ORIGINAL PAPER

Underlying Cause of Death Recorded during 2013 to 2015 at a Tertiary General Hospital in Vientiane Capital, Lao PDR

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ABSTRACT

In Lao People's Democratic Republic (Lao PDR), the cause of death is not registered in death reports. As a result, the government cannot produce official reports that show mortality according to cause of death. This study aimed to report the underlying cause of death in a tertiary general hospital (Mittaphab Hospital) in Vientiane capital. Mittaphab hospital is a governmental teaching hospital with 300 beds for inpatient services specialized in orthopedics, neurology, and hemodialysis. Since a children hospital exists beside Mittaphab Hospital, severe pediatric cases are referred to the child hospital. HIV-positive cases and sputum positive tuberculosis are also transferred to the other specialized hospitals. All of the subjects in this study were patients who died in 2013–2015 at Mittaphab Hospital. Paper-based medical charts were examined by a medical doctor and staff from the medical records division. This chart review revealed that 1,509 patients (1,006 males and 503 females) died in this hospital during the study period. Of those, the number of patients aged <20 years and >80 years was small (6.2% and 7.7%, respectively). The most common underlying causes were injury (29.7%), cerebrovascular diseases (26.8%), renal disease (13.3%), infectious diseases (12.4%), and malignant neoplasm including brain tumor (4.8%). Among those aged 20–59 years, these percentages were 37.9%, 23.7%, 12.3%, 10.2%, and 5.0%, respectively. Although the patients visiting the hospital did not represent the whole population, the distribution of cause of death in the hospital was the only available information reported in Lao PDR.

Key Words: underlying cause of death, hospital statistics, Lao PDR

INTRODUCTION

The information on mortality constitutes the basis of health policy and is essential for any country. The reporting system and its accuracy substantially vary among countries in the world. The reporting system with a higher accuracy needs larger budget; hence, establishing an accurate system is not easy, especially in low-income countries. Although the worldwide mortality rates have been reported in various data books, there were many countries where such data were not actually available.[1,2] In fact, data for some countries were actually the estimates derived from

the average figures reported by the neighboring countries.[3]

In general, the causes of death are classified by the WHO International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) which contains 22 chapters covering 2,046 categories of diseases.[4,5] When there are two or more causes of death, one is selected for coding and reporting purposes. It is called underlying cause of death, defined by the WHO as "the disease or injury which initiated the train of morbidity events leading directly to death; or the circumstances of the accident or violence which produced the fatal injury." Based on this concept, a set of rules are used for coding the underlying cause of death.[6] Since deaths occur where medical professionals and technologies are unavailable, additional ways to determine the cause of death such as verbal autopsy, are needed.[7] When in-hospital mortality in developing countries is described, the classification is heavily influenced by the diagnostic methods and processes at each hospital. Therefore, the classification has to be modified according to the level of hospitals.[8-11]

Lao People's Democratic Republic (Lao PDR) is a land-locked country with a population of 6.54 million. The country has 18 provinces, 148 districts, and 8,573 villages. According to the government estimates, the mortality was 6.3 deaths per 1,000 in 2010.[12] Although a medical university, University of Health Science, in Vientiane Capital has been supplying the country with medical professionals, the number of medical personnel was insufficient (41 doctors and 129 nurses/midwives per 100,000 population) in 2015, according to government reports. In addition, the difference in the distribution of medical professionals between urban and rural is very large.[12,13] Therefore, the government cannot request underlying causes of death to be included in the mortality reports, as this would add to the medical personnel's heavy workload. As a result, the government cannot produce official reports stating the mortality rate of each cause of death. On the other hand, several hospitals have been recording the cause of death for patients. This information is very important to estimate the percentages of each cause in the whole country. This study was conducted to report the causes of death among patients at Mittaphab Hospital in Vientiane Capital, a tertiary hospital that has an ability to identify causes of death for dead patients.

MATERIALS AND METHODS

Characteristics of Mittaphab Hospital

In Lao PDR, there are 5 central general hospitals and 3 special hospitals as tertiary/secondary hospitals. Mittaphab hospital, established in 1988, is one of the 5 general hospitals located in Vientiane capital. It is a governmental teaching hospital with 300 beds for inpatient services including an emergency room, which prioritizes orthopedics, neurology, and hemodialysis cases. The hemodialysis machine was introduced in 1990, and about 13 machines were functional as of October 2016. The medical staff consisted of 103 medical doctors, 225 nurses, and 22 midwives as of 2015. The hospital had 13 operation rooms, one computer tomography (CT) unit introduced in 2006, and one magnetic resonance imaging (MRI) unit introduced in 2015. As for laboratory tests, CEA, PSA, HCG, and AFP were available. Department of obstetrics and gynecology had 15 beds with 1,314 childbirths in 2014. Since a children hospital exists beside Mittaphab Hospital, severe pediatric cases are referred to the child hospital. HIV-positive cases and sputum positive tuberculosis are also transferred to the other specialized hospitals.

Subjects

Subjects were patients who died at Mittaphab Hospital between January 2013 and December

2015 (489 in 2013, 475 in 2014, and 545 in 2015; in total, 1,509). Discharge due to death was recorded as being within the same month of admission or the following month for the 1,476 cases out of 1,509 cases.

Data collection

Mittaphab Hospital uses paper-based medical charts, but routinely makes summary tables on selected items for administrative purposes. The data for this study were provided on an EXCEL spread sheet that summarized the information in medical records. The data were entered by a medical doctor and a few staff of medical records division. Patients' name, address, date of birth, and date of death were not included on the sheet, while year and month of admission and death were entered. The identification numbers linked to the original medical charts were kept at Mittaphab Hospital.

Classification of cause

Underlying cause of death was classified based on ICD-10. Since the availability of clinical information and data for time of diagnosis were limited on the medical charts, the underlying cause of death was unclear in many cases. When two or more causes were described, the underlying cause was selected in the order of injury, cancer, specified blood disease (aplastic anemia, idiopathic thrombopenia, and thalassemia), apoplexy (hemorrhage, infarction, and unspecified), specific infectious disease (tuberculosis, dengue fever, malaria, leptospirosis, meningitis, and abscess), myocardial infarction, specific serious conditions due to diabetes mellitus (ketoacidosis, hyperosmolar hyperglycemic syndrome, and hypoglycemia), liver cirrhosis, pneumonia, sepsis, chronic renal failure, gastrointestinal bleeding, acute kidney injury, heart failure, unspecified diabetes mellitus, hypertension.

Statistical methods

Confidence intervals (CI) of percentages were calculated based on a binomial distribution. The proportions were tested by a Fisher's exact test. The calculations were conducted by STATA version 11.0 (StataCorp. College Station, TX, USA).

Ethical issues

The data was anonymous, and the permission of Mittaphab Hospital was obtained for this analysis. This study was approved by Ethics Committee at Nagoya University Graduate School of Medicine (approval number 8318).

RESULTS

Characteristics of subjects

The study subjects were 1,006 males and 503 females; 496 cases in 2013, 486 cases in 2014 cases, and 527 cases in 2015. As shown in Table 1, the number of children aged less than 10 years were 7; the youngest was 3 months old, there were 2 children aged two years, 1 child aged three years, 1 child aged four years, and 2 children aged five years. Death among those aged 50–59 years were more common than that of other age groups. Those aged 80 years and older were 7.7%. The majority (68.7%) lived in Vientiane Capital, and those from the closest province, Vientiane Province, was 20.5%.

Table 1 Characteristics of died cases in Mittaphab Hospital in 2013–15

Characteristics	Males N (%)	Females N (%)	Total N (%)
Total	1,006 (100)	503 (100)	1,509 (100)
Age at visit/admission			
0–9	3 (0.3)	4 (0.8)	7 (0.5)
10–19	57 (5.7)	29 (5.8)	86 (5.7)
20–29	149 (14.8)	34 (6.8)	183 (12.1)
30–39	127 (12.6)	39 (7.8)	166 (11.0)
40–49	134 (13.3)	67 (13.3)	201 (13.3)
50–59	199 (19.8)	108 (21.5)	307 (20.3)
60–69	151 (15.0)	95 (18.9)	246 (16.3)
70–79	122 (12.2)	73 (14.5)	195 (12.9)
80–	63 (6.3)	53 (10.5)	116 (7.7)
Unknown	1 (0.1)	1 (0.2)	2 (0.1)
Residency			
Vientiane Capital	693 (69.2)	343 (68.2)	1,036 (68.7)
Vientiane Province	130 (12.9)	82 (16.3)	212 (14.0)
The others	183 (18.2)	78 (15.5)	261 (17.3)
Year of death			
2013	329 (32.7)	167 (33.2)	496 (32.9)
2014	317 (31.5)	169 (33.6)	486 (32.2)
2015	360 (35.8)	167 (33.2)	527 (34.9)

Underlying causes of death among the subjects of the study

Table 2 shows the underlying causes of death according to the selection rule described in the Materials and Methods section. The order of disease category is the same, excluding "others" and some of the subcategories that were unspecific.

Injury/suicide/intoxication including traffic accidents, accidental injuries, suicide, and homicide, was the most frequent; 29.7% (95%CI, 27.4–32.1%). It was significantly (p<0.001) higher in males (36.5%, 95%CI 33.5–39.5%) than in females (16.1%, 95%CI 13.0–19.6%). Since no information was available for the reason of bleeding (n=17) and hypovolemic shock (n=3) in Table 3, those were not included here. Malignant neoplasm including brain tumor was 72 (4.8%, 95% CI 3.8–6.0); 4.6% (95% CI 3.4–6.1) in males and 5.2% (95% CI 3.4–7.5) in females. The most common cause of death was liver cancer (n=23), followed by brain tumor (n=20), leukemia (n=7), and stomach cancer (n=4). There were no cases with cervical cancer, but one case was with "pelvic tumor". Cerebrovascular disease was 26.8% (95%CI, 24.6–29.2%). Females had a significantly (p=0.003) higher percentage than males. Hemorrhage (20.7%, 95%CI 18.7–22.8%) was more frequent than infarction (5.5%, 95% CI 4.4–6.8%). Infectious diseases excluding hepatitis were 12.4 (95%CI 10.8–14.2%). It was significantly (p=0.002) higher in females (16.3%, 95%CI 13.2–19.8%) than in males (10.4%, 95%CI 8.6–12.5%). As mentioned above, patients diagnosed with HIV/AIDS and tuberculosis were sent to specialized facilities; however, tuberculosis was listed as a cause of death among 5 males and 3 females. There were 3 males and 1 female with dengue fever, 1 male with malaria, 2 males with leptospirosis, 5 males and

Table 2 Main underlying cause of death at Mittapab Hospital in 2013–15

Diagnosis	Males	Females	Total
	N (%)	N (%)	N (%)
Injury	**367 (36.5)**	**81 (16.1)**	**448 (29.7)** ***
Head injury	323 (32.1)	64 (12.7)	387 (25.6) ***
Other sites[*1]	33 (3.3)	14 (0.3)	47 (3.1)
Suicide/intoxication[*2]	11 (1.1)	3 (0.6)	14 (0.9)
Malignant neoplasm	**46 (4.6)**	**26 (5.2)**	**72 (4.8)**
Liver	19 (1.9)	4 (0.8)	23 (1.5)
Brain[*3]	9 (0.9)	11 (2.2)	20 (1.3)
Leukemia	4 (0.4)	3 (0.6)	7 (0.5)
Stomach	2 (0.2)	2 (0.4)	4 (0.3)
Lymphoma	2 (0.2)	1 (0.2)	3 (0.2)
Gall bladder	1 (0.1)	1 (0.2)	2 (0.1)
Bile duct	1 (0.1)	1 (0.2)	2 (0.1)
Lung	2 (0.2)	0 (0.0)	2 (0.1)
Colorectum	2 (0.2)	0 (0.0)	2 (0.1)
Others[*4]	3 (0.3)	2 (0.4)	5 (0.3)
Unknown	1 (0.1)	1 (0.2)	2 (0.1)
Blood disease[*5]	**4 (0.4)**	**7 (1.4)**	**11 (0.7)**
Cerebrovascular disease[*6]	**245 (24.4)**	**160 (31.8)**	**405 (26.8)** **
Hemorrhage	195 (19.4)	117 (23.3)	312 (20.7)
Infarction	44 (4.4)	39 (7.8)	83 (5.5) **
Infectious disease[*7]	**105 (10.4)**	**82 (16.3)**	**187 (12.4)** **
Tuberculosis	5 (0.5)	3 (0.6)	8 (0.5)
Pneumonia	20 (2.0)	12 (2.4)	32 (2.1)
Sepsis	46 (4.6)	49 (9.7)	95 (6.3) ***
Heart disease[*8]	**36 (3.6)**	**17 (3.4)**	**53 (3.5)**
MI	15 (1.5)	7 (1.4)	22 (1.5)
Heart failure	17 (1.7)	8 (1.6)	25 (1.7)
Diabetes mellitus[*6]	**9 (0.9)**	**13 (2.6)**	**22 (1.5)** *
DKA/HHS/coma	3 (0.3)	5 (1.0)	8 (0.5)
Hypoglycemia	3 (0.3)	5 (1.0)	8 (0.5)
Cirrhosis/hepatitis	**31 (3.1)**	**10 (2.0)**	**41 (2.7)**
Renal disease[*9]	**121 (12.0)**	**79 (15.7)**	**200 (13.3)** *
CKD/ESRD	113 (11.2)	76 (15.1)	189 (12.5) *
Others	**43 (4.3)**	**28 (5.6)**	**71 (4.7)**
Total	1,006 (100)	503 (100)	1,509 (100)

Statistically signifiant difference between males and females (*p<0.05, **p<0.01, and ***p<0.001).
[*1]Includes 2 with suicide, 9 with intoxication, and 2 gunshots, [*2]includes 2 with electic shock, 1 with burn, and 1 with drowning, [*3]includes brain tumor, [*4]includes multiple myeloma (one male), cancer of the nasal sinus (one female), the thyroid (one male), the pelvic (one female), and the prostate (one male), [*5]includes 4 appastic anemia, 4 idiopathic thrombopenic purpura, and 3 thalassemia. [*6]includes type unspecified, [*7]includes the other types infectious diseases, [*8]includes the other types of heart diseases, [*9]includes 10 acute kidney injury and 1 nephrosis. CKD: chronic kidney diasese, DKA: diabetic ketoacidosis, ESRD: end-stage renal disease, HHS: hyperosmolar hyperglycemic syndrome, MI: myocardial infarction

Table 3 Specific underlying cause of death among 72 cases from "others" in Table 2

Diagnosis	Males	Females	Total
	N (%)*	N (%)*	N (%)*
Bleeding	12 (1.2)	5 (1.0)	17 (1.1)
Internal hemorrhage	8 (0.8)	0 (0.0)	8 (0.5)
BI bleeding	3 (0.3)	3 (0.6)	6 (0.4)
Bleeding unspeficied	1 (0.1)	2 (0.4)	3 (0.2)
Hypovolemic shock	1 (0.1)	2 (0.4)	3 (0.2)
SLE	6 (0.6)	2 (0.4)	8 (0.5)
Hemothorax	3 (0.3)	1 (0.2)	4 (0.3)
Asthma	2 (0.2)	2 (0.4)	4 (0.3)
COPD	3 (0.3)	0 (0.0)	3 (0.2)
Gout	3 (0.3)	0 (0.0)	3 (0.2)
Coma unspeficied	2 (0.2)	0 (0.0)	2 (0.1)
Miscellanous	11 (1.1)	17 (3.4)	28 (1.9)

* Calculated for 1,006 males, 506 females, and 1,509 both cases, respectively.
COPD: chronic obstractuve pulmonary disease, GI: gastrointestinal, SLE: systemic lupus erthematosis

1 female with meningitis, and 4 males and 1 female with abscess. Myocardial infarction deaths were found in 15 males and 7 females. Chronic kidney disease was the cause of death in 189 (12.5%, 95% CI 10.9–14.3) cases. Table 3 shows specific underlying causes of death among 72 cases that were classified into the category of "Others" in Table 2.

Underlying cause of death according to age at death

Table 4 shows main underlying causes of death according to age group. Among those aged 10–19 years, the great majority of the deaths were due to injury (68.6%, 95% CI 57.7–78.2). Three cancer deaths were all from brain tumor. Among those aged 20 to 59 years, 325 (37.9%, 95%CI 34.7–41.3) died from injury including 287 head injuries, 203 (23.7%, 95%CI 20.9–26.7%) from cerebrovascular disease including 170 hemorrhages and 28 infarctions, and 105 (12.3%, 95%CI 10.1–14.6%) from renal disease including 97 end stage renal disease (ESRD), and 87 (10.2%, 95%CI 8.2–12.4%) from infectious diseases, and 43 (5.0%, 95%CI 3.7–6.7%) from malignant neoplasms including 13 liver cancers and 13 brain tumors. Among the elderly aged 60 years or older, cerebrovascular disease (35.2%, 95%CI 31.2–39.3%) was the most common cause of death.

Listed causes/complications of death

Information on the possible causes/complications of death were collected from medical charts. The collected were 2,623 in total; 651 cases (43.1%) with one cause, 664 cases (44.0%) with two causes, and 194 cases (12.9%) with three or more causes/complications. Since the underlying cause of death were selected based on the rule described in Materials and Methods, the diseases/conditions with lower priority were not counted in Tables 2 to 4. Accordingly, the listed common causes including the underlying causes were counted. Hypertension was listed in 93 cases (6.2%, 95%CI 5.0–7.5%), diabetes in 93 cases (6.2%, 95%CI 5.0–7.5%), chronic kidney disease/ESRD/acute kidney injury/nephrosis in 222 cases (14.7%, 95%CI 13.0–16.6%), liver cirrhosis/hepatitis in 44 cases (2.9%, 95%CI 2.1–3.9%), and sepsis/pneumonia in 198 cases (13.1%, 95%CI 11.5–14.9%).

Table 4 Main underlying cause of death according to age group at Mittapab Hospital in 2013–15

Diagnosis	Males	Females	Total
	N (%)	N (%)	N (%)
10–19 years			
Injury	45 (78.9)	14 (48.3)	59 (68.6)
Malignant neoplasm	2 (3.5)	1 (3.4)	3 (3.5)
Blood disease	0 (0.0)	2 (6.9)	2 (2.3)
Cerebrovascular	0 (0.0)	5 (17.2)	5 (5.8)
Infectious disease	4 (7.0)	3 (10.3)	7 (8.1)
Heart disease	1 (1.8)	0 (0.0)	1 (1.2)
Diabetes mellitus	1 (1.8)	0 (0.0)	1 (1.2)
Cirrhosis/hepatitis	1 (1.8)	0 (0.0)	1 (1.2)
Renal disease	3 (5.3)	0 (0.0)	3 (3.5)
Others	0 (0.0)	4 (13.8)	4 (4.7)
Total	57 (100)	29 (100)	86 (100)
20–59 years			
Injury	279 (45.8)	46 (18.5)	325 (37.9)
Malignant neoplasm	23 (3.8)	20 (8.1)	43 (5.0)
Blood disease	4 (0.7)	5 (2.0)	9 (1.1)
Cerebrovascular disease	131 (21.5)	72 (29.0)	203 (23.7)
Infectious disease	52 (8.5)	35 (14.1)	87 (10.2)
Heart disease	10 (1.6)	7 (2.8)	17 (2.0)
Diabetes mellitus	4 (0.7)	6 (2.4)	10 (1.2)
Cirrhosis/hepatitis	13 (2.1)	5 (2.0)	18 (2.1)
Renal disease	63 (10.3)	42 (16.9)	105 (12.3)
Others	30 (4.9)	10 (4.0)	40 (4.7)
Total	609 (100)	248 (100)	857 (100)
60 years or older			
Injury	40 (11.9)	16 (7.2)	56 (10.1)
Malignant neoplasm	21 (6.3)	5 (2.3)	26 (4.7)
Blood disease	0 (0.0)	0 (0.0)	0 (0.0)
Cerebrovascular	113 (33.6)	83 (37.6)	196 (35.2)
Infectious disease	48 (14.3)	44 (19.9)	92 (16.5)
Heart disease	25 (7.4)	10 (4.5)	35 (6.3)
Diabetes mellitus	4 (1.2)	7 (3.2)	11 (2.0)
Cirrhosis/hepatitis	17 (5.1)	5 (2.3)	22 (3.9)
Renal disease	55 (16.4)	37 (16.7)	92 (16.5)
Others	13 (3.9)	14 (6.3)	27 (4.8)
Total	336 (100)	221 (100)	557 (100)

Diagnostic tests according to underlying cause of death
    Since the great majority of cases stayed at the hospital in a short period before death, applicable diagnosis tests were limited (Table 5). Except the cases of dead on arrival, blood tests

Table 5 Diagnostic tests provided according to the underlying cause of death

Underlying cause	N	Diagnositc tests					
		Blood	ECG	X-ray	Ultra-sound	CT	MRI*
Total	1,509	1,497	1,257	479	90	743	7
Injury	448	444	325	200	10	322	1
Cancer	72	72	72	26	11	21	3
Blood diseases	11	11	9	2	1	2	0
Cerebrovascular	405	403	369	51	5	355	2
Infectious disease	186	186	162	90	17	20	1
Heart disease	53	53	53	19	4	2	0
Diabetes mellitus	22	21	21	5	0	2	0
Cirrhosis/hepatitis	41	39	31	11	15	2	0
Renal disease	200	198	165	37	19	9	0
Others	71	70	60	38	8	8	0

* Introduced in 2015.

were provided for all cases. ECG, X-ray, Ultrasound imaging, CT, and MRI were conducted on an as needed basis.

All cases (n=53) with heart disease, mainly myocardial infarction, were diagnosis using with ECG. CT was performed on 71.9% (95%CI 67.5–76.0%) of 448 cases with injury and 87.7% (95%CI 84.0–90.7%) of 405 cases with cerebrovascular disease; 92.0% (95%CI 88.4–94.7%) of 312 cases with cerebral hemorrhage and 78.3% (95%CI 67.9–86.6%) of 83 cases with cerebral infarction. One cerebral hemorrhage patient and one cerebral infarction patient had a MRI test. Three out of 20 patients with brain tumor had a MRI test.

DISCUSSION

Main findings

This was the first study to report the causes of death at a tertiary hospital in Lao PDR. Since children with a serious disease, those with HIV/AIDS and tuberculosis were sent to specialized hospitals, deaths of children and deaths from HIV/AIDS and tuberculosis were limited. Main underlying causes more than 10% were injury (29.7%), cerebrovascular diseases including cerebral hemorrhage and infarction (26.8%), renal diseases (13.3%), and infectious diseases (12.4%).

In Lao PDR, traffic accidents of motorcycle riders are a serious problem, mainly due to head or neck injury for no helmet riders,[14] as reflected in this study. This study found that cerebral hemorrhage was more frequent than cerebral infarction. A relatively higher proportion of cerebral hemorrhage compared with Western countries was a consistent finding among Asian countries; the past in Japan[15] and China,[16] and the present among Asian countries.[17,18]

Mortality data in Lao PDR

Since the cause of death is not specified on death reports in Lao PDR, there is no data available on the causes of death for the whole country. Published information on the causes of death among adults in Lao PDR were as follows. Lua *et al.* identified 448 cancer deaths from 757 local health centers in 17 provinces/cities. In 2007–2008, the calculated mortality for various

cancers per 100,000 was 52.2 for liver, 19.0 for colorectum, 17.3 for lung, 7.2 for leukemia and lymphoma, and 6.9 for stomach in males, 28.4 for liver, 19.0 for colorectum, 14.0 for lung, 9.2 for cervix, and 7.1 for stomach in females.[19] A high frequency of liver cancer found in this study was consistent with the previous studies, but the high frequency of brain tumor found in this study was not consistent with the report by Lua *et al.* Loo et al. reported that stroke was the third leading cause of death in Lao PDR based on the World Health Organisation's Ranking (http://www.worldlifeexpectancy.com/laos-coronary-heart-disease).[20] Excluding the maternal and child mortality reports, no other reports were found in PubMed.

Characteristics of patients who visit Mittaphab Hospital: representativeness

This study dealt mainly with deaths among adults as shown in Table 1. The ratio of males to females was two to one, indicating that the access of females might be less than that of males. Since Mittaphab Hospital is a tertiary hospital, patients with serious diseases/injuries are transferred. Although emergency care was provided for the patients admitted with traffic injuries or those with cerebrovascular diseases, the patients have to pay for the services from out-of-pocket or using health insurance if they have one. If the patients are actually poor, the fees could be exempted. Since the transportation by ambulance from a place of accident to hospital is free of charge, it might be relatively rare that the emergency cases were not transferred to tertiary hospitals around Vientiane Capital. Accordingly, those with an emergency condition would have a larger chance to access the hospitals. On the other hand, those with chronic diseases such as liver failure or renal failure had to pay a large amount of money for long treatments. It would be difficult for poor people to access Mittaphab Hospital for chronic diseases. Although the data on income level of patients at Mittaphab Hospital was not available, relatively rich individuals seemed to have accessed the hospital for chronic diseases.

Accuracy of records on the causes of death

Mittaphab Hospital has a computer system for management, but not for medical charts. Number of deaths were routinely reported from each department to the medical record section, and the summary data was entered for managerial purposes. This study was based on the routinely collected data on patients who died at the hospital. The accuracy of the data is influenced by the accuracy of 1) diagnosis, 2) description on findings, 3) record managing, 4) reporting to medical record section, and 5) data entry and analysis. Although the handling of the data collected from medical chart is important, its main limitation of accuracy is the diagnostic process depending on the available technology, as well as the recording of the basis on the diagnosis in medical charts.

In this study, the information on the usage of blood tests, ECG, X-ray test, CT, and MRI was collected to measure the accuracy of diagnosis. Although diagnosis of cancer usually requires pathological evidence, pathologic tests were conducted rarely in Lao PDR. In Mittaphab Hospital, tumor markers (CEA, PSA, HCG, and AFP) and CT were used for diagnosis in practice. The diagnosis of cerebrovascular diseases were mainly based on symptoms and CT while the diagnosis of myocardial infarction was based on ECG.[21] Infectious diseases,[22] thalassemia, ITP, diabetes mellitus, liver cirrhosis, and renal failure were diagnosed based on symptoms and blood tests which seemed to be acceptable for statistical purposes, even though there were some misdiagnosed cases.

In conclusion, this study reported the in-hospital mortality at a tertiary hospital in Vientiane, Lao PDR. The most frequent cause of death was injury, followed by cerebrovascular diseases, renal disease, infectious diseases, and malignant neoplasm including brain tumor. Although the distribution of underlying cause of death in the hospital did not completely reflect the whole population, it could provide the useful information on the mortality impact according to disease

to design health care systems in Lao PDR.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

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