How are inpatient mortality and uncured discharges determined in China?

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Abstract

Main causes of inpatient death and uncured discharges are concerned by all stakeholders of healthcare sector. This paper studies determinants of inpatient death and uncured discharges in China. Based on micro data of 759,001 inpatient medical records from two representative Chinese prefecture-level cities, we find out that while a few common diseases linking to mortality and uncured discharges, patterns of lethal diseases varied widely in China's advanced and less advanced regions. Moreover, exogenous factors, including hospital spending, surgery and healthcare insurance were statistically significant determinants of inpatient death and uncured discharges. These findings have direct policy implications. In the context of China's unfolding healthcare reforms, alleviation of region-specific diseases, improvement of third-party payment schemes, deepening of insurance coverage and enhancement of quality medical treatment will be critical measures to reduce death and uncured rates of inpatients.

JEL Classification: I12, I13

Keywords: Inpatient mortality, Uncured discharges, Diseases, Treatment, Insurance, Payments

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1. Introduction

Main causes of inpatient death and uncured discharges are of great concern to healthcare providers, insurers, policymakers, and academia alike. In practice, outcomes for hospitalized individuals are frequently used as key indicators for gauging the quality of healthcare services and for evaluating the efficiency of healthcare expenses. Some researchers (Dubois et al, 1991), however, have expressed certain reservations, such as suggesting that adjustments are needed to account for severe illnesses and in order to make meaningful comparisons across hospital death rates. Yet, death and uncured discharges of inpatients are complex phenomenon, most likely affected by many variables, ranging from disease particulars, factors specific to individual patients, clinical treatments and socio-economic factors.

Many researchers have focused on diseases which may be fatal for inpatients. For example, Katzman and Karasu (1975) revealed that the senile form of Alzheimer disease may rank as the fourth or fifth most common cause of death in the United States, although the US vital statistics tables do not list "Alzheimer disease," "senile dementia," or "senility" as a cause of death. Foley and Parfrey (1997) showed that cardiac failure is a rapidly increasing lethal condition in ESRD patients and appears to mediate much of the adverse prognostic impact of ischemic heart disease. Palella et al. (2006) indicated that the proportion of deaths among HIV-infected patients attributable to non-AIDS diseases in the highly active antiretroviral therapy (HAART) era include hepatic, cardiovascular, and pulmonary diseases, as well as non-AIDS malignancies. In the context of China, He et al. (2005) suggested that along with behavioral changes toward the Western society, heart disease, cancer, and cerebrovascular disease are the top causes of deaths. But Wagner et al. (2006) pointed out that respiratory diseases may be under-represented in this report. In addition, a few indicated that treatment procedure may affect mortality of inpatients. For instance, Birkmeyer et al. (2002, 2003) documented a linkage between surgeon volume and operative mortality in the United States. Ghaferi et al. (2009) showed that differences in death rates of inpatients with major complications are also the primary determinant of variation in overall mortality with individual operations.

Other researchers also concentrated on effects of socio-economic factors on mortality. Sorlie et al. (1995) discussed how race, employment status, income, education, occupation, marital status and household size affect mortality. Kawachi et al. (1997) indicated that social capital and income inequality may contribute to mortality. Lantz et al. (1998) claimed that socioeconomic differences in mortality are due to a wider array of factors and may persist even with improved health behaviors among the disadvantaged. Smith et al. (1998) argued that cultural rather than material resources are the key determinants of socioeconomic differentials in health. Lynch et al. (2004) found out that higher income inequality is associated with increased mortality at all per capita income levels.

Meanwhile, other researchers have attempted to find effects of health insurance on inpatient mortality. For example, the Institute of Medicine (IoM)'s Committee (2002) estimated the effect of insurance on mortality and claimed that the mortality rate of uninsured people is about one fourth higher than that of people with health insurance in the United States. Kronick (2009) pointed out that the IoM's study is inaccurate and inconsistent, since it drew inferences on the causal relationship between lack of insurance and mortality. According to his estimate based on National Health Interview Survey from 1986 to 2000, Kronick showed that the risk of subsequent mortality

has no different between insured and uninsured respondents. Yet neither IoM (2002) nor Kronick (2009) took into consideration disease types or, controlled for their possible impacts on inpatient death.

Nevertheless, little or no literature exists on all possible determinants of inpatient death and/or uncured discharges.[1] The objective of this paper is to examine comprehensive causal relationships between inpatient mortality and/or uncured discharges and factors including disease types, hospital spending, insurance coverage and medical treatment in China. To serve this end, we collected medical records of individual inpatients from hospitals in two representative prefecture-level cities—one from advanced coastal Zhejiang province and the other from underdeveloped western Sichuan province. The individual-specific micro data set contains personal features, disease types, medical treatment and socio-economic information. We then use both descriptive and empirical methods to study the issues posed.

The rest of the paper is structured as follows. Section 2 briefly discusses the institutional background. Section 3 describes the data set and analytical framework. Section 4 presents statistical analysis and shows empirical results. Section 5 provides concluding remarks.

2. Institutional Background

Thanks to China's rapid economic growth driven by market-oriented reforms, the living standards of the ordinary people have improved significantly over the past three decades. During that same time period, mortality of infant, maternal and infectious diseases have steadily declined and life expectancy has also noticeably increased. On the other hand, however, disease patterns have dramatically changed and disease spectrum has quickly enlarged against the backdrop of large-scaled industrialization and urbanization in which environmental pollution exacerbates, unhealthy lifestyle proliferates and aging population accelerates. Nowadays cancer, diabetes, heart disease and cerebrovascular disease have already become common public health problems across the country.

Prior to the current era of economic reform, China followed a rigid Soviet-style command-economy regime where state sectors dominated all walks of life in urban areas and rural collectivization (the People's Commune system) prevailed in countryside. Under this regime, state-owned enterprises (SOEs) provided working-unit provisions of primitive healthcare to urban employees, and rural health co-ops of the People's Communes provided nominal services to locals in a mix of traditional medical herbs and limited Western modern medicine. After the economic reforms initiated in late 1970s, urban working-unit healthcare provisions ceased functioning as state sectors were restructured and thousands of SOEs went bankrupt, and rural health co-ops collapsed as the de-collectivization campaign phased out the People's Commune system. In the period of late 1980s to 1990s, no social healthcare insurance was available for the general public in both urban and rural areas, resulting in patients paying for healthcare expenses themselves.

Over the past decade, Chinese government has undertaken a fully-fledged healthcare reform effort to establish a basic healthcare insurance system for ordinary people in both urban and rural areas. During this period, the basic healthcare insurance system has been rapidly established, extending the coverage from 5 percent of the Chinese people in 2003 to 95 percent of the total in 2011. Meanwhile,

[1] We sort out research articles on Google Scholar, Jstor, Websites of Science, Wiley, and also search websites of NBER and Brookings, etc. by using relevant key words, but we found few related papers.

the aggregate spending on healthcare of the whole country increased from 3.62 percent of GDP in 2003 to 5.15 percent of GDP in 2011. The current basic healthcare insurance system has many unique features. First, the insurance system is not a universal coverage, but a multiple-layered and segmented framework which distinguishes beneficiaries by their social status. To date, there are three different nets covering urban employees, urban residents without jobs and rural residents, respectively. Secondly, the coverage system is neither nationwide nor provincial. Instead, there are hundreds of basic healthcare insurance nets in China, which are managed by local governments: either prefecture-level city governments or county governments.[2] Thirdly, the different nets have very different ways of financing. The healthcare insurance of urban employees are co-paid by both employers and employees; the insurance of urban residents without jobs is basically subsidized by city governments; and most of the healthcare insurance of rural residents is co-financed by both the central and local governments and only a small portion is paid by individuals. Last, the width in term of diseases covered and the depth in terms of reimbursement percentage for different healthcare nets are very diverse, among which the healthcare net of urban employees is on the top, followed by the net of urban residents without jobs, and the least is the net of rural residents.[3]

Although the newly-established healthcare insurance system is still fundamentally flawed, it has considerably lessened financial burden of ordinary people, especially for urban residents without jobs and rural residents. As a consequence, overall healthcare demand has increased phenomenally across the country in recent years. Among all costs of healthcare services, expenses of inpatients have risen at the fastest pace in the last decade. For example, total number of inpatients was less than 60 million and equivalent to 0.36 percent of outpatients in 2002, but it dramatically climbed to 150 million and was equal to 2.39 percent of outpatients in 2011. Moreover, the average inpatient expense increased about 33 times of average outpatient spending in the same period, so that the total inpatient cost accounted for 40 percent of the total hospital expenses in the country.

In the context of rapid pick-up of healthcare demand nurtured by the establishment of the basic healthcare insurance system together with quickly changed disease pattern and enlarged disease spectrum in China, it is quite necessary and urgent to understand main causes of inpatients death and uncured discharges so as to improve quality of healthcare services under the constrained budget resources.

3. Data and Modeling

Considering income gap between coastal and inland areas and the geographic variation in medical expenditures, we chose two municipalities from 286 prefectural cities in China as the focus of our study and to address the questions posed. The one is the city of Jinhua, in the advanced coastal Zhejiang province, and the city of Nanchong in the underdeveloped western Sichuan province. Jinhua has four counties and one district, with an overall population of 4.54 million and a rural population of 3.55 million, accounting for 78.19 percent of the total. Nanchong, on the other hand, contains eight counties and one district with a total population of 7.24 million and a rural population of 5.91 million, accounting for 81.63 percent of the total. In 2006, GDP per

[2] There are 286 prefecture-level cities and over 1600 counties.

[3] In addition to basic healthcare insurance nets for ordinary people, there are two special healthcare coverage systems for old revolutionary veterans and senior officials. Healthcare expenses of these beneficiaries are fully reimbursed by the government budgets at various administrative levels, and almost all diseases are covered.

capita was 27,108 yuan in Jinhua and 6,384 yuan in Nanchong.[4] We collected inpatient records from all twelve main hospitals, at the secondary A (IIA) level or above, from both regions in the period of 2003-2006, during which the basic healthcare insurance system was established. In each city there is one tertiary teaching hospital ranked as level-IIIA, and the rest are ranked as level-IIIB and level-IIA hospitals. The data set has 759,001 inpatient records, of which 441, 220 are from Jinhua and 317,781 from Nanchong. The cover and rear pages of an individual inpatient record contain personal features including age, gender, marital status, occupations, etc.; and hospitalized information such as disease types by the International Statistical Classification of Diseases 10th Revision (ICD-10), medical treatment, hospital spending, payment method, and others.

Compared with self-reporting surveys and questionnaires, information from medical records of individual inpatients is accurate and free from subjective evaluation and systematic bias. This is especially important in order to avoid an endogenous problem as a formal regressive model is used to verify determinants of inpatient death and uncured discharges. According to the standards set by the Ministry of Health of China[5], each piece of individual inpatient record must list disease type in line with the International Statistical Classification of Diseases and Related Health Problems 10th Revision Code (ICD-10). In addition, every inpatient who leaves a hospital must be one of four treatment outcomes defined by ICD-10, namely, cured, improved, uncured or dead.

Based on the data set collected from both Jinhua and Nanchong, we conducted a descriptive analysis to assess linkages between disease types and hospitalized outcomes, and then employed a formal model to identify determinants of inpatient death and uncured discharges. In the descriptive analysis, on the one hand, we used the data to capture characteristics of inpatients, and calculated statistics of death and uncured discharges with different diseases defined by ICD-10 in both regions. In the empirical model, on the other hand, we set up a logistic regressive model to test for what are statistically significant determinants of death or uncured discharges.

In the logistic regressive model expressed by equation (1), a dependent variable is given as $\frac{Probability(To=1)}{Probability(To=0)}$, being the odd of death (or uncured discharges) in which treatment outcome (To) is a binary with value of 1 denoting death (or uncured discharges) and 0 for improved and cured inpatients. The explanatory variables are as follows. 1) Diseases type (DT), which is a multinomial variable based on ICD-10; 2) hospital spending (HS), which follows a lognormal distribution; 3) surgery (SU), which is a binary with value of 1 denoting surgery and 0 denoting no surgery; 4) healthcare insurance coverage (IC), which is a binary with value of 1 denoting to healthcare insurance and 0 denoting self-payment; and 5) control variables including personal features, hospital level and other relevant in-hospital information.

$$Log[\frac{Probability(To=1)}{Probability(To=0)}] = \beta_0 + \beta_1 DT + \beta_2 HS + \beta_3 SU + \beta_4 IC + \beta_5 Control\ Variables \quad (1)$$

β_i is the regression coefficient for the *i*th explanatory variable, of which a unit change will affect the odds of death or uncured discharges by exp (β_i) times of its original level, and *ceteris paribus*. All statistical and empirical analyses are conducted with the use of SPSS (version 19.0).

[4] *Zhejiang Statistical Year Book 2006*, Beijing: China Statistics Press, 2006; *Sichuan Statistical Year book 2006*, Beijing: China Statistics Press, 2006.

[5] *The Hierarchical Approach to Hospital Management*, Ministry of Health of the People's Republic of China, 1989.

4. Results

Table 1 reports basic characteristics of inpatients in both cities in 2003-2006. As inpatient records with incomplete information were eliminated, there were 345,360 observations of inpatient records in Jinhua and 291,405 in Nanchong. The total death outcomes were 7,479 and uncured discharges were 20,982. The mortality and uncured rates of all diseases were 0.9 percent and 4.0 percent in Jinhua city, 1.5 percent and 3.5 percent in Nanchong city, respectively. The mortality rates (uncured rates) of urban employees, peasantry and others were 1.5 percent (3.2 percent), 0.8 percent (4.7 percent) and 0.4 percent (3.2 percent) in Jinhua, whereas 2.3 percent (1.8 percent), 1.3 percent (3.9 percent) and 0.9 percent (1.6 percent) in Nanchong. Besides, hospital spending per head in Jinhua was as twice as that in Nanchong, and healthcare insurance covered 29 percent of total hospital spending in Jinhua and 33 percent in Nanchong, respectively. Surgeries were over one-third of inpatients in both regions.

Table 2 shows descriptive statistics including death rate, uncured rate, hospitalization times, surgery, gender, hospital spending and self-payment ratio across diseases in both cities. Among all twenty diseases, the top five diseases relating to death or uncured accounted for more than 40 percent of total mortality and uncured discharges in both cities (see Appendix for details of these diseases). In Jinhua, top five diseases ranked by death percentile were R00-R99 *Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified* (4.0 percent), C00-D48 *Neoplasms* (3.4 percent), I00-I99 *Diseases of the circulatory system* (1.6 percent), S00-T98 *Injury, poisoning and certain other consequences of external causes* (1.2 percent) and F00-F99 *Mental and behavioral disorders* (0.8 percent); and top five diseases by uncured discharges were C00-D48 *Neoplasms* (12.4 percent), R00-R99 *Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified* (11.8 percent), Q00-Q99 *Congenital malformations, deformations and chromosomal abnormalities* (8.4 percent), G00-G99 *Diseases of the nervous system* (6.0 percent) and F00-F99 *Mental and behavioral disorders* (5.9 percent), respectively. In Nanchong city, top five diseases by death percentile were C00-D48 *Neoplasms* (5.0 percent), I00-I99 *Diseases of the circulatory system* (4.0 percent), P00-P96 *Certain conditions originating in the perinatal period* (3.2 percent), E00-E90 *Endocrine, nutritional and metabolic diseases* (2.8 percent) and R00-R99 *Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified* (2.7 percent); and top five by uncured discharges C00-D48 *Neoplasms* (11.1 percent), Q00-Q99 *Congenital malformations, deformations and chromosomal abnormalities* (5.8 percent), R00-R99 *Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified* (5.7 percent), D50-D89 *Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism* (4.3 percent) and I00-I99 *Diseases of the circulatory system* (3.5 percent), respectively. In general, percentiles of top five diseases connecting to death in Jinhua were lower than Nanchong, whereas percentiles of top five-diseases linking to uncured in Jinhua were higher than that of Nanchong. Figure 1 plots inpatient numbers of different diseases by ICD-10 code and percentages of death and uncured discharges relating to respective diseases.

Table 1 Basic Features of Inpatients in Two Regions

	Jinhua	Nanchong
Hospital spending (yuan)	6495.36	3074.90
Age (Year)	43.31	38.62
Gender in inpatients (percent)		
Male	51.8	52.1
Female	48.2	47.9
Occupation in inpatients (percent)		
Urban employees	31.2	28.7
Peasantry	53.3	37.6
Others	15.5	33.7
Death in inpatients (percent)	0.9	1.5
Urban employee	1.5	2.3
Peasantry	0.8	1.3
Others	0.4	0.9
Uncured discharges in inpatients (percent)	4.0	3.5
Urban employee	3.2	1.8
Peasantry	4.7	3.9
Others	3.2	1.6
Payment type in total (percent)		
Self-payment	70.6	67.0
Healthcare coverage	29.4	33.0
Surgery in inpatients (percent)	33.5	35.3

Table 2 Descriptive Statistics of Death and Uncured Discharges across Diseases in Two Regions

ICD	Sample Size	Death (percent)	Uncured (percent)	Hospitalized Times	Surgery	Female (percent)	Hospital spending (yuan)	Self-payment (percent)
				Jinhua				
A00-B99	17563	0.7 percent	4.6 percent	1.13(0.68)	2.8 percent	24.1 percent	5648.94(6996.00)	79.2 percent
C00-D48	35719	3.4 percent	12.4 percent	1.29(1.17)	49.5 percent	55.3 percent	9693.92(12304.18)	65.8 percent
D50-D89	3046	0.4 percent	4.6 percent	1.19(0.75)	3.2 percent	50.5 percent	4628.49(6446.98)	73.0 percent
E00-E90	8685	0.5 percent	2.1 percent	1.31(1.27)	20.2 percent	51.1 percent	5682.71(5705.12)	49.8 percent
F00-F99	1084	0.8 percent	5.9 percent	1.24(0.74)	1.4 percent	54.8 percent	6193.17(15334.90)	56.9 percent
G00-G99	4901	0.7 percent	6.0 percent	1.31(1.43)	6.4 percent	38.9 percent	6164.41(9849.85)	56.8 percent
H00-H59	8784	0.0 percent	2.3 percent	1.13(0.49)	75.4 percent	54.0 percent	3221.40(2601.89)	60.3 percent
H60-H95	2973	0.0 percent	2.2 percent	1.06(0.29)	49.2 percent	49.5 percent	3918.48(3420.35)	61.7 percent
I00-I99	36213	1.6 percent	4.7 percent	1.39(1.43)	8.2 percent	41.3 percent	9547.26(13873.04)	52.0 percent
J00-J99	42817	0.5 percent	2.3 percent	1.25(1.07)	17.7 percent	36.1 percent	4730.38(7472.43)	71.5 percent
K00-K93	43566	0.5 percent	2.6 percent	1.15(0.66)	45.6 percent	39.5 percent	5667.87(7263.56)	68.7 percent
L00-L99	1830	0.1 percent	3.2 percent	1.19(0.64)	44.4 percent	36.4 percent	3704.65(4587.41)	73.6 percent
M00-M99	4837	0.2 percent	3.7 percent	1.18(0.72)	41.7 percent	49.2 percent	7463.54(11088.79)	57.3 percent
N00-N99	20525	0.3 percent	2.9 percent	1.15(0.89)	47.6 percent	58.9 percent	4730.87(5190.12)	65.7 percent
O00-O99	34799	0.0 percent	0.4 percent	1.05(0.24)	51.1 percent	99.7 percent	3097.39(2383.01)	93.7 percent
P00-P96	8404	0.6 percent	4.6 percent	1.03(0.19)	0.5 percent	39.1 percent	2766.48(2513.20)	96.5 percent
Q00-Q99	2649	0.4 percent	8.4 percent	1.08(0.34)	69.5 percent	39.9 percent	5628.21(7935.38)	75.7 percent
R00-R99	3179	4.0 percent	11.8 percent	1.14(0.66)	17.4 percent	39.3 percent	4607.94(10554.26)	65.3 percent
S00-T98	44431	1.2 percent	3.3 percent	1.02(0.24)	47.2 percent	28.6 percent	10446.84(15433.36)	81.6 percent
Z00-Z99	19355	0.1 percent	2.0 percent	2.70(2.21)	15.8 percent	47.8 percent	5535.24(7315.48)	58.7 percent
Total	345360	0.9 percent	4.0 percent	1.26(1.07)	33.5 percent	44.2 percent	6524.03(10078.80)	70.6 percent
				Nanchong				
A00-B99	13510	1.4 percent	3.4 percent	1.07（0.83）	10.2 percent	35.6 percent	2966.70（3768.29）	68.8 percent
C00-D48	20635	5.0 percent	11.1 percent	1.10（0.90）	63.9 percent	56.1 percent	5279.77（5708.31）	70.7 percent
D50-D89	2129	1.1 percent	4.3 percent	1.08（0.61）	11.4 percent	47.5 percent	2604.20(2806.08)	70.0 percent
E00-E90	4399	2.8 percent	2.0 percent	1.08(0.52)	10.1 percent	49.7 percent	3201.49(3289.32)	60.0 percent
F00-F99	1529	0.8 percent	2.6 percent	1.08(0.48)	2.4 percent	55.5 percent	1480.69(1723.76)	68.9 percent

G00-G99	5428	1.5 percent	3.3 percent	1.05(0.61)	6.9 percent	44.3 percent	2987.66(4373.04)	62.6 percent
H00-H59	4986	0.0 percent	1.7 percent	1.02(0.48)	68.4 percent	53.4 percent	1763.90(1731.19)	73.2 percent
H60-H95	1479	0.0 percent	0.5 percent	1.03(0.22)	20.3 percent	57.1 percent	1673.49(1312.21)	63.5 percent
I00-I99	35097	4.0 percent	3.5 percent	1.09(0.64)	10.7 percent	41.9 percent	4336.36(6783.96)	64.6 percent
J00-J99	51580	0.4 percent	0.6 percent	1.06(0.69)	17.7 percent	38.5 percent	1567.60(2164.52)	66.5 percent
K00-K93	44125	0.5 percent	1.5 percent	1.05(0.63)	47.4 percent	43.6 percent	2794.61(3152.96)	69.4 percent
L00-L99	2389	0.1 percent	0.9 percent	1.02(0.30)	30.4 percent	37.4 percent	1817.82(2158.92)	69.9 percent
M00-M99	4993	0.3 percent	2.1 percent	1.03(0.32)	42.8 percent	42.6 percent	3512.06(4385.39)	65.7 percent
N00-N99	18573	0.4 percent	2.2 percent	1.04(0.71)	49.9 percent	55.3 percent	3054.78(2828.47)	68.5 percent
O00-O99	27668	0.0 percent	0.3 percent	1.03(0.59)	70.0 percent	100.0 percent	2000.82(1285.06)	54.8 percent
P00-P96	3739	3.2 percent	3.2 percent	1.02(0.37)	1.3 percent	38.3 percent	1957.05(1836.06)	77.9 percent
Q00-Q99	1602	0.9 percent	5.8 percent	1.01(0.13)	78.0 percent	38.5 percent	6031.96(7860.22)	73.1 percent
R00-R99	3390	2.7 percent	5.7 percent	1.04(0.23)	17.8 percent	40.5 percent	1721.02(2323.68)	70.5 percent
S00-T98	37417	1.5 percent	2.0 percent	1.02(0.61)	37.0 percent	31.9 percent	4289.66(7500.74)	71.8 percent
Z00-Z99	6737	0.3 percent	2.0 percent	1.11(0.63)	38.0 percent	44.7 percent	3409.05(4458.59)	64.4 percent
Total	291405	1.5 percent	2.5 percent	1.05(0.66)	35.3 percent	47.9 percent	3070.53(4695.58)	67.0 percent

Note: Standard errors are in parentheses.

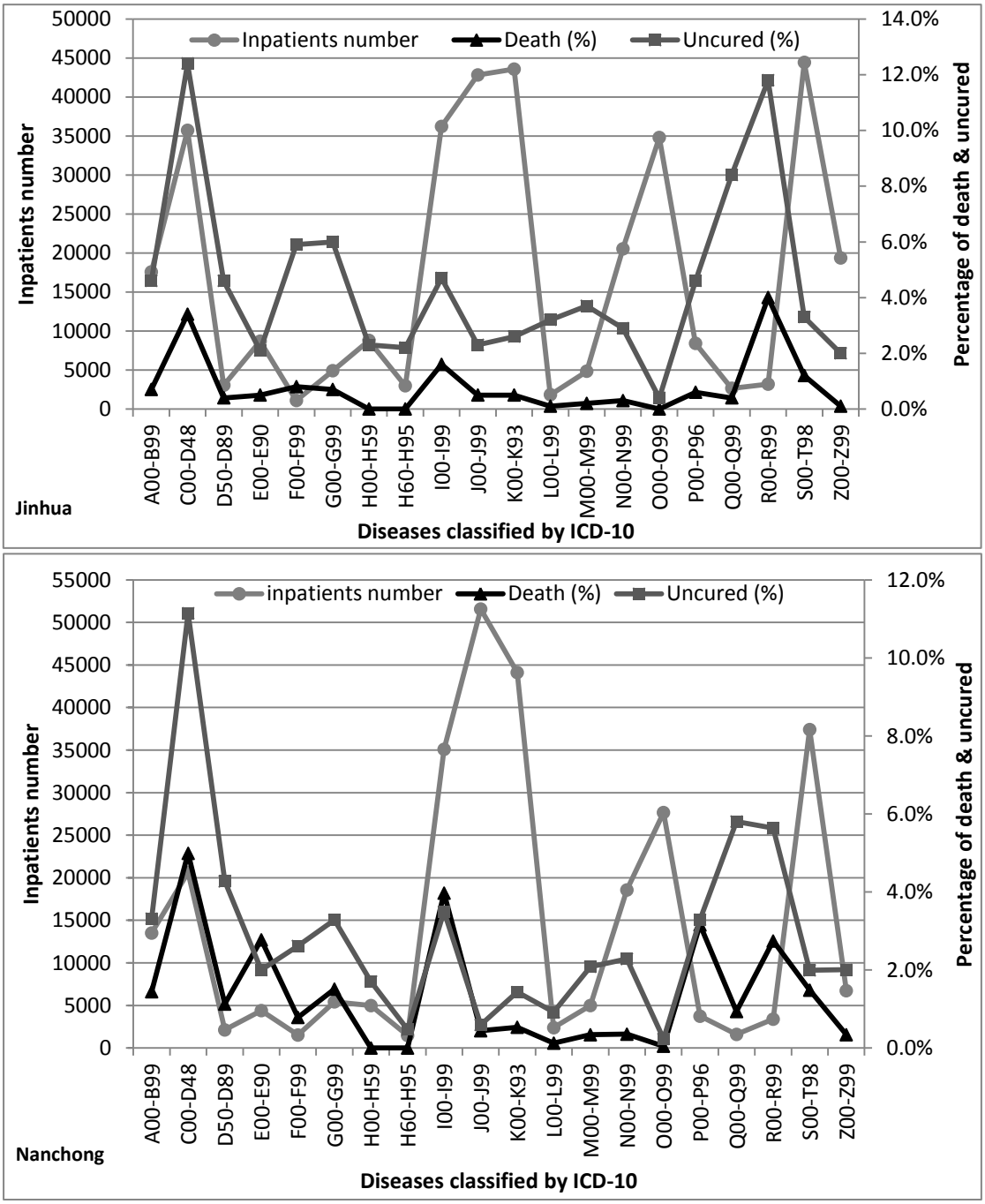

Figure 1: Inpatients Number, Death and Uncured Discharges across Diseases in Jinhua and Nanchong

Although the statistics for the descriptive analysis depict basic features for inpatients and reveal percentiles of diseases to death and uncured discharges, we cannot conclude causality for inpatient death or uncured discharges. Hence, we employed a logistic model to test for whether these diseases are statistically significant determinants of death or uncured discharges in both cities. In order to identify causal relationship between them, we conducted regressions of death and uncured discharges with respect to the diseases based on the equation (1) with control variables including age, condition of illness, first hospitalization, hospital level, hospitalized days, gender, marital status, and occupation to eliminate disturbing influences.

In Part A of Table 3 the dependent variable is death against improved and cured outcomes,

and Part B details uncured discharges against improved and cured outcomes. Parameters of diseases are arrayed in line with their magnitudes so as to distinguish relative importance of respective diseases in explaining death and uncured discharges. The empirical results suggest that in both cities diseases C00-D48 (*Neoplasms*) and R00-R99(*Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified*) were two common statistically significant causes of death, whereas C00-D48 (*Neoplasms*), Q00-Q99 (*Congenital malformations, deformations and chromosomal abnormalities*) and R00-R99 (*Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified*) were three common statistically significant causes of uncured discharges. In Jinhua city, most diseases had statistically significant and positive effects on death except three diseases such as O00-O99 (*Pregnancy, childbirth and the puerperium*), H60-H95 (*Diseases of the ear and mastoid process*) and H00-H59 (*Diseases of the eye and adnexa*), and all diseases had statistically significant and positive effects on uncured discharges. In Nanchong city, however, only eleven diseases had significant and positive impacts on death, eight diseases including F00-F99 (*Mental and behavioral disorders*), M00-M99 (*Diseases of the musculoskeletal system and connective tissue*), J00-J99 (*Diseases of the respiratory system*), K00-K93 (*Diseases of the digestive system*), N00-N99 (*Diseases of the genitourinary system*), L00-L99 (*Diseases of the skin and subcutaneous tissue*), H60-H95 (*Diseases of the ear and mastoid process*), and H00-H59 (*Diseases of the eye and adnexa*) had no such effects, and disease O00-O99 (*Pregnancy, childbirth and the puerperium*) even had negatively significant impact on death; while just five diseases like C00-D48 (*Neoplasms*), Q00-Q99 (*Congenital malformations, deformations and chromosomal abnormalities*), R00-R99 (*Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified*), D50-D89 (*Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism*) and A00-B99 (*Certain infectious and parasitic diseases*) had positively significant effects on uncured discharges, and the rest diseases showed either insignificant or even negative effects.

Table 3 Results of Death and Uncured Discharges Regressed by Diseases

A: death regressed by diseases						B: uncured regressed by diseases					
Jinhua			**Nanchong**			**Jinhua**			**Nanchong**		
	β	**Sig.**		***β***	**Sig.**		***β***	**Sig.**		***β***	**Sig.**
C00-D48	6.800	0.000	**C00-D48**	2.730	0.000	**C00-D48**	3.831	0.000	**C00-D48**	1.581	0.000
R00-R99	6.526	0.000	**R00-R99**	1.635	0.000	**Q00-Q99**	3.374	0.000	**Q00-Q99**	1.126	0.000
S00-T98	5.454	0.000	**Q00-Q99**	1.403	0.000	**R00-R99**	3.344	0.000	**R00-R99**	0.719	0.000
I00-I99	5.317	0.000	**E00-E90**	1.301	0.000	**A00-B99**	3.031	0.000	**D50-D89**	0.469	0.002
A00-B99	5.230	0.000	**I00-I99**	1.286	0.000	**G00-G99**	2.866	0.000	**A00-B99**	0.177	0.093
G00-G99	4.772	0.000	**A00-B99**	1.174	0.000	**F00-F99**	2.819	0.000	**G00-G99**	0.157	0.196
P00-P96	4.756	0.000	**P00-P96**	0.910	0.001	**P00-P96**	2.702	0.000	**F00-F99**	-0.004	0.985
K00-K93	4.737	0.000	**D50-D89**	0.789	0.017	**M00-M99**	2.607	0.000	**N00-N99**	-0.080	0.441
Q00-Q99	4.677	0.000	**S00-T98**	0.668	0.005	**D50-D89**	2.540	0.000	**P00-P96**	-0.121	0.399
D50-D89	4.657	0.000	**G00-G99**	0.614	0.022	**I00-I99**	2.332	0.000	**I00-I99**	-0.141	0.142
J00-J99	4.592	0.000	**F00-F99**	0.394	0.326	**S00-T98**	2.175	0.000	**M00-M99**	-0.266	0.065
E00-E90	4.298	0.000	**M00-M99**	0.255	0.447	**L00-L99**	2.104	0.000	**E00-E90**	-0.474	0.001
N00-N99	4.220	0.000	**J00-J99**	0.205	0.403	**N00-N99**	2.069	0.000	**H00-H59**	-0.493	0.001
F00-F99	4.151	0.001	**K00-K93**	0.133	0.584	**H00-H59**	1.919	0.000	**S00-T98**	-0.544	0.000
M00-M99	3.894	0.000	**N00-N99**	0.018	0.946	**K00-K93**	1.822	0.000	**K00-K93**	-0.675	0.000
L00-L99	2.999	0.034	**L00-L99**	-0.803	0.200	**J00-J99**	1.785	0.000	**L00-L99**	-1.107	0.000
O00-O99	-10.909	0.979	**O00-O99**	-1.635	0.000	**H60-H95**	1.784	0.000	**J00-J99**	-1.396	0.000
H60-H95	-11.108	0.990	**H60-H95**	-15.479	0.988	**E00-E90**	1.471	0.000	**H60-H95**	-2.046	0.000
H00-H59	-11.210	0.984	**H00-H59**	-16.968	0.976	**O00-O99**	0.679	0.000	**O00-O99**	-2.055	0.000
-2 Log likelihood	**χ2**	**Nagelk-erke R^2**	**-2 Log likelihood**	**χ2**	**Nagelk-erke R^2**	**-2 Log likelihood**	**χ2**	**Nagelk-erke R^2**	**-2 Log likelihood**	**χ2**	**Nagelk-erke R^2**
15019.76	3251.59	0.186	26544.27	10947.03	0.308	51644.61	7524.82	0.148	50077.25	8066.52	0.153

Each parameter indicates that *ceteris paribus*, disease type will lead odds of death or uncured discharges by exp (β) times the corresponding odds of Z00-Z99 (*Factors influencing health status and contact with health services level*), which is used as the reference category.

In addition to disease effects, exogenous factors such as hospital spending, surgery and healthcare insurance are most likely to be other important determinants of death and uncured discharges in China. Hence, we further conducted regressions of death and uncured discharges with respect to exogenous factors based on the equation (1) with inclusion of all diseases and control variables to test for whether there were causal relationships between them. In Part A of Table 4, the dependent variable of death against improved and cured outcomes is regressed by exogenous variables with inclusion of all diseases and control variables. According to the results, these exogenous variables had quite different effects on death of inpatients in both cities. In sum, surgery had statistically significant yet opposite effects on death of inpatients in two regions. Specifically, surgery had negative impact on death in Jinhua, whereas it had positive effect in Nanchong. Moreover, hospital spending also had statistically significant and opposite effects on death in both regions—it was positive in Jinhua and negative in Nanchong. Finally, healthcare insurance did not have significant effect on inpatient death in both regions. These puzzled findings suggest that inpatients of these two places may be faced with different constraints in hospitalization.

Table 4 Results of Death and Uncured Discharges Regressed by Exogenous Variables

	Jinhua		Nanchong	
A: death regressed by exogenous variables				
	β	Sig.	β	Sig.
Constant	-15.130	0.000	-5.950	0.000
ICD classification		0.000		0.000
Hospital spending	0.587	0.000	-0.165	0.000
Surgery	-1.347	0.000	0.236	0.000
Healthcare insurance	-0.103	0.121	0.004	0.935
Age	0.000	0.920	0.010	0.000
Condition of illness		0.000		0.000
Serious	2.595	0.000	3.541	0.000
Critical	0.322	0.000	0.735	0.000
First hospitalization	-1.161	0.000	-0.364	0.000
Hospital level				0.000
IIIA	-0.543	0.000	0.555	0.000
IIIB			-0.117	0.178
IIA			-0.042	0.529
Hospitalized days	-0.017	0.000		
Male	0.389	0.000	0.493	0.000
Married	0.624	0.000	0.654	0.000

Occupation			0.000			0.000
Urban employee	0.135		0.465	0.436		0.000
Peasant	-0.417		0.025	-0.457		0.000
Diagnostic statistics	-2 Log likelihood	$\chi 2$	Nagelk-erke R^2	-2 Log likelihood	$\chi 2$	Nagelke -rke R^2
	12519.03	3357.99	0.221	26397.02	10994.17	0.310
B: uncured regressed by exogenous variables						
	β		Sig.	β		Sig.
Constant	-2.412		.000	-1.798		0.000
ICD classification			.000			0.000
Hospital spending	-.701		.000	-0.562		0.000
Surgery	-2.179		.000	-1.302		0.000
Healthcare insurance	-.338		.000	-0.192		0.000
Age	.000		.251	0.007		0.000
Condition of illness						
Serious	1.855		.000	1.845		0.000
Critical	.304		.000	0.083		0.009
First hospitalization	-.040		.524	0.005		0.945
Hospital level						
IIIA	-.014		.716	0.121		0.016
IIIB				0.045		0.493
IIA				-0.045		0.335
Hospitalized days	-.015		.000			
Male	.314		.000	0.328		0.000
Married	.477		.000	0.366		0.000
Occupation						
Urban employee	.631		.000	0.142		0.002
Peasant	.870		.000	0.381		0.000
Diagnostic statistics	-2 Log likelihood	$\chi 2$	Nagelk-erke R^2	-2 Log likelihood	$\chi 2$	Nagelk-erke R^2
	41642.47	10893.50	0.237	45920.58	12063.60	0.228

Sig. indicates significant level. Hospital spending is yuan in logged form.

In Part B of Table 4, the dependent variable of uncured discharges against improved and cured outcomes is regressed by explanatory variables. According to the computed results, surgery

had statistically significant effect to lower uncured discharges in both regions, and so did hospital spending. Moreover, unlike results in Part A of the same Table, healthcare insurance had significant effect to reduce uncured discharges in both cities. These findings indicate that payment of hospital spending, provision of medical service and coverage of healthcare insurance are statistically significant determinants for uncured discharges of inpatients in different areas.

5. Conclusion

In this paper we studied determinants of mortality and uncured inpatients in China. Based on 759,001 medical records of individual inpatients from two prefecture-level cities in the period of 2003-2006, we used descriptive analysis to document linkages between disease types and hospitalized outcomes, and designed an empirical model to test for causal relationships between hospitalized outcomes and all possible explanatory variables.

The calculated statistics indicate that rates of death and uncured discharges varied in different cities. Although overall mortality rate of inpatients in economically-advanced Jinhua was 40 percent lower than that in underdeveloped Nanchong, overall uncured rate in the former was 14 percent higher than the latter. Moreover, mortality rates of urban employees, peasantry and others in Jinhua were respectively 35 percent, 39 percent, and 56 percent lower than those in Nanchong, but uncured rates of employees, peasantry and others in Jinhua were 78 percent, 21 percent and 100 percent higher than Nanchong, respectively. The descriptive analysis also reveals that top five diseases claimed more than 40 percent of total death and uncured discharges in both cities, though the patterns of lethal diseases differed in both cities. Despite C00-D48 (*neoplasms*), I00-I99 (*diseases of the circulatory system*) and R00-R99 (*abnormal clinical & lab findings*) were listed as three top common diseases connecting to death in both cities, other diseases were ranked differently in both regions. Similarly, only C00-D48 (*neoplasms*), Q00-Q99 (*congenital malformations, deformations & chromosomal abnormalities*) and R00-R99 (*abnormal clinical & lab findings*) were three top common diseases relating to uncured discharges in the two areas, but the rest diseases ranked differently. The different disease patterns may jointly reflect regional features, disparity of economic development healthcare service quality.

The formal logistic model is able to identify causality between hospitalized outcomes and explanatory variables. In both regions only C00-D48 (*neoplasms*) and R00-R99 (*abnormal clinical & lab findings*) were documented as two common statistically significant determinants of inpatient death, while C00-D48 (*neoplasms*), Q00-Q99 (*congenital malformations, deformations & chromosomal abnormalities*) and R00-R99 (*abnormal clinical & lab findings*) were significant common determinants of uncured discharges. In Jinhua, the majority of diseases and all diseases were verified to be statistically significant and positive determinants of inpatient death and uncured discharges. In Nanchong, however, merely eleven diseases and five diseases were respectively proved to be statistically significant and positive determinants of death and uncured discharges. It is worth noting that F00-F99 (*mental & behavioral disorders*), M00-M99 (*musculoskeletal & connective tissue diseases*), J00-J99 (*respiratory diseases*), K00-K93 (*digestive diseases*), N00-N99 (*genitourinary diseases*), and L00-l99 (*diseases of skin & subcutaneous tissue*) were not statistically significant causes of inpatient death in Nanchong, yet they were all significant death causes in Jinhua. Besides, just C00-D48 (*neoplasms*), Q00-Q99 (*congenital malformations, deformations & chromosomal abnormalities*), R00-R99 (*abnormal*

clinical & lab findings), D50-D89 (*diseases of blood & immune disorders*), and A00-B99 (*infectious & parasitic diseases*) were significant causes of uncured discharges in Nanchong, whereas all diseases were confirmed to be significant determinants of uncured discharges in Jinhua. These findings strongly suggest that not all diseases had causal linkages to inpatient death and uncured discharges, especially in the economically-disadvantaged region; and nexuses between diseases and inpatient death and/or uncured discharges in different regions varied largely.

In addition to identified diseases as main causes of inpatient death and uncured discharges, hospital spending, surgery and healthcare insurance were proved to have strong effects on death and uncured discharges of inpatients. Firstly, there was a statistically significant and positive causal relationship between death and hospital spending in Jinhua, though this relationship was negative in Nanchong. This finding may suggest that increase in financing for hospitalization in low-income region might reduce death but it was not necessary in high-income area. Indeed, there exists big gap between hospital spending in China's developed and less developed regions, which is most likely to have strong effect on hospitalized outcomes. During 2003-2006, for example, hospital spending per capita was 3,070.53 yuan ($472) in Nanchong, about 30 percent lower than that of the national average, whereas it was 6,524.03 yuan ($1,003) in Jinhua, around 49 percent higher than that of the national level.[6] Besides, spending was verified to be statistically significant in reducing uncured discharges in both regions. Secondly, the statistically significant negative relationship between death and surgery in Jinhua was confirmed, whereas positive death-surgery nexus in Nanchong was observed. In developed Jinhua, performance of surgery reduced mortality, but in backward Nanchong the positive linkage may be attributed to lack of timely surgery for inpatients with critical conditions, due to either budget constraints or limited provision of quality healthcare services. Moreover, surgery was proved to have statistically significant effect to lower uncured discharges in both regions. Finally, though healthcare insurance had no significant effect on mortality, it did significantly reduce uncured discharges in both cities. This may explain why peasantry had higher uncured rate compared to urban residents because the former's healthcare coverage is much thinner than that of the latter under the fragmented healthcare insurance system. As a result, high cost of serious illnesses is a main barrier to prevent poor peasants from undertaking timely medical treatment and even forces them to abort it.

These results have direct policy implications. For instance, regional disease patterns need immediate attention so as to reduce mortality and uncured discharges of hospitalization. It is crucially important to relieve budget constraints for inpatients in economically disadvantaged regions and increase healthcare coverage for rural residents, for the purpose of improving wellbeing of low-income households. Last but not the least, there is an urgent need for enhancing the supply of quality healthcare service, especially in underdeveloped regions, to lower inpatient mortality rates.

[6] *China Social Statistical Yearbook 2007*, Beijing: China Statistics Press, 2007.

Appendix. List of ICD-10 Codes

Chapter	Blocks	Title
I	A00–B99	Certain infectious and parasitic diseases
II	C00–D48	Neoplasms
III	D50–D89	Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
IV	E00–E90	Endocrine, nutritional and metabolic diseases
V	F00–F99	Mental and behavioral disorders
VI	G00–G99	Diseases of the nervous system
VII	H00–H59	Diseases of the eye and adnexa
VIII	H60–H95	Diseases of the ear and mastoid process
IX	I00–I99	Diseases of the circulatory system
X	J00–J99	Diseases of the respiratory system
XI	K00–K93	Diseases of the digestive system
XII	L00–L99	Diseases of the skin and subcutaneous tissue
XIII	M00–M99	Diseases of the musculoskeletal system and connective tissue
XIV	N00–N99	Diseases of the genitourinary system
XV	O00–O99	Pregnancy, childbirth and the puerperium
XVI	P00–P96	Certain conditions originating in the perinatal period
XVII	Q00–Q99	Congenital malformations, deformations and chromosomal abnormalities
XVIII	R00–R99	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified
XIX	S00–T98	Injury, poisoning and certain other consequences of external causes
XX	V01–Y98	External causes of morbidity and mortality
XXI	Z00–Z99	Factors influencing health status and contact with health services
XXII	U00–U99	Codes for special purposes

Source: "International Classification of Diseases 10th Revision". *The World Health Organization*. 2010.

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