The Strategy of Rescues and Early Detection in Aging Society
Risk to Long-Term Care Institution

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Abstract

The cost of long-term care has increased in recent years and will more likely keep continuously increasing in the future. It would be valuable to predict the survival probability of an admitted patient being discharged to a long-term care institution in order to prevent the hazard risk. In this study, the Cox proportional hazard model is applied to estimate the hazard risk to the long-term care institution. The individual probability of being transferred to a long-term care institution is then able to assign to each patient about they are admitted to a medical facility. As the results, the aged people, the people lack of support in social, physical, mental aspects, and disable to care themselves, were found of higher probability to be often transferred into the long-term care institution.

Keyword: Long-term care, the elderly, Cox proportional hazard model

Introduction

According to the U.S. Census 2010, the population of those age 65 and older has been increased to 20.55%, and almost 70% of them are estimated necessarily to have the long-term care, as the U.S. Department of Health and Human Services reported (US Census Bureau, 2008). U.S. Congressional Budget Office also estimates the increasing demand for the elderly long-term care, because the high birth rate of the baby boomers after the World War 2nd, and the life expectancy keeps rising year by year. That is, even if the cost of long-term care per capita remains unchanged, the long-term care cost will rise due to the increase of the aging population alone (Mendelson, Schwartz, 1993) (Thompson, 2013). For better planning, it is necessary to know the risk associated with and the probability of a patient entering long-term care when they are sent or admitted to medical care facilities. Several scholars have identified some individuals to enter into the nursing home (Guralnik, Simonsick,

Ferrucci, 1994) (Gaugler, Krichbaum, Wyman, 2009) (Goodwin, Howrey, Zhang, Kuo, 2011). They used the logistic regression method to investigate the individuals admitted to the nursing home for the long-term care. They used the Cox proportional hazard model (Jiska, Philip, 2011) to assess the possible risk of entering nursing home according to the some factors, including age, ethnicity, physical and mental function status, etc. (Dagani, Ferrari, Boero, et al., 2013) (Marengoni, Nobili, Romano, et al., 2013) (Nielsen, Siersma, Waldemar, Waldorff, 2014). Similarly, in this study, the Cox proportional hazard model is applied to find out the probability and predict the individuals who are possibly to be transferred to the long-term care institution finally, after individuals were sent into medical care facilities (Cox, Oakes, 1984).

Data

The data used in this analysis is from the National Hospital Discharge Survey of 2008. The data contains patients discharged from 239 hospitals located in the 50 states and the District of Columbia of the Unite States excluding Federal, military and Veteran Administration hospitals. While individuals were sent or admitted to the hospital, they were diagnosed at Emergency Department (ER), Out Patient Department (OPD), and the Ward with the ICD-9-CM code (Stewart, Ware, 1992). After treatment, there are several kinds of their discharged status, including May Be Discharged (MBD) home, leaving against medical advice, transferred to a short-term facility, transferred to a long-term care institution, and death. The event of leaving hospital, we are interested, is the patient transferred to a long-term care institution.

There were 165,630 patients admitted into different medical facilities. Among them, 68,376 were males and 97,254 were females. Among the males, 6,370 were transferred to a long-term care institution before the end of the data collection and 10,582 females are transferred to a long-term care institution before the end of the data collection. The ages of patients are from 0 to 90 years old with mean age of 49.14. When the patients were divided into 6 groups by their ages listed in Table 1, the patients, transferring to a long-term care institution, increases while their age increasing.

Table 1

The Patients Distribution by Age

Age	Number	Number of transferring to a long-term care institution
0-17	25,318	51 (0.20%)
18-40	35,293	275 (0.78%)
41-65	48,260	2,870 (5.95%)
66-74	19,334	2,808 (14.52%)
75-84	23,353	5,708 (24.44%)
85-90	14,072	5,240 (37.24%)

Model & Methodology

The patients, not to mention actively or passively, were sent to the hospital for help. The most important factors, that leading to disability to be transferred for the long term care, were dependent upon 4 factors. The first was the severity of the stressful events, and it was the most important. The second was the patient himself, with or without the support of social, mental, physical aspects, which could help the sickness or dysfunction speedy recovery. The third was the hospital facility and specialized capacity could afford and effectively treat the patient. The last was the wealth, which made the rich accept better choices of drugs, therapy, specialist, environment, etc. If the one who could not get enough scores in the above 4 factors, he

was considered to have high hazard risk of being discharged to the long term care institution.

Without considering the distribution of the days before the onset of the event, the Cox proportional hazard model is applied to assess the possible risk on the occurrence of the event. In our cases, the time is the number of days of hospitalization (or the number of days before being transferred to a long-term care institution) and the event is the of individual discharged to a long-term care institution. Individuals who experienced the event before or at the end of the data collection are called uncensored observations while individuals who did not experience the event are called censored observations. There were 16,952 uncensored individuals and 148,678 censored individuals.

The model was introduced by Cox (1993) and the basic idea is that the hazard function (or hazard rate) is a function of a baseline hazard function multiplying a function of explanatory variables. The hazard function in its mathematical form is $h(t, x, \beta)=h0(t)exp(x\beta)$ where t is the number of days admitted before being transferred to a long-term care institution, x is the vector of the explanatory variables with the corresponding coefficients denoted by β, and h_0 is the unobserved baseline hazard function. The hazard function generates a conditional probability, risk, or so-called hazard rate that is interpreted as the instantaneous probability of the event coming at time t given the individual has survival prior to time t. In our case, the hazard rate is the probability to be transferred to a long-term care institution at the (n+1) day, and before the transferring, the individual had stayed in the hospital for n days.

Results

The explanatory variables included in the models are listed in Table 2.

Table 2

Explanatory Variables and Test

Category	Group	Parameter Estimate	p-value	Hazard Ratio
Sex	Male	–0.13420	<0.0001	0.874
	Female(reference group)			
Age	0 to 17(reference group)			
	18 to 40	1.07451	<0.0001	2.929
	41 to 65	2.45781	<0.0001	11.679
	66 to 74	2.99249	<0.0001	19.935
	75 to 84	3.39484	<0.0001	29.810
	85 to 90	3.72941	<0.0001	41.655
Race	White	–0.00923	0.6621	0.991
	Black	–0.11642	<0.0001	0.890
	American Indian	–0.32467	0.1223	0.723
	Asian	–0.51164	<0.0001	0.600
	Others (reference group)			

Marital Status	Married	–0.41021	<0.0001	0.664
	Single	0.11983	0.0005	1.127
	Widowed, Divorced, Separated	–0.14838	<0.0001	0.862
	Not Stated (reference group)			
Geographic Region of Hospital	Northeast	0.10614	0.0038	1.112
	Midwest	0.24957	<0.0001	1.283
	South	0.01957	0.5848	1.020
	West (reference group)			
Bed size of the hospital	0-99	0.80871	<0.0001	2.245
	100-199	0.56428	<0.0001	1.758
	200-299	0.52632	<0.0001	1.693
	300-499	0.36026	<0.0001	1.434
	500 and over (reference group)			
Ownership of Hospital	Proprietary	–0.12805	<0.0001	0.880
	Government	–0.36099	<0.0001	0.697
	Nonprofit (reference group)			
Principal Expected Source of Payment	Government	0.52329	<0.0001	1.688
	Private	0.05637	0.4797	1.058
	Self-pay	–0.46964	0.0001	0.625
	Others (reference group)			
Type of Admission	Emergency or Urgent	0.16236	0.0139	1.18
	Elective	–0.11696	0.0856	0.890
	Newborn	–0.48320	0.1153	0.617
	Not Available (reference group)			
Source of Admission	Physician Referral	0.53292	<0.0001	1.704
	Clinical Referral	–0.08782	0.5222	0.916
	HMO Referral	1.32150	0.0002	3.749
	Transfer from Other Institutions	0.64955	<0.0001	1.915
	Others (reference group)			

ICD-9-CM diagnosis codes	Infectious and Parasitic Diseases	–0.20869	<0.0001	0.812
	Neoplasms	–0.73084	<0.0001	0.482
	Endocrine, Nutritional and Metabolic Diseases, and Immunity Disorders	0.15867	<0.0001	1.172
	Diseases of the Blood and Blood-Forming Organs	0.05395	0.4333	1.055
	Mental Disorders	–0.67279	<0.0001	0.510
	Diseases of the Nervous System and Sense Organs	0.11219	0.0138	1.119
	Diseases of the Circulatory System	–0.22356	<0.0001	0.800
	Diseases of the Respiratory System	–0.20418	<0.0001	0.815
	Diseases of the Digestive System	–0.40806	<.0001	0.665
	Diseases of the Genitourinary System	0.14693	<0.0001	1.158
	Complications of Pregnancy, Child-birth, and the Puerperium	–9.62844	0.7716	0.00007
	Diseases of the Skin and Subcutane-ous Tissue	–0.07212	0.1903	0.930
	Diseases of the Musculoskeletal Sys-tem and Connective Tissue	0.84731	<0.0001	2.333
	Congenital Anomalies	–0.88014	0.0088	0.415
	Certain Conditions Originating in the Perinatal Period	–2.54763	0.0117	0.078
	Symptoms, Signs, and Ill-Defined Conditions	–0.01135	0.9730	0.989
	Injury and Poisoning (reference group)			

Source: Made by authors

Note: Grouping of International Classification of Diseases (ICD) is based on Lou Ann Schraffenberger (2006).

Discussions

Health, as WHO defined, is a state of complete well-being status in physical, mental and social aspects, not merely the absence of diseases or infirmity. The patients transferred to the long term care institution, as the clinical doctor suggesting, could not get the enough well-being capacity at the social, mental, and physical parts, which were able to help them take care of their own daily life and keep up their immunity (Michael, Susan, 2012).

From the coefficient estimation, female, single, and higher aged individuals were thought weaker in social custom, all of them have higher hazard rates. In comparison with the single, divorced, widowed, or separated, the married people have a lower hazard rate because of the family mental support. Diseases coded by the ICD-9-CM diagnosis, the diseases related to the musculoskeletal system and connective tissue, the nervous system and sense organs, usually resulted in the physical disability. All the above groups have higher hazard

rates. Those patients with much more endocrine, nutritional, metabolic diseases, immunity disorders, poor physical status, were also noted to have higher hazard rate as well.

The rich have more money, the poor become poorer. Because the rich had more advantages than the poor, there were many benefits in medical therapy, such as better drugs, equipment, therapy, even hiring specialist doctors. So, the self-pay hospital is less hazard rates than the private and government. Nonprofit hospitals, as the government hospitals, have a higher hazard rate in transferring individuals to a long-term care institution. It was the same reason. On the other viewpoint, the bigger hospital scale, the lower average cost. The smaller hospital had relative less profits unless with higher bed turn-over rate, or full bed occupied rate. Patients, with the same diseases, could be hospitalized for more days in bigger hospitals. From the above data, 6.60% of the individuals were transferred to a long-term care institution from a hospital with bed more than 500 comparing to 10.85% for all the hospitals combined with less than 500 beds. The higher the number of beds in the hospital, the less the hazard rate is.

Individuals, admitted due to emergency, were thought to be something sickness seriously. The HMO, Institutions, and physician referrals were the same professional trepidation concerned. All the above admissions have higher hazard rate and sometimes higher morbidity and mortality rate as well.

Conclusions

The survival analysis may be the useful tool to find out the peak point of the hazard onset, in order to prevent the unlucky tragedy. In this study, it has been shown that the elderly i.e. the age did have a higher probability of transferring to a long-term care institution at any given time. As the above observation and study, the patients, which acquired not much support in physical, mental, and social aspects, shall have high risk of hazard rate to become disabled and even cripple. Not only physical but also mental, there were many factors, including age, admission type of patients, hospital scale admitted, diseases of diagnosis, which were selected much more in the report, could not only remind us to detect the risk and hazard earlier to prevent further morbidity and crisis, but also teach us to treat patients and their family more humane and friendly, that help them speedy recovery.

References

Cox, D. R., & Oakes, D. (1984). *Analysis of survival data*, 1-203, New York: Chapman and Hall Press.

Dagani, J., Ferrari, C., Boero, M., et al. (2013). A prospective, multidimensional follow-up study of a geriatric hospitalized population: predictors of discharge and well-being, *Aging Clin Exp Res, 25*(6), 691-701.

Gaugler, J. E., Yu, F., Krichbaum, K., & Wyman, J. F. (2009). Predictors of Nursing Home Admission for Persons with Dementia, *Medical Care*, 47(2), 191-198.

Goodwin, J. S., Howrey, B., Zhang, D. D., & Kuo, Y. F. (2011). Risk of Continued Institutionalization After Hospitalization in Older Adults, *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, 66A(12), 1321-1327.

Guralnik, J. M., Simonsick, E. M., & Ferrucci, L., et al. (1994). A Short Physical Performance Battery Assessing Lower Extremity Function: Association With Self-Reported Disability and Prediction of Mortality and Nursing Home Admission, *Journal of Gerontology*, 49 (2), M85-M94.

Jiska, C. M., & Philip, W. W. (2011). Predictors of entry to the nursing home: Does length of follow-up matter? *Archives of Gerontology and Geriatrics*, 53(3), 309-315.

Marengoni, A., Nobili, A., Romano, V., et al. (2013). Adverse Clinical Events and Mortality During Hospitalization and 3 Months After Discharge in Cognitively Impaired Elderly Patients, *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, 68 (4), 419-425.

Mendelson, D. N., & Schwartz, W. B. (1993). The effects of aging and population growth on health care costs, *Health Affairs*, 12 (1), 119-125.

Michael, J. B., & Susan, E. L. (2012). Shared Decision Making - The Pinnacle of Patient - Centered Care, *New England Journal of Medicine*, 366(9), 780-781.

Nielsen, A. B. S., Siersma. V., Waldemar, G., & Waldorff, F. B. (2014). The predictive value of self-rated health in the presence of subjective memory complaints on permanent nursing home placement in elderly primary care patients over 4-year follow-up, *Age and Ageing*, 43(1), 50-57.

Stewart, A. L., & Ware, J. E. (1992). *Measuring Functioning and Well-being: The medical outcomes study approach*, 1-455. Duke University Press.

Thompson, F. J. (2013). Health Reform, Polarization, and Public Administration, *Public Administration Review*, 73(s1), S3-S12.