed to 2.47** ↓
		9 Unknown	
2.44	When s/he had chest pain, how long did it last?	1 Less than 30min	
		2 From 30min to 24 hours	
		3 Longer than 24 hours	
		9 Unknown	
2.45	Did the chest pain occur when in activity?	1 Yes	
		2 No	
		9 Unknown	
2.46	Where was the pain?	□ *1 Over the sternum*	
		□ *2 Over the heart/in the arm*	
		□ *3 Left side*	
		□ *4 Other, specify* ↘	
		9 Unknown	
2.47	**Did s/he have diarrhoea?**	1 Yes	
		2 No	**proceed to 2.49** ↓
		9 Unknown	
2.48	For how long did s/he have diarrhoea?	day ↘	
		99 Unknown	
2.49	**Did s/he have constipation?**	1 Yes	
		2 No	
		9 Unknown	
2.50	**At any time during the final illness was there blood in the stool?**	1 Yes	
		2 No	**proceed to 2.52** ↓
		9 Unknown	
2.51	Was there blood in the stool until death?	1 Yes	
		2 No	
		9 Unknown	
2.52	**Did s/he pass too little urine or no urine at all?**	1 Yes	
		2 No	
		9 Unknown	
2.53	**Did s/he vomit within a week before death?**	1 Yes	
		2 No	**proceed to 2.57** ↓
		9 Unknown	
2.54	If yes, when did the last time s/he vomit?	day ↘	
		hour ↘	
		99 Unknown	

2.55	Did the vomit look like bright red/blood red?	1 Yes	
		2 No	
		9 Unknown	
2.56	Did the vomit look like a coffee-colored fluid?	1 Yes	
		2 No	
		9 Unknown	
2.57	**Did s/he have difficulty on swallowing?**	1 Yes	
		2 No	**proceed to 2.60** ↓
		9 Unknown	
2.58	For how long did s/he have difficulty on swallowing?	month ↘	
		day ↘	
		99 Unknown	
2.59	What kind of food that s/he difficult swallowed?	1 Solids	
		2 Watery	
		3 Both	
		9 Unknown	
2.60	**Did s/he have pain on swallowing?**	1 Yes	
		2 No	
		9 Unknown	
2.61	**Did s/he have abdominal pain?**	1 Yes	
		2 No	**proceed to 2.64** ↓
		9 Unknown	
2.62	For how long did s/he have abdominal pain?	Day ↘	
		Hour ↘	
		99 Unknown	
2.63	Where in the abdoment was the pain located?	1 Upper abdomen	
		2 Lower abdomen	
		3 Other	
		9 Unknown	
2.64	**Did s/he have abdominal distension?**	1 Yes	
		2 No	**proceed to 2.67** ↓
		9 Unknown	
2.65	For how long did s/he have abdominal distension?	month ↘	
		day ↘	
		99 Unknown	
2.66	Did the distension develop rapidly or gradually?	1 Rapidly	
		2 Gradually	
		9 Unknown	
2.67	**Did s/he have any mass in the abdomen?**	1 Yes	
		2 No	**proceed to 2.69** ↓
		9 Unknown	
2.68	For how long did s/he have the mass in the abdomen?	month ↘	
		day ↘	
		99 Unknown	
2.69	**Did s/he have headache?**	1 Yes	
		2 No	**proceed to 2.72** ↓
		9 Unknown	
2.70	For how long dis s/he have the headache?	day ↘	
		hour ↘	
		99 Unknown	
2.71	Did the headache develop rapidly or gradually?	1 Rapidly	
		2 Gradually	
		9 Unknown	
2.72	**Did s/he have a stiff or painful neck?**	1 Yes	
		2 No	**proceed to 2.74** ↓
		9 Unknown	

2.73	For how long did s/he have a stiff or painful neck?	month ↘	
		day ↘	
		99 Unknown	
2.74	**Did s/he become unconscious?**	1 Yes	
		2 No	**proceed to 2.78** ↓
		9 Unknown	
2.75	Did the unconsciousness start suddenly or slowly?	1 Suddenly	
		2 Slowly	
		9 Unknown	
2.76	For how long was s/he unconscious?	day ↘	
		hour ↘	
		9 Unknown	
2.77	Was the unconsciouness last until s/he died?	1 Yes	
		2 No	
		9 Unknown	
2.78	**Within 3 months before death, did s/he have mental confusion?**	1 Yes	
		2 No	**proceed to 2.81** ↓
		9 Unknown	
2.79	For how long did s/he have mental confusion?	month ↘	
		day ↘	
		hour ↘	
		99 Unknown	
2.80	Did the mental confusion start suddenly or slowly?	1 Suddenly	
		2 Slowly	
		9 Unknown	
2.81	**Within 3 months before death, did s/he have amnesia?**	1 Yes	
		2 No	
		9 Unknown	
2.82	**Did s/he have convulsions?**	1 Yes	
		2 No	**proceed to 2.85** ↓
		9 Unknown	
2.83	For how long did s/he have convulsion?	hour ↘	
		minute ↘	
		99 Unknown	
2.84	Did s/he become conscious after the convulsion?	1 Yes	
		2 No	
		9 Unknown	
2.85	**Did s/he have paralysis?**	1 Yes	
		2 No	**proceed to 2.88** ↓
		9 Unknown	
2.86	For how long did s/he have paralysis?	year ↘	
		month ↘	
		day ↘	
		99 Unknown	
2.87	S/he had paralysis of which side of the body?	☐ *1 Right side*	
		☐ *2 Left side*	
		☐ *3 Lower limbs*	
		☐ *4 Upper limbs*	
		☐ *5 One leg*	
		☐ *6 One arm*	
		☐ *7 The whole body*	
		☐ *8 Others, specify* ↘	
		9 Unknown	
2.88	***The deceased person is***	**1 Female**	**countinue PART 3** ↓
		2 Male	**proceed to PART 4** ↓

	PART 3: SYMPTOMS AND SIGNS ASSOCIATED WITH ILLNESS OF WOMEN		
3.1	**Did she have an swelling in the breast?**	1 Yes	
		2 No	
		9 Unknown	
3.2	**Did she have an ulcer in the breast?**	1 Yes	
		2 No	
		9 Unknown	
3.3	**Did she have vaginal bleeding in between menstrual periods?**	1 Yes	
		2 No	
		9 Unknown	
3.4	**Did she have vaginal bleeding after menopause?**	1 Yes	
		2 No	
		9 Unknown	
3.5	**During the week before death, did she have a vaginal bleeding?**	1 Yes	
		2 No	
		9 Unknown	
	Is she 15-49 years?	1 Yes	
		2 No	**proceed to 5** ↓
3.6	**Before death, did she have failure to menstruate?**	1 Yes	
		2 No	**proceed to 3.8** ↓
		9 Unknown	
3.7	If yes, how many week did it be delay?	Weeks ↘	
		99 Unknown	
3.8	**Did she die during**	1 Pregnancy	**Skip 3.12 - 3.15**
		2 Abortion	**Skip 3.13 - 3.15**
		3 Within 6 weeks after abortion	
		4 In labour	**proceed to 3.12** ↓
		5 Within 6 weeks after giving birth	**proceed to 3.14** ↓
		6 Not pregnant	**proceed to 5** ↓
		9 Unknown	**proceed to 5** ↓
3.9	How long was she pregnant?	Months ↘	
		99 Unknown	
3.10	Did she suffer from severe abdominal pain that was not labor pain immediately before death?	1 Yes	
		2 No	
		9 Unknown	
3.11	During pregnancy, did she suffer from vaginal bleeding?	1 Yes	
		2 No	
		9 Unknown	
3.12	**Was there excessive bleeding on the day labor or abortion started?**	1 Yes	
		2 No	
		9 Unknown	
3.13	**How long did the labor or the abortion take?**	hour ↘	
		99 Unknown	
3.14	**Was there excessive bleeding after giving birth or abortion?**	1 Yes	
		2 No	
		9 Unknown	
3.15	**Within 6 weeks after giving birth or abortion, did she have foul smelling vaginal discharge?**	1 Yes	
		2 No	**proceed to 5** ↓
		9 Unknown	

	PART 4: LIFE STYLE		
4.1	**Did the deceased smoke tobacco?**	1 Yes	
		2 No	**proceed to 4.4** ↓
		3 Used to	
		9 Unknown	
4.2	Which type of tobacco did the deceased consume?	1 Filtered cigarette	
		2 Pipe	**proceed to 4.4** ↓
		3 Chewing tobacco	
		4 Local type	
		5 Other, specify ↘	
		9 Unknown	
4.3	*How much tobacco did s/he smoke per day ?*	↘	
		99 Unknown	
4.4	**Did the deceased ever drink alcohol?**	1 Yes	
		2 No	**proceed to 5** ↓
		9 Unknown	
4.5	Within 12months before death, how often did s/he drink alcohol?	1 Every day	
		2 About 3 - 4 times/week	
		3 About 1 - 2 times/week	
		4 About 2 - 3 times/month	
		5 About 1 time/month	
		6 About 6 - 11 times/year	
		7 About 1 - 5 times/year	
		9 Unknown	
	PART 5: ADDITIONAL INFORMATION ABOUT RESPONDENT		
5.1	Age	↘ ..... years	
5.2	Education level	1 Pre-school	
		2 Illiterate	
		3 Primary school	
		4 Secondary school	
		5 High school	
		6 Graduate/Postgraduate	
END OF INTERVIEW ***THANK RESPONDENT FOR THEIR COOPERATION***			

	VERBAL AUTOPSY QUESTIONNAIRE NEONATAL AND CHILD DEATH	FORM 3 ID:	
	PART 1: GENERAL INFORMATION ABOUT THE PREGNANT AND DELIVERY PROCESS		
1.1	**Was the child a single or multiple birth?**	1 single-ton	
		2 Twin/Triplet or more	
		9 Unknown	
1.2	**What was the birth order of the child that died?**	1 First	
		2 Second	
		3 Third or higher	
		9 Unknown	
1.3	***How is the mother's health now?***	1 Healthy	**proceed to 1.6** ↓
		2 Not alive	
1.4	Was the mother die during labor?	1 Yes	**proceed to 1.6** ↓
		2 No	
		9 Unknown	
1.5	After giving birth, for how long did the mother die? *(Within 24h = 00 day. 1 month = 28 days)*	Month ↘	
		Day ↘	
		99 Unknown	
1.6	**Where was the child born?**	1 Hospital	
		2 Commune health center	
		3 Maternity hospital	
		4 Other health facilities	
		5 On route to hospital or health facility	
		6 Home	
		7 Other ↘	
		9 Unknown	
1.7	**At birth what was the size of the baby?**	1 Very small	
		2 Smaller than normal	
		3 Normal	
		4 Larger than normal	
		9 Unknown	
1.8	**What was the birth weight of the baby?**	↘ ..... gam	
		9999 Unknown	
1.9	**Did the baby ever cry after birth, even a little?**	1 Yes	
		2 No	
		9 Unknown	
1.10	**Did the baby ever move after birth, even a little?**	1 Yes	
		2 No	
		9 Unknown	
1.11	**Did the baby breathe after birth, even a little?**	1 Yes	
		2 No	
		9 Unknown	
1.12	***CHECK 1.9, 1.10, and 1.11: all three code "NO"***	**A**	**proceed to 1.13** ↓
	OTHER	**B**	**proceed to 1.17** ↓

1.13	**Were there any bruises or signs of injury on child's body after the birth?**	1 Yes	
		2 No	
		9 Unknown	
1.14	**Was the baby macerated, that is, showed signs of decay?**	1 Yes	
		2 No	
		9 Unknown	
1.15	**Did the baby have any malformation?**	1 Yes	
		2 No	**proceed to 1.19** ↓
		9 Unknown	
1.16	What kind of malformation did the baby have?	☐ *1 Very small head*	
		☐ *2 Very large head*	
		☐ *3 Malformation on the back*	
		☐ *4 Other, specify* ↘	
		9 Unknown	
	AFTER FINISH 1.16		**proceed to 1.19** ↓
1.17	How old was s/he when s/he have the illness that led to death? *(Within 24h = 00 day. 1 month = 28 days)*	Years ↘	
		Months ↘	
		Days ↘	
		99 Unknown	
1.18	How long did the illness last? *(Within 24h = 00 day. 1 month = 28 days)*	Years ↘	
		Months ↘	
		Days ↘	
		99 Unknown	
1.19	**Age of the baby**	1 Under 28 days	**proceed to PART 2** ↓
		2 From 28 days to 12 years	**proceed to PART 5** ↓

	PART 2: PREGNANCY/DELIVERY		
2.1	**During the last 3 months of pregnancy did the mother suffer from any of the following illnesses:**	☐ *1 Convulsive*	
		☐ *2 High blood pressure*	
		☐ *3 Anaemia*	
		☐ *4 Diabetes*	
		☐ *5 Breech birth*	
		☐ *6 Umbilical cord come out before the baby was born*	
		☐ *7 Fetal distress*	
		☐ *8 Excessive bleeding before or during delivery*	
		☐ *9 Febrile illness*	
		☐ *98 Other, specify* ↘	
		99 Unknown	
2.2	**How many months was the pregnancy when the baby was born?**	Month ↘	
		Week ↘	
		99 Unknown	
2.3	**Was the pregnancy end earlier or later than expected?**	1 Earlier	
		2 Normal	
		3 Later	
		9 Unknown	
2.4	**Did the baby stop moving in the womb?**	1 Yes	
		2 No	
		9 Unknown	
2.5	**When did the baby stop moving in the womb?**	Hour before labor started ↘	
		Day before labor ↘	
		99 Unknown	
2.6	**When did the water break?**	1 Before labor started	
		2 During labor	**proceed to 2.8** ↓
		9 Unknown	
2.7	**How many hours after the water broke was the baby born?**	1 Less than 24h	
		2 One day or more	
		9 Unknown	
2.8	**What color was the water?**	1 Dark color	
		2 Normal	
		3 Other, specify ↘	
		9 Unknown	
2.9	**Was the water foul smelling?**	1 Yes	
		2 No	
		9 Unknown	
2.10	**How long did the labor pains last?** ***(Less than 1 hour = "00")***	Hour ↘	
		99 Unknown	
2.11	**Did the child's mother receive any tetanus vaccinations during the pregnancy?**	1 Yes	
		2 No	**proceed to 2.13** ↓
		9 Unknown	
2.12	If yes, how many doses?	1 One	
		2 Two	
		3 More than two	
		9 Unknown	

2.13	**For this pregnancy, How many times did the mother go to prenatal health care?**	1 Not at all	**proceed to 2.15** ↓
		2 At least three	
		3 Three times	
		4 More than three	
		9 Unknown	
2.14	Where did the mother received prenatal health care?	☐ *1 Commune health center*	
		☐ *2 Maternity hospital*	
		☐ *3 Hospital*	
		☐ *4 Khác, ghi rõ* ↘	
		9 Unknown	
2.15	**Who assisted with the delivery?**	1 Doctor	**proceed to 2.17** ↓
		2 Nurse/Midwife	
		3 Relative	**proceed to 2.17** ↓
		4 Mother (herself)	
		5 Traditional birth attendant	
		6 Other, specify↘	
		9 Unknown	
2.16	If was nurse/midwife at the commune health center, record the name:	↘	
2.17	**What type of delivery was it?**	1 Normal vaginal delivery	
		2 Caesarean section	
		9 Unknown	
2.18	**During labor, did the mother receive any medicine?**	1 Yes	
		2 No	
		9 Unknown	
2.19	**CHECK THE ANSWER IN 1.12.**	A	**proceed to PART 4** ↓
		B	**proceed to PART 3** ↓
	PART 3: NEONATAL CONDITIONS		
3.1	**Were there any bruises or signs of injury on child's body after the birth?**	1 Yes	
		2 No	
		9 Unknown	
3.2	**Did the baby have any malformation?**	1 Yes	
		2 No	**proceed to 3.4** ↓
		9 Unknown	
3.3	What kind of malformation did the baby have?	☐ *1 Very small head*	
		☐ *2 Very large head*	
		☐ *3 Malformation on the back*	
		☐ *4 Other, specify* ↘	
		9 Unknown	
3.4	**Did the baby breathe after birth?**	1 Yes	
		2 No	**proceed to 3.6** ↓
		9 Unknown	
3.5	Did the baby have breathlessness?	1 Yes	
		2 No	
		9 Unknown	
3.6	**Was the baby given assistance to breathe?**	1 Yes	
		2 No	
		9 Unknown	

3.7	**Was s/he able to cry soon after birth?**	1 Yes	**proceed to 3.9** ↓
		2 No	
		9 Unknown	
3.8	For how long after birth, did s/he cry?	1 Within 5 min	
		2 From 6 to 30 min	
		3 Over 30 min	
		4 Never cry	**proceed to 3.11** ↓
		9 Unknown	
3.9	**Did s/he have difficulties in crying after a period of well-being?**	1 Yes	
		2 No	**proceed to 3.11** ↓
		9 Unknown	
3.10	For how long before die s/he have difficulty in crying?	1 Less than 1day	
		2 One day or more	
		9 Unknown	
3.11	**Was the baby able to suckle or bottle-feed soon after birth?**	1 Yes	**proceed to 3.13** ↓
		2 No	
		9 Unknown	
3.12	**Was the baby ever able to suckle or bottle-feed?**	1 Yes	
		2 No	**proceed to 3.17** ↓
		9 Unknown	
3.13	**Did the baby stop suckling or bottle-feeding?**	1 Yes	
		2 No	**proceed to 3.17** ↓
		9 Unknown	
3.14	How many days after birth did the baby stop suckling or bottle-feeding? *(Less than 1 day = "00")*	Day ↘	
		99 Unknown	
3.15	How many days before die did the baby stop suckling or bottle-feeding? *(Less than 1 day = "00")*	Day ↘	
		99 Unknown	
3.16	Could the baby open her/his mount when s/he stop sucking or bottle-feeding?	1 Yes	
		2 No	
		9 Unknown	
3.17	**During the illness that led to death did s/he have difficulty in breathing?**	1 Yes	
		2 No	**proceed to 3.20** ↓
		9 Unknown	
3.18	How many days after birth did s/he have difficulty in breathing *(Less than 1 day = "00")*	Day ↘	
		99 Unknown	
3.19	How many day did s/he have difficulty in breathing *(Less than 1 day = "00")*	Day ↘	
		99 Unknown	
3.20	**During the illness that led to death, did s/he have fast breathing?**	1 Yes	
		2 No	**proceed to 3.23** ↓
		9 Unknown	
3.21	How many days after birth did s/he have fast breathing? *(Less than 1 day = "00")*	Day ↘	
		99 Unknown	
3.22	How many day did s/he have fast breathing? *(Less than 1 day = "00")*	Day ↘	
		99 Unknown	
3.23	**During the illness that led to death, did the baby have chest indrawing?**	1 Yes	
		2 No	
		9 Unknown	
3.24	**Did the baby have grunt? DEMONSTRATE**	1 Yes	
		2 No	
		9 Unknown	
3.25	**During the illness that led to death, did the baby have convulsion?**	1 Yes	
		2 No	
		9 Unknown	

3.26	**During the illness that led to death, did s/he have a fever?**	1 Yes	
		2 No	**proceed to 3.29** ↓
		9 Unknown	
3.27	How many days after birth did s/he have a fever? *(Less than 1 day = "00")*	Day ↘	
		99 Unknown	
3.28	How many days did the fever last? (Less than 1 day = *"00"*)	Day ↘	
		99 Unknown	
3.29	**During the illness that led to death, did the baby become cold to the touch?**	1 Yes	
		2 No	**proceed to 3.32** ↓
		9 Unknown	
3.30	How many days after birth did the baby become cold to the touch? *(Less than 1 day = "00")*	Day ↘	
		99 Unknown	
3.31	How many day did the body feel cold? *(Less than 1 day = "00")*	Day ↘	
		99 Unknown	
3.32	**During the illness that led to death, did the baby become unresponsive suddently?**	1 Yes	
		2 No	
		9 Unknown	
3.33	**Did the baby become unresponsive or unconscious?**	1 Yes	
		2 No	
		9 Unknown	
3.34	**During the illness that led to death, did s/he have a bulging fontanel?**	1 Yes	
		2 No	
		9 Unknown	
3.35	**During the illness that led to death, did s/he have drainage from the umbilical cord stump?**	1 Yes	
		2 No	
		9 Unknown	
3.36	**During the illness that led to death, did s/he have redness around the umbilical cord stump?**	1 Có	
		2 No	**proceed to 3.38** ↓
		9 Unknown	
3.37	Was the redness spread to surrounding areas?	1 Yes	
		2 No	
		9 Unknown	
3.38	**During the illness that led to death, did s/he have areas of skin that were red, hot or peeling?**	1 Yes	
		2 No	
		9 Unknown	
3.39	Did s/he have areas of skin that were bluish black?	1 Yes	
		2 No	
		9 Unknown	
3.40	**During the illness that led to death, did s/he bleed from anywhere?**	1 Có	
		2 No	**proceed to 3.42** ↓
		9 Unknown	
3.41	From where?	↘	
3.42	**During the illness that led to death, did s/he have diarrhoea?**	1 Yes	
		2 No	**proceed to 3.44** ↓
		9 Unknown	
3.43	On the day when the diarrhoea was most frequent, how many times did s/he pass stools per day?	Times ↘	
		9 Unknown	

3.44	**During the illness that led to death, did s/he have any vomiting?**	1 Yes
		2 No
		9 Unknown
3.45	**During the illness that led to death, did s/he have yellow skin?**	1 Yes
		2 No
		9 Unknown
3.46	**During the illness that led to death, did s/he have yellow eyes?**	1 Yes
		2 No
		9 Unknown
3.47	**Was the baby die suddently?**	1 Yes
		2 No
		9 Unknown
	PART 4: ADDITIONAL INFORMATION ABOUT RESPONDENT	
4.1	Age	..... years
4.2	Education level	1 Pre-school
		2 Illiterate
		3 Primary school
		4 Secondary school
		5 High school
		6 Graduate/Postgraduate
END OF INTERVIEW ***THANK RESPONDENT FOR THEIR COOPERATION***		

	PART 5: CHILDHOOD CONDITIONS		
5.1	**During the illness that led to deaht, did s/he have a fever?**	1 Yes 2 No 9 Unknown	**proceed to 5.6** ↓
5.2	For how long did s/he have a fever? *(Less than 1 day = "00")*	Day ↘ 99 Unknown	
5.3	Did s/he have fever when s/he death?	1 Yes 2 No 9 Unknown	**proceed to 5.6** ↓
5.4	Did s/he have a high fever?	1 Mild 2 Medium 3 High 9 Unknown	__ __.__°C
5.5	Was the fever continuous or on and off?	1 Continuous 2 On and off 3 Other, specify 9 Unknown	
5.6	**Did s/he have diarrhoea?**	1 Yes 2 No 9 Unknown	**proceed to 5.11** ↓
5.7	On the day when the diarrhoea was most frequent, how many times did s/he pass stools per day?	Times ↘ 9 Unknown	
5.8	How many day before death, did s/he have diarrhoea? *(Less than 1 day = "00")*	Day ↘ 99 Unknown	
5.9	Did s/he usually have diarrhoea?	1 Yes 2 No 9 Unknown	**proceed to 5.11** ↓
5.10	How many day before death, did s/he stop diarrhoea? *(Less than 1 day = "00")*	Day ↘ 99 Unknown	
5.11	**At any time during the final illness was there blood in the stool?**	1 Yes 2 No 9 Unknown	
5.12	**Did s/he have a cough?**	1 Yes 2 No 9 Unknown	**proceed to 5.16** ↓
5.13	For how long did s/he have a cough? *(Less than 1 day = "00")*	Số ngày ↘ 99 Unknown	
5.14	Was the cough severe?	1 Yes 2 No 9 Unknown	
5.15	Did the child vomit after s/he coughed?	1 Yes 2 No 9 Unknown	
5.16	**Did s/he have difficulty in breathing?**	1 Yes 2 No 9 Unknown	**proceed to 5.18** ↓
5.17	For how long did s/he have difficulty in breathing?	Day ↘ 99 Unknown	

5.18	**Did s/he have fast breathing?**	1 Yes	
		2 No	**proceed to 5.20** ↓
		9 Unknown	
5.19	For how long did s/he have fast breathing?	Day ↘	
		99 Unknown	
5.20	**Did s/he have chest indrawing?**	1 Yes	
		2 No	
		9 Unknown	
5.21	**Did s/he have noisy breathing (grunting or wheezing)? *(DEMONSTRATE)***	1 Yes	
		2 No	
		9 Unknown	
5.22	**Did s/he have grunting when breathed in?**	1 Yes	
		2 No	
		9 Unknown	
5.23	**Did s/he have grunting when breathed out?**	1 Yes	
		2 No	
		9 Unknown	
5.24	**Did s/he have wheezing?**	1 Yes	
		2 No	
		9 Unknown	
5.25	**Did s/he have flaring of the nostrils?**	1 Yes	
		2 No	
		9 Unknown	
5.26	**Did the child experience any convulsions/fits during the illness that led to death?**	1 Yes	
		2 No	
		9 Unknown	
5.27	**Was the child unconscious during the illness that led to death?**	1 Yes	
		2 No	**proceed to 5.29** ↓
		9 Unknown	
5.28	For how long before died s/he became unconcious?	1 Less than 6 hours	
		2 From 6 to 23 hours	
		3 One day and more	
		9 Unknown	
5.29	**Did s/he have a stiff neck?**	1 Yes	
		2 No	
		9 Unknown	
5.30	**<u>ONLY FOR UNDER 2 YEARS OLD</u>: did s/he have a bulging fontanel?**	1 Yes	
		2 No	
		9 Unknown	
5.31	**During the illness that led to death, did s/he have a skin rash?**	1 Yes	
		2 No	**proceed to 5.35** ↓
		9 Unknown	
5.32	From where?	1 Face	
		2 Trunk	
		3 Arms and legs	
		4 Whole body	
		9 Unknown	
5.33	For how long did s/he have the skin rash?	Day ↘	
		99 Unknown	
5.34	Did the rash have blisters containing clear fluid?	1 Yes	
		2 No	
		9 Unknown	

5.35	**During the illness that led to death, did the child become very thin?**	1 Yes	
		2 No	
		9 Unknown	
5.36	**During the illness that led to death, did the child have swollen legs or feet?**	1 Yes	
		2 No	**proceed to 5.38** ↓
		9 Unknown	
5.37	How long (days) did the swelling last?	Week ↘	
		Day ↘	
		99 Unknown	
5.38	**During the illness that led to death, did the child's skin flake off in patches?**	1 Yes	
		2 No	
		9 Unknown	
5.39	**Did the child's hair change in colour to a reddish (or yellowish) colour?**	1 Yes	
		2 No	
		9 Unknown	
5.40	**Did s/he have abdominal distension?**	1 Yes	
		2 No	
		9 Unknown	
5.41	**Did s/he look pale (anaemic)?**	1 Yes	
		2 No	
		9 Unknown	
5.42	**Did s/he have any lumps on the armpit?**	1 Yes	
		2 No	
		9 Unknown	
5.43	**During the illness that led to death, did the child have a whitish rash inside the mouth or on the tongue?**	1 Yes	
		2 No	
		9 Unknown	
5.44	**During the illness that led to death, did s/he bleed from anywhere?**	1 Yes	
		2 No	**proceed to 5.46** ↓
		9 Unknown	
5.45	From where?	↘	
5.46	**Did s/he have areas of skin that were bluish black?**	1 Yes	
		2 No	
		9 Unknown	
	PART 6: ADDITIONAL INFORMATION ABOUT RESPONDENT		
6.1	Age	↘ ..... years	
6.2	Education level	1 Pre-school	
		2 Illiterate	
		3 Primary school	
		4 Secondary school	
		5 High school	
		6 Graduate/Postgraduate	
END OF INTERVIEW ***THANK RESPONDENT FOR THEIR COOPERATION***			

APPENDIX 2

Table A. Agreement between VACoD and MCoD, all other causes

Cause	Agreed n (%)	No agreement n (%)
Childhood-cluster diseases	1 (100)	0 (0)
Hepatitis	1 (100)	0 (0)
Diarrheal	0 (0)	1 (100)
Other respiratory diseases	0 (0)	1 (100)
Skin diseases	0 (0)	1 (100)
Other infectious diseases	1 (50.0)	1 (50.0)
Neuropsychiatric conditions	1 (50.0)	1 (50.0)
Senility	0 (0)	2 (100)

Table B. Cross tabulation of medical and VA diagnoses, all other causes

VACoD	MCoD																	Total
	(2)	(4)	(5)	(8)	(9)	(14)	(15)	(17)	(19)	(20)	(21)	(23)	(24)	(26)	(27)	(29)	(30)	
Tuberculosis (1)	2	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	**3**
HIV/AIDS (2)	**8**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**8**
Diarrheal (3)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0**
Childhood-cluster diseases (4)	-	**1**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**1**
Hepatitis (5)	-	-	**1**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**1**
Other infectious diseases (8)	-	-	-	**1**	1	-	-	-	-	-	-	-	-	-	-	-	-	**2**
Respiratory infections (9)	-	-	-	1	**1**	-	-	-	1	-	-	-	-	-	-	-	-	**3**
Cancer (13)	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	1	-	**3**
Other neoplasms (14)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0**
Diabetes (15)	-	-	-	-	1	-	**3**	-	-	-	-	-	1	1	-	-	-	**6**
Endocrine disorders (16)	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	**1**
Neuropsychiatric conditions (17)	-	-	-	-	-	-	-	**1**	-	-	-	-	1	-	-	-	-	**2**
CVDs (18)	-	-	-	-	2	-	3	-	1	-	-	1	2	-	-	2	-	**11**
COPD (19)	-	-	-	-	2	-	-	-	**4**	1	-	-	-	-	-	-	-	**7**
Asthma (20)	-	-	-	-	3	-	-	-	1	**1**	-	-	-	-	-	1	-	**6**
Other respiratory diseases (21)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0**
Liver diseases (22)	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	**1**
Other digestive diseases (23)	-	-	-	1	-	-	-	-	-	-	-	**3**	1	-	-	1	-	**6**
Genitourinary diseases (24)	-	-	-	-	-	-	-	-	-	-	1	-	2	-	-	-	-	**3**
Skin diseases (25)	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	**1**
Musculoskeletal diseases (26)	-	-	-	-	-	-	-	1	-	-	-	1	-	**1**	-	-	-	**3**
Congenital anomalies (27)	-	-	-	1	1	-	-	-	-	-	-	1	-	-	**2**	-	-	**5**
Senility (28)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0**
Ill-define (29)	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	**2**	-	**4**
Transport accidents (30)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**2**	**2**
Injuries (31)	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	**2**
Total	**10**	**1**	**1**	**7**	**11**	**1**	**7**	**2**	**7**	**2**	**3**	**8**	**7**	**2**	**2**	**8**	**2**	**81**

Table C. All other causes derived from VA by gender, all ages

	Male		Female
DISEASE	**n**	**DISEASE**	**n**
COPD	44	HIV/AIDS	28
Asthma	28	Neuropsychiatric conditions	24
Other digestive diseases	27	Asthma	24
Neuropsychiatric conditions	24	Other digestive diseases	18
Musculoskeletal diseases	24	Musculoskeletal diseases	18
Other infectious diseases	19	Diarrheal	15
Diarrheal	17	Other infectious diseases	12
Hepatitis	15	Genitourinary diseases	12
Genitourinary diseases	14	Congenital anomalies	9
Other respiratory diseases	13	Hepatitis	6
Congenital anomalies	7	Endocrine disorders	6
Endocrine disorders	6	Other respiratory diseases	6
Other neoplasms	4	Dengue	2
Perinatal conditions	3	Perinatal conditions	2
Nutritional conditions	2	Childhood-cluster diseases	1
Childhood-cluster diseases	1	Nutritional conditions	1
Malaria	1	Other neoplasms	1
Dengue	1	Skin diseases	1
Maternal conditions	1		
Skin diseases	1		
Total	252	Total	186

Table D. All other causes derived from VA by gender, 15-59 years

	Male		Female
DISEASE	**n**	**DISEASE**	**n**
Asthma	14	Asthma	5
Hepatitis	11	Musculoskeletal diseases	4
Neuropsychiatric conditions	11	Other respiratory diseases	3
Musculoskeletal diseases	10	Genitourinary diseases	3
Genitourinary diseases	8	Diarrheal	1
Diarrheal	6	Childhood-cluster diseases	1
Other infectious diseases	6	Dengue	1
Other respiratory diseases	4	Other infectious diseases	1
Other neoplasms	3	Endocrine disorders	1
Congenital anomalies	3		
Perinatal conditions	2		
Childhood-cluster diseases	1		
Dengue	1		
Skin diseases	1		
Total	81	Total	20

Table E. All other causes derived from VA by gender, 60 years and above

	Male		Female
DISEASE	**n**	**DISEASE**	**n**
Asthma	14	Asthma	19
Musculoskeletal diseases	14	HIV/AIDS	16
Other infectious diseases	12	Neuropsychiatric conditions	16
Neuropsychiatric conditions	12	Diarrheal	14
Diarrheal	11	Musculoskeletal diseases	13
Other digestive diseases	11	Other digestive diseases	12
Other respiratory diseases	9	Other infectious diseases	11
Endocrine disorders	6	Genitourinary diseases	8
Genitourinary diseases	6	Congenital anomalies	8
Hepatitis	4	Hepatitis	6
Nutritional conditions	2	Endocrine disorders	5
Congenital anomalies	2	Other respiratory diseases	3
Malaria	1	Perinatal conditions	2
Maternal conditions	1	Dengue	1
Other neoplasms	1	Nutritional conditions	1
		Other neoplasms	1
		Skin diseases	1
Total	106	Total	137

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