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Pattern and Predictors of Death in Hospitalized Adult Patients in Mongolia: A Nationwide Study

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Objective: Hospital death patterns and predictors can illustrate the general image of certain parameters of the healthcare system. Studies related to the pattern of in-hospital deaths in Mongolia are lacking. Thus, we aimed to determine the patterns and predictors of death among hospitalized adult patients in Mongolia in 2020. **Methods:** Data from 86 hospitals providing inpatient care in Mongolia were used. 1795 hospital deaths from 296,083 hospital admissions were analyzed between the 1st of January and the 30th of June 2020. **Results:** The mean age of the participants was 56.3 ± 15.3 years, 59.4 % were male, and the median hospital stay was 2.2 days. In this study, weekend admission, urban setting, older age, and male gender were significant predictors of in-hospital death. Logistic regression analysis revealed that male gender and weekend admission were significant predictors of in-hospital death. In addition, people who died at different levels of hospitals were significantly different by residency. **Conclusions:** Mongolian rural people who have acute illness are rarely died in hospital settings. Weekend admission, male gender, and urban setting were independent significant predictors while between-subject-effect of male gender and urban setting was highest on in-hospital death.

Keywords: Hospital mortality, prevalence, risk factors, gender role, residence characteristic

Introduction

In hospital death patterns can represent the general national healthcare image [1]. In some higher-income country, less than thirty-five percent of all death was registered in a home setting. But in lower-middle income countries including Mongolia, more than 50 percent of death was registered in home settings [2]. Although, home death domination is a good effect on the economic situation of the healthcare system, on the other hand, the death registration information may be not reliable and the end-of-life care quality of that country may be poor [3]. Studies related to patterns of in-hospital death were lacking in Mongolia. Open available basic information on hospital death is necessary for the further development of the acute care field of our country. Also, it could be necessary for decision-making process of the healthcare administration policy.

Furthermore, Mongolia is facing a significant gap in life expectancy between male and female (Women 74, Men 64) and is considered to be much higher than upper-income countries as well as some lower middle income countries [4]. There is also the inadequacy of data on hospital death predictors in Mongolia and the causes of gender-related life expectancy are not studied sufficiently [5 - 6]. Identifying predictors of death could be a crucial role for several reasons that are relevant to clinical practice, including monitoring the right patients with tight control, involving expert practitioner's opinions in decision-making, transporting severe patients to critical care centers in the early stage, starting initial resuscitation without delay, establishing targets for intervention and providing cost-effective methods for prognosis [7]. If doctors are aware of such predictors, they can identify patients with higher mortality risk and take steps to improve healthcare quality [8].

This situation greatly applies to Mongolia since acute care and intensive care have been developing greatly in the country over the past decade. There is still a shortage of acute care experts, especially in end-of-life care in Mongolia [9 - 10]. For this reason, we hypothesize that some parts of country's healthcare images of intensive care units could be different from each other.

Additionally, Mongolia is the most sparsely populated country in the world; hence, it would take several hours a day to transport the patients between hospitals. All the National Centers are located only in the UB city. Some rural hospitals are located more than 1600 km from the capital city, thus, professional end-of-life care coverage in the rural country may be much lower than in urban areas. In this study, we are assessing the predictors of hospital death by using the medical records of individual hospitals and revealing a special image of hospital death at a nationwide level in Mongolia. This study differs from the previous studies by sample size selection and illustrates the healthcare outcome difference between rural and urban setting by all caused death and gender-related factors. Some papers on this subject were published in the field of cardiology and non-surgical diseases [11 - 14]. Other studies related to this did not include all countries of their nationality. Our study focused on all caused hospital mortality risk factors and patterns at a nationwide level.

Materials and Methods

Research design

This multicenter cross-sectional study included patients aged 16 years or older who were admitted from January 1, 2020, through June 30, 2020, to 86 primary care hospitals that regulate the emergency care system. In recent years there was an average of 16,024 deaths recorded per year among patients older than 16 years old. From the national statistics, 1795 hospital deaths (from 296,083 hospital admissions) were recorded in the first half of 2020. Patients were eligible for inclusion in the study if they were above 16 years of age (this age considered to be labor age by physical maturation and legal in most countries including Mongolia), patients were alive when they were admitted to the hospital, medical records were filled out and hospital data contains at least one death data. The exclusion criteria were cases admitted to community, specialty institutions, and hospitals without accident and emergency units; cases admitted to hospitals where the death data were not registered, cases in hospitals that had not permitted using study materials, and poor-quality data. All caused-in-hospital death predictors provides a larger sample size based on the nationally representative sample. In addition, an important source of known bias is the assignment of a substantial fraction of deaths to causes of death that is not the underlying causes of death, often called "garbage codes". Researchers already noted that around 20 % of all death was recorded as caused by sepsis which is a common garbage code, not the true cause of death in 2020 [15]. We calculated septic death in our sample as 341 (confidence level 98 %, margin of error 5 %) from all the adult death count at the end of 2019 (total 16,946), and the sample size of all caused death to be 1705. Also, we have considered our sample size with 50% of the national inpatient admissions in 2020 and enrolled the death cases which was 1787 from 296,083 admissions between January 2020 and June 2020 by criteria. These cases were collected by electronic case records review. In this stage we have collect all vital registration data (age, gender, admission day, hospital stay, hospital category, death place) of our participants. Also, we have used the national statistical data from the open-source network to compare and conclude our results of vital registration data. In phase II of the study 1353 cases (confidence level 95 %, margin of error 5 %) that died in hospitals were collected through manual case records review. Every full medical record of dead cases was read by the researchers and kind of variables collected through the certain questionnaires. From January 2020 through June 2020, a total of 1795 patients who died from 325,708 admissions were assessed for eligibility. Out of the 296,083 patient admissions that fitted the eligibility requirements, 1785 patients who died were enrolled in the study. From 1785 patients who died, 432 patients were excluded for reasons provided in figure 1. Variables such as demographic characteristics, hospital categories and geographical data questionnaire were used to analyze hospitalized patient mortality factors while acute and chronic disease, and residency was used to reveal patterns of hospital death. We were classified hospitals in to primary, secondary, and tertiary level based on their healthcare coverage of diseases. Primary hospital is the first level of healthcare patients receive and covers all essential healthcare. Secondary and tertiary hospital are upper level of care when the previous level care providers refer them to the hospital to take specific expertise help.

Statistical analysis

An unpaired t-test was carried out for continuous variables to compare the mean between the two groups. The Pearson Chi-square test of independence was used to compare groups in terms of categorical data. For the primary outcome of hospital death predictors, binary and logistic regression analysis was used to evaluate the association of some risk factors and hospital death, which was summarized using OR (95%, CI). A comparison was done in the following two sub-groups: survived group and the death group. Statistical significance was determined at a p-value lower than 0.05. Years potential life lost variables calculated from life expectancy of Mongolians in 2019 by their gender (Women 74, Men 64). Analyses were performed with SPSS version 25 program.

Ethical statement

The study was approved by the Research Ethics Committee of Ach Medical School on November 19, 2021 (No.2021/3-11). All hospital admissions were provided informed consent before participating in this study.

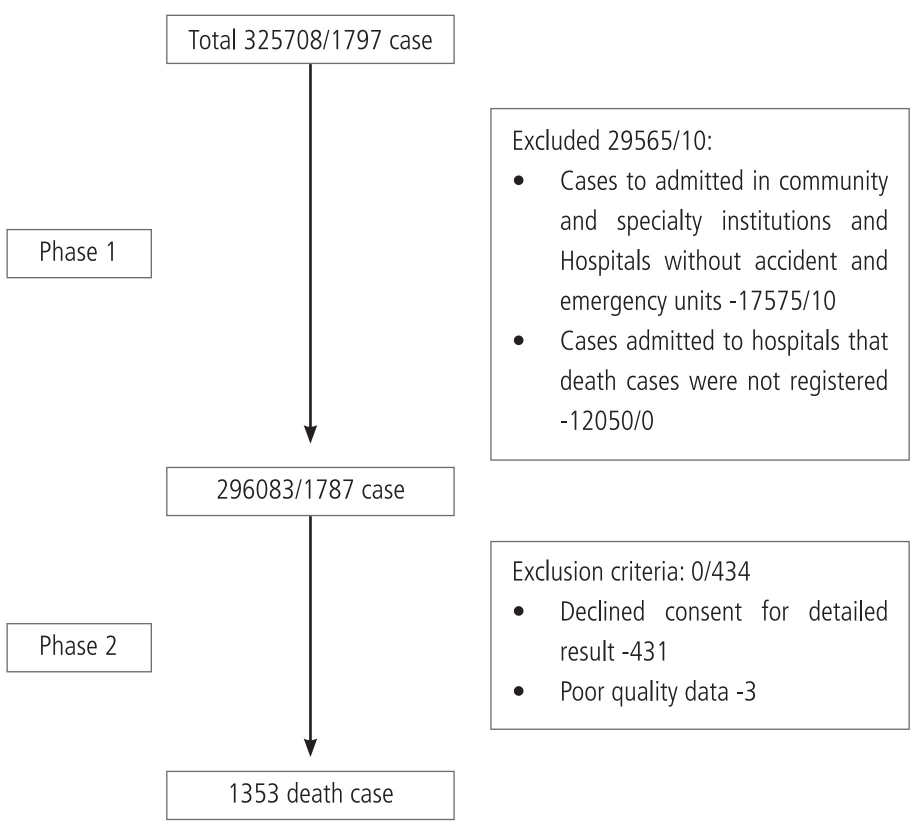

Figure 1. Flowchart of sample. Sample flowchart has described process of selecting participants eligible for study.

Results

Of the 2,215,679 adult residents of Mongolia at the end of 2019, 325,708 (15.3 %) were hospitalized in the first half of 2020; 0.08 % died in a hospital setting. Table 1 shows the distribution of the demographics of hospital death vs the population of Mongolia above 16 years based on national statistical records and their p-value by the chi squire test.

The mean age of the population [70.1] and people [56.6] who died in the hospital setting was significantly different [p = 0.001] from younger people dying in the hospital setting in Mongolia. The gender and residency categories were not significantly different than the total population and hospital death groups. Although urban people were dominant in-hospital death and soum people least, there was no significant differences between the prevalence of the total population and in- the hospital death count. The total population and in-hospital death group were divided into several groups by marital status. Never married (31.5 % vs 17.9 %), Married/Cohabited (60.6 % vs 57.4 %), Divorced/Separated (2.4 % vs 3.4 %), and Widowed (5.5 % vs 21.4 %) groups were calculated by chi squire test and there was a significant difference only in the widowed group.

Interestingly, never married people's death in-hospital setting was not significantly different by their distribution from the total population proportion. Educational level distribution of Primary/Secondary/Associate was 86.8 % in the total population group and 83.6 % in-hospital death group while the percent of a degree above bachelor was 13.8 % in total population group and 16.4 % in-hospital death group. Also, the difference between all educational groups was not significant. Thus, there was no relation between the educational level in hospital death pattern.

Some predictors of hospital death from total admissions are illustrated in Table 2. The dependent variable was an outcome of hospital admission (dead or survived) and the independent variables were patient-related and hospital-related factors. Hospital death was significantly more common in people who were admitted to the hospital on weekend days [OR = 2.96, p = 0.001], older age [OR = 1.03, p = 0.001], male gender [OR = 2.56, p = 0.001] and in urban setting [OR = 2.04, p = 0.001]. Also, public hospitals [OR = 3.45, p = 0.001] were strongly associated with the in-hospital death compared with private hospitals. Public hospitals were compared with their levels. Public primary hospitals [OR = 0.76] were a negative effect on in-hospital death risk while public tertiary hospitals [OR = 3.01] were a positive effect on in-hospital death risk. Public secondary hospitals [OR = 1.02, p = 0.61] had no significant effect on hospital death. Finally, longer stay [OR = 0.86], farther distance [OR = 0.99], and number of beds [OR = 1.00] in hospitals were not strongly associated with in-hospital death. In Figure

Table 1. Demographics of hospital death and total population above 16 years in Mongolia.

Variables	Total population 16 < years	Hospital death incidence	P value
Age (median)	2215679 (70.1)	1353 (56.6)	0.001
Gender			
Male	1070173 (48.3)	804 (59.4)	0.522
Residence			
Capital city	1013452 (45.7)	783 (57.9)	0.241
Province	462855 (20.9)	295 (21.8)	0.762
Soum	737821 (33.3)	275 (20.3)	0.071
Marital status			
Never married	698825 (31.5)	242 (17.9)	0.061
Married /Cohabited	1342258 (60.6)	777 (57.4)	0.712
Divorced/Separated	52955 (2.4)	46 (3.4)	0.653
Widowed	121419 (5.5)	290 (21.4)	0.002
Education			
Primary/Secondary	1923653 (86.8)	1131 (83.6)	0.312
Diploma	302883 (13.7)	222 (16.4)	0.712

Table 2. Predictors of hospital death from total admissions by binary logistic regression.

Covariates	Dependent variable			
	Survivors N (%)	Non-survivors N (%)	Odds ratio (95% CI)	P-value
Age (Mean)	48.6 ± 16.9	56.6 ± 15.6	1.03 (1.026-1.031)	0.001
Below 65 years	240229 (81.6)	1236 (68.9)	0.5 1 (0.45-0.55)	0.001
Above 65 years	54059 (18.4)	559 (31.1)	2.01 (1.81-2.22)	0.001
Gender (Male)	111017 (37.7)	1077 (60.0)	2.48 (2.25-2.72)	0.001
Admission (Weekend)	28375 (9.6)	455 (25.3)	3.18 (2.86-3.54)	0.001
Death place (Urban)	144720 (49.2)	1192 (66.4)	2.04 (1.85-2.25)	0.001
Total hospital bed of country	5322 ± 3621	6546 ± 3434	1.00 (1.00-1.00)	0.001
Hospital stays (Day)	7.33 ± 5.25	5.97 ± 18.75	0.86 (0.84-0.87)	0.001
Hospital distance from UB	377 ± 507	230 ± 409	0.99 (0.99-0.99)	0.001
Hospital administration (Public)	201889 (68.6)	1585 (88.3)	3.45 (2.99-3.99)	0.001
Hospital level (Public Primary)	47189 (16)	227 (12.6)	0.76 (0.66-0.87)	0.001
Hospital level (Public Secondary)	98176 (33.4)	609 (33.9)	1.03 (0.93-1.13)	0.612
Hospital level (Public Tertiary)	56524 (19.2%)	749 (41.7%)	3.01 (2.74-3.34)	0.001

Table 3. Predictors of hospital death from total admissions by logistic regression.

Independent variables	Dependent variable			
	Survivors N (%)	Non-survivors N (%)	Odds ratio (95% CI)	P-value
Age below 65 and G:Female	148548 (50.5)	418 (23.3)	Reference	
Age below 65 and G:Male	91681 (31.2)	818 (45.6)	3.17 (2.82-3.57)	0.001
Age above 65 and G:Female	34723 (11.8)	300 (16.7)	3.07 (2.65-3.56)	0.001
Age above 65 and G:Male	19336 (6.6)	259 (14.4)	4.76 (4.07-5.56)	0.001
Age below 65 and A:Week	216537 (73.6)	908 (50.6)	Reference	
Age below 65 and A:Weekend	23692 (8.1)	328 (18.3)	3.30 (2.90-3.75)	0.001
Age above 65 and A:Week	49375 (16.8)	432 (24.1)	2.08 (1.86-2.34)	0.001
Age above 65 and A:Weekend	4684 (1.6)	127 (7.1)	6.47 (5.35-7.8)	0.001
Age below 65 and S:Rural	123473 (42.0)	533 (29.7)	Reference	
Age above 65 and S:Rural	26056 (8.9)	109 (6.1)	0.97 (0.79-1.19)	0.763
Age below 65 and S:Urban	116526 (39.6)	933 (52)	1.85 (1.67-2.06)	0.001
Age above 65 and S:Urban	28233 (9.6)	220 (12.3)	1.80 (1.54-2.11)	0.001
G:Female and A:Week	166700 (56.6)	552 (30.8)	Reference	
G:Female and A:Weekend	16571 (5.6)	166 (9.2)	3.02 (2.54-3.6)	0.001
G:Male and A:Week	99212 (33.7)	788 (43.9)	2.41 (2.15-2.67)	0.001
G:Male and A:Weekend	11805 (4)	289 (16.1)	7.42 (6.40-8.50)	0.001

Continued

G:Male and S:Rural	53996 (18.3)	79 (4.4)	Reference	
G:Male and S:Urban	57021 (19.4)	998 (55.6)	12.00 (9.50-15.00)	0.001
G:Female and S:Rural	95572 (32.5)	524 (29.2)	3.75 (2.95-4.75)	0.001
G:Female and S:Urban	87699 (29.8)	194 (10.8)	1.51 (1.16-1.96)	0.002
S:Rural and A:Week	131183 (44.6)	876 (48.8)	Reference	
S:Rural and A:Weekend	13537 (4.6)	316 (17.6)	3.52 (3.07-3.98)	0.001
S:Urban and A:Week	134729 (45.8)	464 (25.8)	0.52 (0.46-0.58)	0.001
S:Urban and A:Weekend	14839 (5.0)	139 (7.7)	1.43 (1.17-1.68)	0.001

G: Gender, A: Admission, S: Setting

Table 4. Acute and complications of chronic illness YPLL by the residence of hospital death per 100000 population.

Parameters	YPLL (Median)	Frequency	Total 100000 population
Acute illness			
Capital city	12.1	437	528
Province center	10.1	193	427
Soum	13.8	188	355
Complicated chronic illness			
Capital city	14.8	354	518
Province center	11.8	106	270
Soum	12.8	90	158

*YPLL= Years Potential Life Lost. Years of potential life lost of hospital death illustrated with median by the rural and urban citizen groups.

2, the percent of participants who died in the hospital setting are illustrated by their levels of hospitals and residency in the crosstab. By this image, we can show that the domination of urban people's death burden in the upper level of the hospital was significantly higher than rural people. But the middle level of hospital death distribution also contains province and soum people. Furthermore, about 40 % of soum people die in level 1 hospitals while the province and urban people rarely die at that level.

The results of logistic regression models are shown in Table 3. The co-effects of 65 > age with male gender [OR = 3.17], 65 < age with female [OR = 3.07] and male gender [OR = 4.76] were significantly higher than 65 > age with female gender [OR = 1.00, reference value] effect. Also, co-effects of 65 < age with weekend admission [OR =6 .47] and weekday admission [OR = 2.08], 65 > age with weekend admission [OR = 3.30] were much higher than 65 > with weekday admission [OR = 1, reference value] effect. Although, between effects of 65 > age and urban death [OR = 1.85], 65 < age and urban death [OR = 1.80] were a positive effect on death occurrence, 65 < age and rural death effect [OR = 0.97, p = 0.76] was non-significant compared with 65> age and rural death [OR = 1.00, reference value]. Between subject effects of the male gender with weekend admission [OR = 7.42], weekday admission [OR = 2.41] and female gender with weekend admission [OR = 3.02] were higher effects on hospital death when compared with female gender and weekday admission effect [OR = 1.00, reference value]. For the gender and urbanization effect, the male gender with urban death [OR = 12.00] was the highest of all other effects while the female gender with rural death [OR = 3.75], and female gender with urban death [OR = 1.51] were a much higher effect on the death predictor value when compared with male gender and rural death [OR = 1.00, reference value]. Furthermore, weekend admission was a significant predictor of death individually, but the effect of weekend admission with urban death [OR = 1.43] was less than the single effect while weekend admission with rural death [OR = 3.52] was more correlated with death compared with weekday admission with rural death [OR = 1.00,

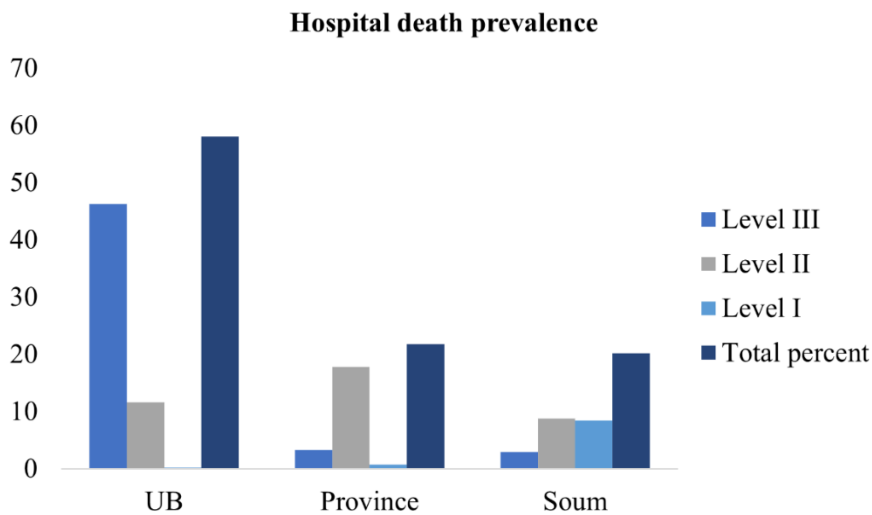

Figure 2. Hospital death prevalence percent by the hospital level and residency categories.

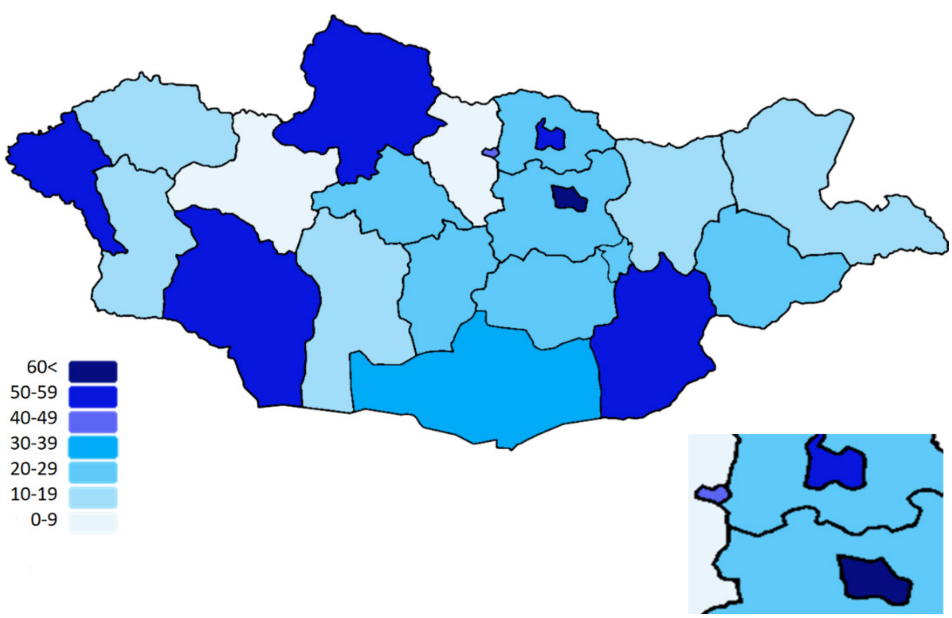

Figure 3. Years potential life lost of all caused hospital death per 10000 populations in Mongolia.

reference value]. Also, weekday admission with urban death [OR = 0.52] was a significant positive effect on survival. From this, we can conclude that the 65 < age effect is not revealed in Mongolia. Also, urban death shows us that male participants mostly die in an urban setting than in rural setting and we should study it more definitively. Finally, urban death with weekend and weekday effects is less than rural death occurrence.

Moreover, the frequency of acute illness is more common in the city than province and soum. The years potential life lost (YPLL) of soum (Median of YPLL = 13.8) death was highest while city (Median of YPLL = 12.1) and province (Median of YPLL = 10.1) death were lower. Also, the complication of chronic illness is more common in the city than in soum and provinces. YPLL is highest in the city (Median of YPLL = 14.8) while lowest in the province (Median of YPLL = 11.8) is illustrated in Table 3.

All cause of hospital death of years potential life lost per 10,000 population in Mongolia is shown with individual provinces in Figure 4. The highest all-cause of hospital deaths

YPLL was in Ulaanbaatar city (60 < in 10,000). YPLL 50 - 59 in 10,000 were Darkhan, Khuvsgul, Dornogobi, Gobi-Altai, and Bayan-Ulgii. YPLL of Orkhon was 40 - 49 in 10,000. YPLL of Umnugobi was 30 - 39 in 10,000. YPLL 20 - 29 in 10,000 were predominantly central regional provinces, Uvurkhangai, Arkhangai, Selenge, Dundgobi, Tov, Gobisumber, and Sukhbaatar. Khovd, Uvs, Khentii, Dornodand Bayankhongor were 10 - 19 in 10,000. The lowest (0 - 9 in 10,000) YPLL were in Zavkhan and Bulgan provinces.

Discussion

This study determines that age, gender, weekend admission, and urbanization were the significant predictors in the nationwide level multicenter observational study. In Mongolia younger people are dying in hospitals compared with the national mean age parameter. Older age was independently associated with in-hospital mortality similar to the studies of Arie Shirom and Simon that the mortality was poor with older age effect [16, 17]. But patients aged over 65 years is associated with poor mortality in the hospital setting was already studied by Bergland A et al. In our study a 65 years old effect was not observed. This result can tell us the Mongolian younger group people don't have more chance to survive while higher income countries younger patients have more chance to survive when they admit to the hospital [18]. Furthermore, male patients predominantly died of independently associated in-hospital mortality compared with females. Weekend admission was at risk of a high rate of mortality and urbanization was also dependently associated with hospital mortality.

Among the 1000 adult patients being admitted to acute hospitals in Mongolia, death was 5.5. The average national median of deaths occurring in hospitals between 2005 and 2017 was 52 % [10]. Hospital death in Mongolia is 2 to 3 times lower than high-income countries [19]. The rate of in-hospital death from all death was 28 %. It means the home death rate is common in Mongolia and its reliability could not be confident. The mean age of in-hospital death was younger in Mongolia which is the same as the previously published studies of lower-middle and middle-income countries [20]socioeconomic inequalities, and the availability of health factors on life expectancy (LE. Although older age was a significant predictor of in-hospital death, the same as in other countries, the results of 65 years upper vs the lower age group were different in Mongolian rural hospitals death rates in the two groups, they were not different when compared with urban age groups [21]. Male gender was an independent predictor of death. Considering some parameters between factors effects, male patients admitted on the weekend had a death rate several times higher compared with female patients admitted on a weekday. These results are the same as other studies [22].

Weekend admission was significantly lower in Mongolia although emergency admission to the hospital is allowed during non-working hours. Weekends are independently related to a higher mortality rate. It is the same with some studies that only admission of Saturday, and Sunday death is common in hospital deaths [23]. Although in some studies Friday, Saturday and Sunday admission were higher, in Mongolia Friday was the same as other weekdays [24]. Urbanization is another predictor of death in Mongolia. This outcome is different from other studies [25]. For the relationship between death place and residency, most patients (88 %) who died in the upper level of the hospital were urban people. Only, 12 % of them were rural people. That was the result of our sparsely populated country. On the one side, that was the result of our sparsely populated country. But, on the other hand, if the density of urban population is 48 % and the rural population 52 %, the rural people cannot take enough care for their diagnosis. This should be a concerning problem.

Although primary hospital (soum hospital) death was fewer than in the city, the years potential life lost of one person death was significantly higher than the province. By the death of the place, most in-hospital deaths are occurring in the capital city and years potential life lost are also high. The second most common deaths are occurring in urbanized or countries that were in rural medical university countries and the farthest location in the country from the capital city. The third and fourth occurrences of common in-hospital death were in mining countries. Fifth was also in the central and regional countries of Khangai. In the most western and eastern regional countries in-hospital death occurrence was fewest in Mongolia.

One of the limitations of this study is that the participants have not been followed up, so recent and timely results could not be calculated. Also, hospital admission indications were different in individual countries; there were maybe unnecessary admissions that occurred on weekdays, hence, information about unnecessary admissions should be studied. Some citizens have not registered their movement in the new place. This study is the first nationwide retrospective study that analyzed routinely collected hospital data to determine predictors and causes of death in Mongolia. It also determines the predictors of in-hospital death and the health administration's policy use of this information for the system development.

Conclusions

Mongolians rarely die in a hospital setting except for the widowed people. Rural people mostly died in the lower level of hospitals with acute illness while urban people die in the highest level with chronic illness. Weekend admission, male gender, and urban setting were independent significant predictors while between-subject-effect male gender and urban setting was highest on in-hospital death.

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