CHAPTER 4

General Discussion and Conclusions

This final chapter presents a general discussion and conclusions for the thesis covering the three manuscripts in Appendix I. The discussion of this thesis is organized along the line of a structured discussion for scientific papers (Docherty and Smith, 1999). Therefore, this chapter covers the first section with the statement of principal findings and a general discussion of this study. The second section looks at the strengths and weaknesses of this study. The third section covers applicability of the findings and implications for policy recommendations. The final section mentions further research directions.

4.1 Summary of overall finding

Transport accidents were the leading causes of death in the chapter XX: external causes of morbidity and mortality of ICD-10. They were mostly misclassified as causes of death in unspecified event, undetermined intent (Y34) followed by exposure to unspecified factor (X59) in ICD-10 (Chapter XX). After adjusting VR data from the years 1996 to 2009, it was found that transport accident deaths were under-reported two times over. The mean estimated transport accident mortality rate was 34.5 per 100,000 population, and peaked among males aged 20-29 years. The trends and direction of transport accident mortality rates in 2004 to 2009 were divided into nine regions. Five provinces (four in the Central region and one in the North region) had high mortality rate. The lowest mortality rate was in Bangkok, and the increasing trends were found in three provinces in the North region, four provinces in the Central and Eastern region, and five provinces in the South region of Thailand.

4.1.1 Discussion and conclusions

This study focuses on transport accident death data with an emphasis on public health in Thailand. A good classification for transport accident deaths in VR system is essential for addressing the problem and prevention purposes. Many previous studies have focused on the high proportion of ill-defined cause of death codes R00-R99 in VR data which is only one indicator of the quality of causes of death (Mathers *et al*., 2005; Tangcharoensathien *et al*., 2006; Rao *et al*., 2010). With regard to other vague causes of death codes in the results of this thesis, most (38.1%) of misclassified transport accident deaths were assigned as unspecified or undetermined intent codes of external causes of mortality in ICD-10 codes such as X59, Y29, Y34, Y86 (Table 3.1). Most misclassified suicide deaths, 20.3%, were assigned as deaths from unspecified or undetermined intent codes of external causes of mortality in ICD-10 such as X95, Y18, Y19, Y20, Y29, Y34. This information means that the VR data were unreliable for estimating of deaths due to transport accident and suicide which were coded with unknown causes of death for more than 20% of cases (Bhalla *et al*., 2010).

To address the misclassification, the Thai 2005 VA study validated the actual causes of death in VR system but used a small sample size of 2.5% of the VR system and covered nine of 76 provinces in Thailand (11.8%) (Byass, 2010; Rao *et al*., 2010). Thus, statistical methods are necessary to use for estimating the number of deaths from the causes of interest linking the VA data to the VR system and analyzing by various factors (sex, age, province, location of death, ICD-10 code reported). In this current year, several studies used the same methods as this thesis for estimating cause-specific deaths such as liver cancer (Waeto *et al*., 2014) and HIV (Chutinantakul *et al*., 2014b). No studies to date have used these models for estimating the actual number of transport accident deaths.

For the methods used in this thesis, logistic regression model with three variable coverage gave high accuracy for estimating the same number of cause-specific deaths as the VA data with AUC more than 0.9 and good sensitivity for transport accident (73.8%) and suicide (62.0%) deaths. These results were similar to previous studies of HIV deaths (69.3%) (Chutinantakul *et al*., 2014b) and liver cancer deaths (64.0%) (Waeto *et al*., 2014). Whereas, the sensitivity of other accidents (cause-unspecific deaths) from this thesis was lower than the cause-specific deaths. The other accidents group consisted of 13 codes blocks (W00-X59) in the chapter XX of ICD-10 which was classified as non-specific causes of death. This method can exactly allocate deaths into cause-specific groups, while the correctly allocation of deaths into non-specific causes is uncertain.

After adjusting the number of deaths from 1996 to 2009, transport accidents were the leading cause of death in the external causes in ICD-10 (Chapter XX). The estimated number of transport accident deaths was two times higher than the VR report over, similar to the studies by Tangcharoensathien *et al*. (2006) and Porapakkham *et al*. (2010). Considering only the year 2004, the estimated number of transport accident deaths were higher than the VR report 2.1 times, while Ditsuwan *et al*. (2011) reported the number of transport accident deaths 1.8 times higher than VR reported. This difference may result from using different methods.

In previous studies, Thailand was found to have the highest transport accident mortality rates in the South-East Asia region of 25.4 per 100,000 population in 2007 based on the VR system (World Health Organization, 2009b). After adjusting the VR data, our study found that the transport accident mortality rates increased from the reported rates to 34.3 per 100,000 population in 2007 and to 33.0 per 100,000 population in 2008 which was 1.4 times higher than the previous study in 2007, and 1.7 times higher than the world average for middle-income countries in 2008 (World Health Organization, 2009a). In 2004, our study found that the transport accident mortality rate was 35.1 per 100,000 population, whereas Ditsuwan *et al*. (2011) found 40 per 100,000 population. This difference resulted from using different methods. Although, the estimated transport accident mortality rates in our study were found to steadily decrease from 2005 to 2009. But they are still higher than the target mortality rate in Thailand in 2012 (14.15 per 100,000 population) and in 2020 (10.0 per 100,000 population) (Thai Road Foundation and Thailand Accident Research Center, 2011).

Between 2004 to 2009, transport accident mortality rates peaked in males aged 20-29 years, which agreed with study conducted by Sriwattanapongse *et al*. (2013). However, the results differed from studies conducted by Siripanich *et al*. (2009) in 1998 to 2007, Thai Roads Foundation and Thailand Accident Research Center (2011) in 2010 and the global study in 2004 by World Health Organization (2009a) which found the highest deaths were in those aged 15-24 years. A study conducted in Bangladesh from 1998 to 2005 by Anjuman *et al*. (2007) reported that the highest deaths were found among those aged 16-30 years. The global survey in 2008 (World Health Organization, 2013) showed that transport accident deaths were highest among

15-24 year olds in low- and middle-income countries. These findings contrast with death rates in South Africa in the years 2001 to 2006 where death rates were highest in the 35-49 years age group (Lehohla, 2009). We found that males died from transport accident deaths at four times the rate of females, agreeing with the study conducted by the Thai Roads Foundation and Thailand Accident Research Center (2011) and Yiengprugsawan *et al*. (2014). This is in contrast to Lehohla (2009) who reported that transport accident death rate in the years 2001 to 2006 in males was 2.9 times higher than in females. Those differences significantly affect mortality rates among transport accident deaths in both gender and all age groups. Our key finding is that, transport accident deaths were highest among young people, particularly males, relating to at risk groups (aged 16-29 years) and more common risk behaviors for transport accidents including driving when fatigued, unprotected riding, drink driving (Pitaktong *et al*., 2004; Nakahara *et al*., 2005; World Health Organization, 2006, Yiengprugsawan *et al*., 2012).

Thailand in 2004 to 2009, transport accident deaths have remained a major problem in regards to both severity and the direction of mortality rates. Our study divided Thailand's 76 provinces into nine patterns of transport accident mortality rates. A steady decrease transport accident mortality rates was found in 39 provinces and 25 provinces had constant mortality rates. The decreasing trend of transport accident mortality rates may be coming from Government policy which has placed high emphasis on addressing these problems since 2003 (Tanaboriboon and Satiennam, 2005). Our finding of the lowest of transport accident mortality rate in Bangkok may be related to law enforcement of safety behaviors and a result of inequalities in transport resource allocation between the capital city and other provinces in Thailand

(Thai Road Foundation and Thailand Accident Research Center, 2011). The provinces in low mortality rate groups had 1.1 to 1.9 times lower rates than the overall mean. Whereas, the medium and high mortality rates groups had rates 1.1 to 1.5 times higher than the overall mean. However, all patterns of transport accident mortality rates were higher than the Thai target rates for 2012 by 1.3 to 3.7 times and for 2020 by 1.8 to 5.3 times. Our findings suggest that, 12 provinces with increasing trends in transport accident mortality rates are major problems which need to be addressed urgently. In particular, it is evident that the sharply increasing trends of transport accident mortality in three provinces in the South (Narathiwat, Pattani and Yala) might due to the fact that there are more holidays in this area such as New Year, Songkran festival, Chinese New Year than other provinces in Thailand. Especially, the Hari Raya Idilfitri festive seasons and Hajj pilgrimage cause a mass movement of Muslims from one place to other places during the periods (Al-Harthi and Al-Harbi, 2001; Kareem, 2003).

4.2. The strengths and weaknesses of this study

4.2.1 Strengths of the study

The main strength of this study is that it allows a robust estimate of the number of transport accident deaths in Thailand, essential information for health planning. Applying several statistical methods together allows available reliable data such as the VA data to improve the quality of VR data.

4.2.2 Limitations

There are some limitations in this study. First, the sample survey design of the VA study was inefficient for two reasons. Firstly, the outcome of the VA study was the true cause of death of transport accident death, and by far the strongest predictors of this outcome are the reported causes and place of death. Neither of these variables was used in the stratification. Instead, only the total number of deaths in the district (a relatively weak predictor of cause of death) was used. So, the efficiency of sample survey design can be improved by stratifying on variables that are good predictors of the outcome. The second reason is that the VA study was based on the probability-proportional-to-size (PPS) sample and an opportunity was lost to improve efficiency by focusing on deaths with poorly predictable outcomes such as ill-defined or unknown and unspecified septicemia, rather than those with highly predictable outcomes such as transport accident and suicide deaths. A PPS sample is just a random sample from a population, which can be much less efficient than selecting levels of the main predictor in groups with similar standard errors (Lumley, 2010).

4.3. Applicability of the findings and implications for policy recommendations

Our methods are appropriate for estimating the number of deaths which were misclassified for cause of death.

As well, the information from a cross-tabulation presented the association of codes between VA and VR causes of deaths. This information showed patterns of misclassification of routine reported cause of deaths in VR system which could be associated with transport accident deaths. Agencies should be cautious when issued cause of death in the VR system.

The finding of variations in patterns of transport accident mortality rates in Thailand by gender-age group and geographic region in each year can be used for assessing inequality in health and transport accident death problems in each region-year group. This can lead to increased effectiveness in solving and reducing the problem of transport accident mortality in Thailand.

4.4. Further study

The results of separating the patterns of transport accident mortality rates into nine region-year groups should be used for forecasting transport accident mortality in Thailand. The methods developed in this study should also be used for analysis of other cause of death groups and to compare leading causes of death with other studies (Porapakkham *et al*., 2010).

"Data becomes information when it's organized; information becomes knowledge when it is placed in actionable context. Without context, there is little value"

Kent Greenes, CKO, SAIC Consulting