# Trend of mortality rates for ill-defined in 2000-2009

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**Abstract**

This study aimed to investigate the trends of ill-defined death rate and identify factors associated with ill-defined death rate in Thailand from 2000 to 2009. Reported death data were obtained from the Bureau of Health Policy and Strategy, Thai Ministry of Public Health. Ill-defined death rates separated by year, geographic region, gender, and age group were calculated. Log linear model was used to identify factors associated with ill-defined death rate. During the period from 2000-2009, 1,441,347 ill-defined deaths were reported. Of these, 721,495 (50.1%) were females. The overall ill-defined death rate per 100,000 population was 222.7. Gender, age group, year and regions were statistically significantly associated with ill-defined death rate. Males had higher ill-defined death rate than females. Age group 10-19 years had the lowest ill-defined death rate. Ill-defined death rate in Bangkok was lower than other regions. Ill-defined death rate had a slightly decreasing trends as we found that death rate and those in year 2008 and 2009 were lower than average. In conclusion, ill-defined mortality trend in Thailand has not much changed and much higher than other countries around the world. Therefore the utility of the mortality data still has huge limitations.

**Keywords:** Mortality rate, retrospective study, Ill-defined death, Thailand

**Introduction**

One of the most important issues of the utilization of mortality data is the high percent of deaths coded as ill-defined. The higher percent of deaths coded as ill-defined indicates the lower of the reliability and accuracy of cause-specific mortality data (Mathers et al, 2005, Lozano et al, 2001). This problem is common in developing countries with the percent varies considerably across countries ranged from 19% in Albania to 49% in Thailand (Mathers et al, 2005). In contrast, in developed countries the percent of ill-defined most were less than 4% such as 0.8% in Cuba year 2004, 0.7% in Australia year 2003, 1.2% in United States year 2002, 1.4% in Canada year 2003, 2.8% in Sweden year 2002 and 3.4% in Japan year 2004 (Siejel, 2011). The trend of ill-defined in most developed countries declined, especially it dropped for 2.5% in England and Wales by year 2000 (Griffiths and Brock, 2003), 3% in Japan and Spain and 6% in France by year 2004 (Eileen et al, 2010). Most of these decreasing trend resulted from the decreased use of senility code. In most developing countries, ill-defined death rate had a increasing trend. The trend drop from 13.8% in 1997 to 10.1% in 2007 in South Africa (Bradshaw et al, 2010) whereas the trend increased from 0.8% to 4.0 % in males and from 0.8% to 5.5 % in females in year 1989-2000 in Russia (Gavrilova et al, 2005). Ill-defined deaths in Sri Lanka and Thailand were reported for

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more than 40% (Mathers et al, 2005). Incorrect or systematic biases in diagnosis, incorrect or incomplete death certificates, misinterpretation of International Classification of Diseases 10th (ICD-10) rules for selection of the underlying cause, and variations in the use of coding categories for unknown and ill-defined causes cause the increasing trend of ill-defined (WHO, 2012). Coding practices also cause of inaccuracy of mortality data, particularly in the use of codes for "ill-defined" and "unknown cause of dead" (WHO, 2010a). Thus, the use of codes for ill-defined and unknown causes must be taken into account to validly compare mortality rates for specific causes across countries (WHO, 2004). Death certificate in Thailand has the problem about incompleteness and inaccuracy of the mortality data due to ill-defined or unknown cause of dead. There was 40% of death that defined as unclear or unknown each year in period of 2005-2008 (Ministry of Public Health, 2002). Therefore, the incompleteness and inaccuracy of mortality data affect the uncertain mortality statistics. In the other word, it leads to overestimate for some diseases and underestimate for other diseases. This study aimed to examine the distribution and trends of "ill-defined" deaths in Thailand under period of 2000 to 2009.

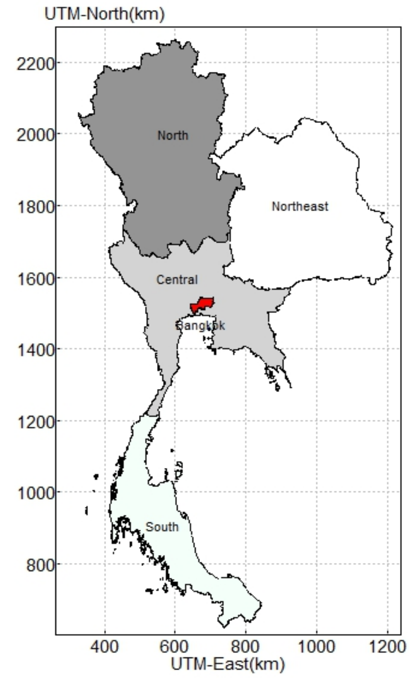


**Figure 1** Region map of Thailand

**Methodology**

**Data sources**

Ill-defined causes of deaths were based on information from death certificate for year 2000-2009, available from the Bureau of Health Policy and Strategy, Thai Ministry of Public Health. Ill-defined causes are defined as deaths coded R00-R99 from International Classification of Diseases, $10^{th}$ revision (ICD-10) (WHO, 2010b). Projected populations at risk by gender, age group, year and province were obtained from the Institute of Population Studies, Mahidol University.

The determinants of this study are year, geographic region, gender, and age group. There are 5 regions: Bangkok, Central, Northeastern, Northern and Southern as shown in figure 1. Age was divided into nine groups: 0-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, and 80 and over. The outcome is ill-defined death rates (deaths per 100,000 population).

Suppose that $D_{ijkm}$ is a random variable denoted number of ill-defined deaths in year $i$, region $j$, age-group *k*, and gender *m* in estimated population $P_{ijkm}$. Thus the mortality rate can be computed by

$$y_{ijkm} = \frac{KD_{ijkm}}{P_{ijkm}} \qquad (1)$$

where $Y_{ijkm}$ is ill-defined mortality rate for year *i*, region *j*, age-group *k*, and gender *m*, *K* is a scaling constant such as 1,000, 10,000 or 100,000.

**Multiple linear regression**

Since death rate for ill-defined was considered as a continuous outcome and the determinants comprise gender, age group, region and year. Multiple linear regression analysis was the appropriate method for statistical modeling. The model takes the form

$$y_{ijkm} = \mu + \alpha_i + \beta_j + \gamma_k + \delta_m \qquad (2)$$

when $y_{ijkm}$ is the ill-defined death rate, $\mu$ is the overall effect, $\alpha_i$ is the effect of year, $\beta_j$ is the effect of region, $\gamma_k$ is the effect of age group, and $\delta_m$ is the effect of gender. The model is fitted to the data using least squares, which minimizes the sum of squares of the residuals. Linear regression analysis resets four assumptions including the association is linear, the variability of the error (in the outcome variable) is uniform and these errors are normal distributed. If these assumptions were not met, the data may need to be transformed. In this study, the death rates outcome was transformed by taking natural logarithms. The estimated additive model for death rates takes the form

$$\ln(y_{ijkm}) = \mu + \alpha_i + \beta_j + \gamma_k + \delta_m \qquad (3)$$

the $y_{ijkm}$ is the death rate, $\mu$ is the overall effect, $\alpha_i$ is the effect of year, $\beta_j$ is the effect of region, $\gamma_k$ is the effect of age group, and $\delta_m$ is the effect of gender. All statistical modeling and graphical displays were performed using R statistical software (R Development Core Team, 2012).

**Results**

There were 1,441,347 deaths reported as ill-defined during 10 year period (2000-2009) in Thailand. Among these, 719,852 (49.9%) were males. Ill-defined deaths in 2000 were reported for 41% and 38% in 2009. The highest percent of ill-defined death was in age group 80 years and over (38.3%). The overall ill-defined death rate per 100,000 population was 222.7.

Figure 2 shows the trend of mortality rates by gender, age group, year and region. The results showed that ill-defined mortality increases with age for both sexes. Age group 80 years and over had the highest ill-defined mortality rate whereas the lowest mortality rate was found in age group 10-19 years in all years and regions. Ill-defined mortality had a slightly decreasing trend from 2000-2003 in both sexes. The highest ill-defined mortality rate was found in the Northeast region whereas the lowest mortality rate was found in Bangkok.

Figure 3 shows the standardized residuals plot after fitting linear regression model (3) to the ill-defined death rate. R-square from linear regression model was 98.5%. It indicates that linear model had a good fit.

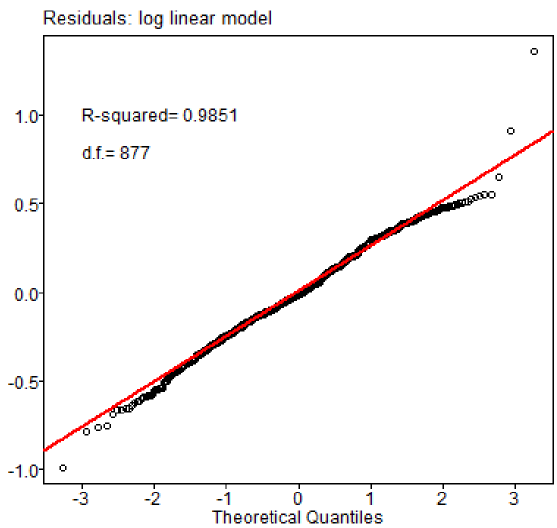


**Figure 3** Residuals plot for log linear model

Figure 4 shows the confidence interval of death rates for ill-defined from multiple regression model. Gender, age group, year and regions were statistically significantly associated with ill-defined death rates. Males (5.15, 95% confidence intervals (CI) =5.13-5.17) had the higher death rate than females (4.56, 95%CI=4.54-4.58). Ill-defined death rate in Bangkok (4.38, 95%CI=4.34-4.41) was lower than of other regions. Death rate in Northern (5.06, 95%CI=5.02-5.09), Northeastern (4.96, 95%CI=4.93-5.00) and Southern (4.98, 95%CI=4.95-5.02) were higher than average death rate. Ill-defined death rate in year 2000 (5.15, 95%CI=5.09-5.20), 2001 (4.96, 95%CI=4.91-5.02) and 2002 (4.81, 95%CI=4.76-4.86) were higher than average whereas death rates in 2007 (4.75, 95%CI=4.70-4.80), 2008 (4.71, 95%CI=4.66-4.73) and 2009 (4.68, 95%CI=4.63-4.73) were lower than average. Figure 5 shows ill-defined death rates by age group 10-19 years (2.11, 95%CI=2.06-2.16) had lowest ill-defined death rate. Death rate in age group 60-69 years (6.08, 95%CI=6.03-6.13), 70-79 (7.48, 95%CI=7.43-7.53) and 80 and over (8.96, 95%CI=8.91-9.01) were higher than average death rate whereas death rates in age group 0-9 years (3.01, 95%CI=2.96-3.06), 20-29 (3.17, 95%CI=3.11-3.22), 30-39 (3.79, 95%CI=3.74-3.84) and 40-49 (4.20, 95%CI=4.15-4.25) were lower than average.

**Discussion**

Ill-defined death rate in this study dropped from 41% in 2000 to 31% in 2009. A slightly decreasing trend of ill-defined death rate found in this study is also consistent with the result from Sri Lanka (Bulletin of the world health organization, 2005). However ill-defined death rate in Thailand is higher than many other countries (Siejel, 2011; Griffiths and Brock, 2003; Eileen et al, 2010; Bradshaw et al, 2010; Gavrilova et al, 2005). This reporting the cause of death is not completed that Thailand is in the group of countries with the highest percent of deaths from ill-defined (Bulletin of the world health organization, 2005).

Gender, age group, year and region were associated with ill-defined death rate. This study found higher reporting of ill-defined death rates among male than female. Griffiths and Brock also found the similar result (Griffiths and Brock, 2003).

Ill-defined death increased with age. Then result support the finding by (Amico el at, 1999). The mortality rates slightly decrease in the recent year.

Thailand is in the group of countries with the highest ill-defined death rate in the world (Bulletin of the world health organization, 2005). Bangkok had the lowest ill-defined death rate. This can be explained that ill-defined code that to be use in rural area where most of deaths occur outside hospital.

**Conclusion**

In conclusion, ill-defined mortality trend in Thailand has not much changed and it much higher than other countries around the world. Therefore the utility at the mortality data still has huge limitations.

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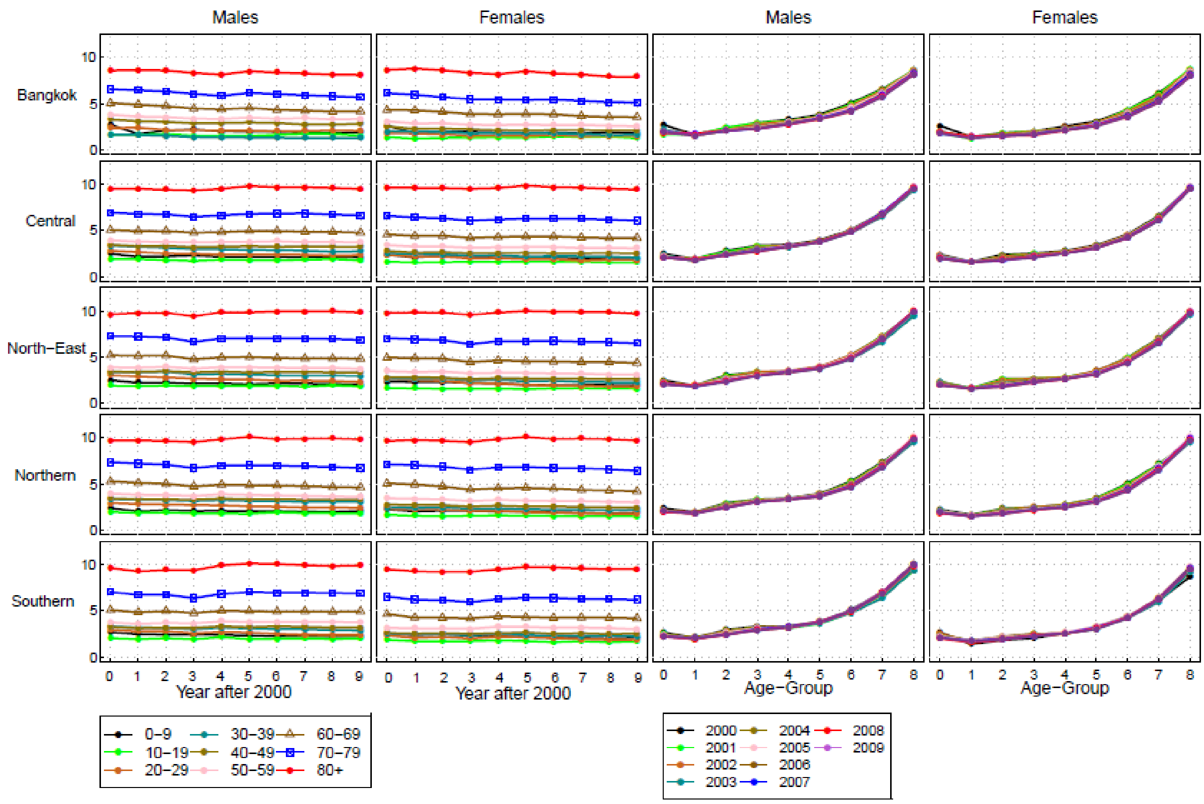


**Figure 2** Death rates (per 100,000 population) of ill-defined by gender, age group, year and region

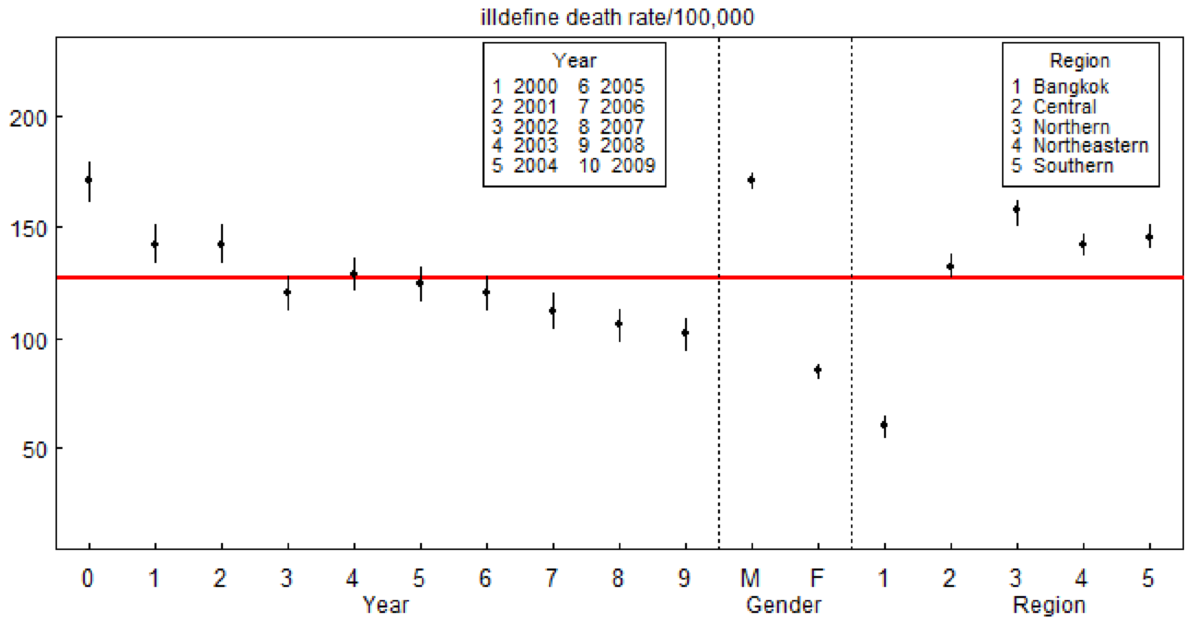


**Figure 4** 95% Confidence intervals plot for year gender and region of ill-defined death rate per 100,000 population during the period 2000-2009

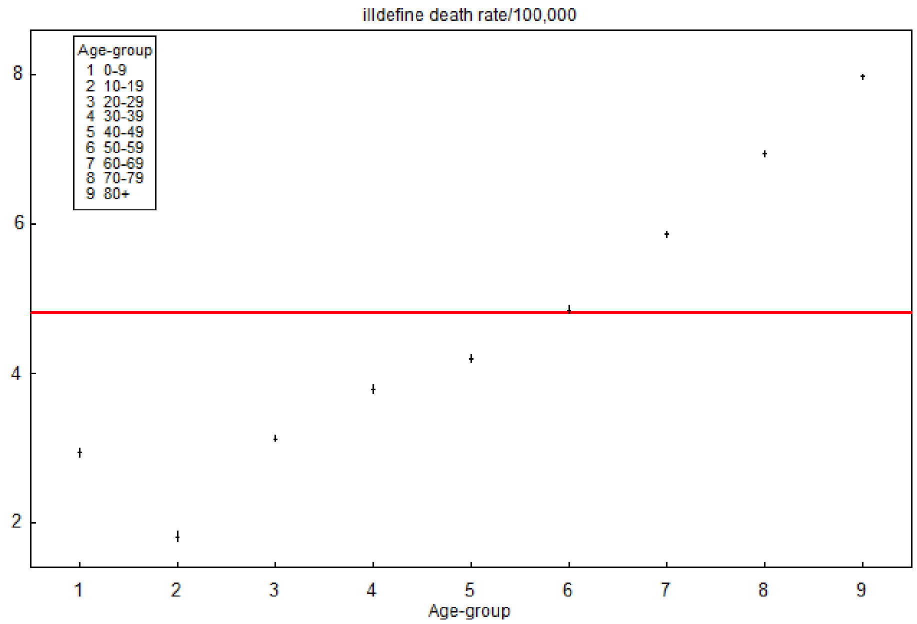


**Figure 5** 95% Confidence intervals plot for age-group of ill-defined death rate per 100,000 population during the period 2000-2009