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Study On Patients of Prolonged Hospital Stay in A Tertiary Public Hospital in South China: A Retrospective Analysis

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Keywords:

Hospital length of stay; Prolonged hospital stay; Risk factors

Abbreviations:

OR: Odds ratio; LOS: Hospital length of stay; tLOS: Total hospital length of stay; URBMI: The Urban Resident Basic Medical Insurance; UEBMI: The Urban Employee Basic Medical Insurance; NCMS: The New Cooperative Medical Scheme

1. Abstract

Prolonged hospital stay (LOS) increases morbidity rates and is associated with excessive health system costs. The present study explored the factors related to prolonged hospital stay among patients. We retrieved all patients data through a search in the medical record system (DMIEAS) from 2019 to 2022. Patients were divided into a non-prolonged LOS group (≤30 days) and a prolonged LOS group (>30 days). Logistic regression analysis was performed to obtain odds ratios (ORs) for prolonged hospitalization with the following variables: age, sex, ethnicity, payment type, admission route, admission condition, history of operation, and mode of discharge.

In total, 486,528 patients were discharged from our institute, of which 11404 patients stayed for more than 30 days (2.34%). The number of patients with prolonged LOS has decreased in the last four years from 2.72% (2019) to 1.99% (2022). The factors associated with prolonged hospitalization were male sex(OR=1.402,95%CI=1.348-1.457, P<0.000), urgent admission(OR=1.665, 95%CI=1.346-2.061, P=0.000), surgery history((OR=1.108, 95%CI=1.065-1.152, P=0.000), Han ethnicity (OR=1.051, 95%CI=1.011-1.093, P=0.004), and being insured by URBMI (OR=1.199, 95%CI=1.138-1.263, P=0.000). Compared to other age groups, those aged 45-59 and aged ≥90 years were significantly associated with prolonged LOS(OR=1.107, 95%CI=1.043-1.175, P=0.001; OR=3.459, 95%CI=2.842-4.211, P=0.000). The characteristics of the disease and primary surgery also become the main reasons for hospitalizations exceeding 30 days. Awareness of the risk factors for a prolonged LOS might contribute to reducing hospitalization stay and its related negative consequence. Accurate prediction of prolonged LOS in different hospital may be more challenging and require variable that were not include in our study. Further research is warranted.

2. Introduction

In an increasingly competitive and resource-limited healthcare marketplace, appropriate and efficient utilization management by hospitals is of growing importance and scrutiny [1]. The length of hospital stay is recognized as an important indicator of medical services, in addition to the efficiency of hospital management, patient quality of care, and functional evaluation [2]. Health care providers and hospital administrators are interested in early and accurate LOS predictors for both economic and organizational reasons. Inpatients with prolonged LOS, referred to as LOS outliers, pose a challenge to hospitals and health systems by contributing to high costs with lower reimbursements, while assuming all the risks associated with hospital-acquired conditions. A matched cohort study reported a link between the need for guardianship and mean LOS exceeding 30 days in a subset of adult inpatients and a mean LOS exceeding 30 days [3]. European studies from Spain, Portugal, and the United Kingdom have reported in-hospital outlier populations and the economic burden on national health system models. European outlier populations range from 3.5% to 5%, accounting for 19% to 25% of the total inpatient days and 15% of the total hospital costs. Although LOS outliers comprise a small proportion of patients, they consume a disproportionately large amount of health care resources [4]. In a Canadian study, 40% of acute hospital days were consumed by 5% of prolonged hospitalizations (with a definition of 30 days) [5].

In the wake of COVID-19, the role of health professionals has become much more critical in society, as well as the availability of health resources has improved significantly. Prolonged hospital stays can strongly influence people's development and daily life. Furthermore, prolonged hospitalization is associated with an unacceptable burden on healthcare resources and undermines the productive capacity of the population through the time lost during hospitalization [6]. A previous study showed that the probability of experiencing an adverse event increased by approximately 6% on hospital day [7]. As China's health reform and an aging population trend have led to increased patient volumes, reducing prolonged length of stay is an important goal for hospitals seeking to increase bed availability, maximize cost efficiency, and reduce iatrogenic complications. Prolonged length of stay is defined as a duration of 30 days or more, much longer than the average LOS for medical stays in china (8.8 days for public tertiary hospitals in 2021) [8]. As an important indicator, the management, analysis, and evaluation of patients who have been hospitalized for more than 30 days are incorporated in the Detailed Rules for the Evaluation of the Tertiary Comprehensive Hospital in China. Therefore, effective control of the prolonged length of hospitalization is an urgent problem for medical institutions. The identification of risk factors associated with hospital length of stay may play an important role in understanding how to reduce resource consumption and enhance quality of care. Previous studies have showed that prolonged hospital stay is associated with patient demographic and clinical characteristics include age, sex, infection and comorbidity [9-13].

Previous study analyzed the prolonged LOS based on some specific patients, such as women with disabilities, truma patients, oldest-old patients [14-18]. Therefore, based on all the admitted patients, our study aims to better understand the landscape of long-stay hospitalizations and to evaluate factors predicting whether an individual has a higher chance of longer hospitalization time. We conducted a study of inpatients with stays over 30 days from 2019 to 2022 in a tertiary hospital in South China, to identify the disease of the patients, and to characterize the predictors of prolonged hospitalizations among patients to guide future efforts aimed at optimizing healthcare resources in our institution.

3. Methods

3.1. Study Design and Setting

A retrospective study was designed. We conducted the present study by reviewing de-identified data from the DMIEAS (Disease Management Intelligent Analysis and Evaluation System) during a 4-year period from 2019 to 2022 for patients admitted to the First Affiliated Hospital of Guangxi Medical University (FAH-GXMU) in South China. The 2750-bed tertiary hospital was founded in 1934 and was the first Grade A, Class III general hospital in Guangxi. This institute consists of 46 clinical departments, 71 wards, and 19 medical technical departments. In the Performance Appraisal of National Tertiary Public Hospital in 2021, FAH-GXMU ranks 43th among 1355 nationwide hospitals and top one in Guangxi Province. Patients hospital discharge data were obtained from the DMIEAS (Disease Management Intelligent Analysis and Evaluation System). This information base is linked with the HIS, a compulsory registry for every patient admitted to the hospital. In our study, a long length of hospital stay (LOS) was defined as an inpatient stay of >30 days. We obtained details on patients who had a hospital stay of > 30 days and ≤ 30 days.

3.2. Study Variables

In order to investigate the potential influencing factors associated with prolonged hospital stay. The potential influencing factors included patients' demographic information such as age, gender, ethnicity. Apart from demographic data, patients' LOS, payment type, admission condition, admission route, history of operation, and mode of discharge were also included in this study. Patients' payment type were divided into six types including the Urban Resident Basic Medical Insurance (URBMI), the Urban Employee Basic Medical Insurance(UEBMI), the New Cooperative Medical Scheme(NCMS) commercial insurance, self-paying and other. UEBMI, URBMI and NCMS are the three types of social health insurance subsidized by the Chinese government. UEBMI is for employed urban workers, initiated in 1998. The URBMI program is proposed for the unemployed, retired, students, and children.

The New Cooperative Medical Scheme (NCMS), established in 2003, mainly targets farmers in rural areas. While enrolment under the UEBMI is compulsory for urban employees, the NCMS and URBMI are voluntary insurance programs. Admission condition was divided into 3 levels in our study, including urgent, critical and general. Urgent means patients' needs to be dealt with immediately. Critical means patients with serious disease such as breathing difficulty, heart arrest. General means patients in a stable condition.

Admission route (how did the patients get to the hospital) was divided into 3 ways, including emergency, outpatient, transferred from other institutions. Mode of discharge was divided into 4 ways, including medical advice for discharge, medical advice for transfers, died and voluntary discharge.

3.3. Data Management and Analysis

Patients' hospital discharge data were obtained from the DMIEAS. The DMIEAS contains social demographic and clinical data for each documented hospital stay, including basic patient information, primary diagnosis, admission condition, primary surgery, admission and discharge status, and the length of stay for each patient. Primary diagnosis was made by International Classification of Diseases, Ninth Revision codes (ICD-10, ICD-9-CM-3) from an administrative database that had been developed, validated, and maintained by our hospital medicine group. Data were analysed using the statistical package IBM SPSS version 25.0 for Windows (IBM Corp 2017). Descriptive statistics, including numbers, frequencies, and percentages, were used to detail the demographic variables. Data are reported as mean with standard deviation for continuous parametric data, median with interquartile range (IQR) for non-parametric data, and proportions for categorical variables. The variables were analyzed and evaluated as risk factors for prolonged LOS included age, sex, ethnicity, payment type, admission condition, admission route, history of operation, and mode of discharge. A descriptive analysis of these patients was performed, and the demographic variables of the patients with or without prolonged LOS were compared. Chi-square test for categorical variables with the Yates correction was applied to examine differences in values between the two groups. Binary and ordinal logistic regression analyses were performed to determine the statistically significant causes of prolonged hospital stay. Statistical significance was set at $p < 0.05$.

4. Results

Between 1st January the year 2019 and 31st December of the year 2022, a total of 486,528 patients were discharged from the hospital and eligible for the present analysis. A patient flow diagram is shown in (Figure 1). Patients had hospital stays of greater than 30 days accounting for 2.34% of total outpatients.

As presented in (Figure 2), our findings also show that the number of patients with prolonged LOS has decreased in the last four years from 2.72% (2019) to 1.99% (2022). With the outbreak of Covid-19, proportion of prolonged LOS of total inpatients peaked at 2.99 in the year of 2020.

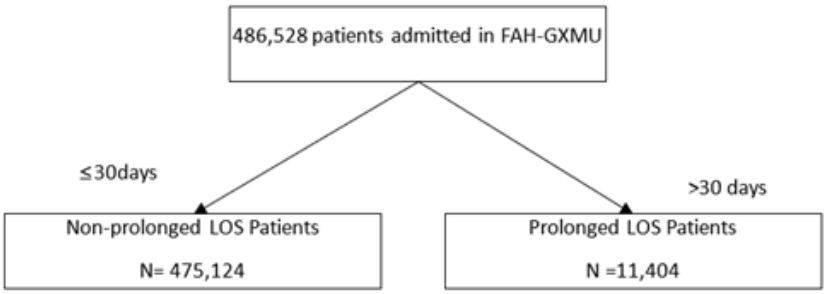

Figure 1: Study flowchart. Of the 486,528 patients admitted in FAH-GXMU were enrolled. The 486,528 patients were divided into a non-prolonged LOS patients' group (N=475,124) and prolonged LOS patients' group (N=11,404).

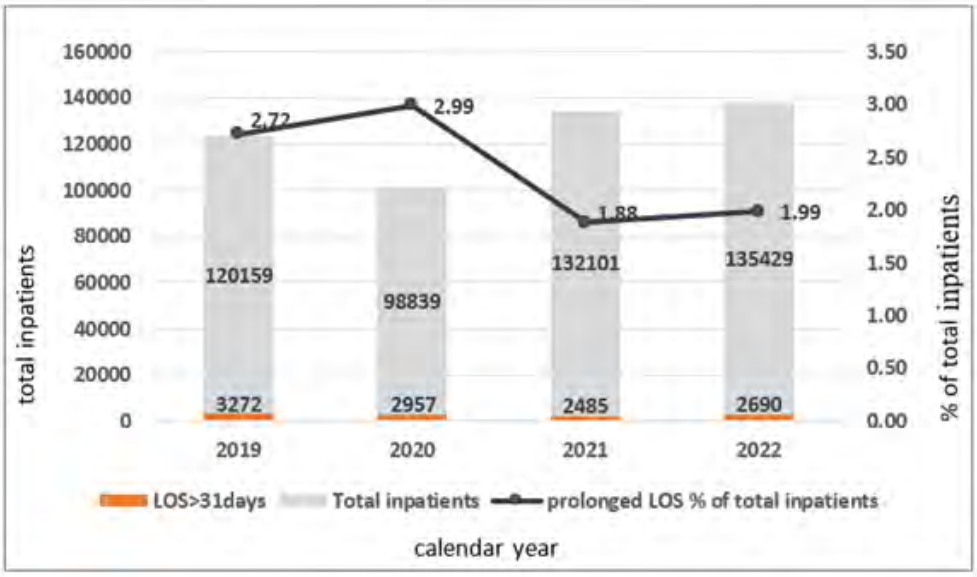

Figure 2: Total inpatients, Prolonged LOS inpatients Count and % of total

4.1. Hospital Stay Distribution of prolonged LOS Inpatients

As shown (Table 1), LOS of prolonged inpatients were concentrated in 31-40days (48.00%). Of these, length of hospital stays (LOS) for this cohort ranged from 31 to 720 days, with a median of 41 days （IQR, 35.00-51.00), compared to 6.83 days (IQR,3.00-9.00) in the non-prolonged group. Their ages ranged from 0 to 103 years, with a median age of 44 years (IQR, 31-61 years old).

4.2. Characteristic of Patients with and without Prolonged Hospitalization and Influencing Factor Associated with Prolonged Hospitalization

(Table 2) compares the characteristics of patients with and without prolonged LOS. Age, sex, ethnicity, insurance, admission route, admission condition, history of operation, and mode of discharge were among the variables that differed significantly between the 2 groups. The most common insurance for prolonged and non-prolonged hospitalization was URBMI, but this insurance represented a larger percentage of prolonged hospitalizations, so as for the male sex. Patients with prolonged hospitalizations were more likely to be transferred from other institutions (1.63% VS 0.73%, P＜0.01).

4.3. Predictors of Prolonged Hospitalizations

In logistic regression model (Table 3), we found male sex was significantly associated with prolonged LOS (OR=1.402, 95%CI=1.348-1.457, P<0.000). Patients' urgent admission condition with urgent were significantly associated with prolonged LOS (OR=1.665, 95%CI=1.346-2.061, P=0.000). Compared to other age groups, those aged 45-59 and aged ≥90 years were significantly associated with prolonged LOS (OR=1.107, 95%CI=1.043-1.175, P=0.001; OR=3.459, 95%CI=2.842-4.211, P=0.000). Those insured by URBMI had the highest odds of being prolonged LOS patients compared to those insured by self-paying and other insurance (OR=1.199,95%CI=1.138-1.263, P=0.000). Patients that had A history of surgery was associated with an increased risk of prolonged surgery (OR=1.108, 95%CI=1.065-1.152, P<0.001). For instance, those insured by URBMI, being male, were more prone to have a longer duration of hospitalization. The results of the binary logistic regression between covariates and prolonged LOS are presented in (Table 4 and 5). It should be noted that male gender were 1.402 times more likely to have a longer LOS than females (P<0.05).

Table 1: Hospital Stay Distribution of prolonged LOS Inpatients

Days of Hospital Stay	Number(n)	Percent (%）
31-40	5473	48
41-50	2965	26
51-60	1317	11.5
61-70	659	5.8
71-80	337	3
81-90	539	4.7
>90	114	1
Total	11404	100

Table 2: Univariate variables based on hospital length of stay(n=486528)

Variables	Hospital length of stay(d)		Statistical Value	P value
	>30(n=11404)	≤30(n=475124)		
Gender			395.685	0
Male	7197 (63.11%)	255208 (53.71%)		
Female	4207 (36.89%)	219916 (46.29%)		
Ethnic			6.072	0.014
Han	7147 (62.67%)	292368 (61.54%)		
Minority	4257 (37.33%)	182756 (38.46%)		
Age (years)			386.545	0
≤14	1830 (16.05%)	69291 (14.58%)		
15-29	979 (8.58%)	42902 (9.03%)		
30-44	2017 (17.69%)	92890 (19.55%)		
45-59	3516 (30.83%)	141515 (29.78%)		
60-74	2265 (19.86%)	103878 (21.86%)		
75-89	669 (5.87%)	23435 (4.93%)		
≥90	128 (1.12%)	1213 (0.26%)		
Insurance			222.88	0
UEBMI	2037 (17.86%)	90454 (19.04%)		
URBMI	6034 (52.91%)	223137 (46.96%)		
NCMS	757 (6.64%)	30918 (6.51%)		
Commercial Insurance	1 (0.01%)	70 (0.01%)		
Self-Paying	1210 (10.61%)	69526 (14.63%)		
Other	1365 (11.97%)	61019 (12.84%)		
Admission Route			2082.11	0
Emergency	2716 (23.82%)	51097 (10.75%)		
Outpatient	8503 (74.56%)	420562 (88.52%)		
Transferred from other institutions	185 (1.63%)	3465 (0.73%)		
Admission Condition			274.584	0
Urgent	103 (0.90%)	943 (0.20%)		
Critical	14 (0.01%)	199 (0.04%)		
General	11287 (98.97%)	473982 (99.76%)		
Surgery			9.149	0.002
Yes	4491 (39.38%)	193800 (40.79%)		
No	6913 (60.62%)	281324 (59.21%)		
Mode of Discharge			1722.73	0
Medical advice for discharge	10581 (92.78%)	461712 (97.18%)		
Medical advice for transfers	58 (0.51%)	3736 (0.79%)		
Died	288 (2.53%)	1691 (0.36%)		
Voluntary discharge	477 (4.18%)	7985 (1.68%)		

Table 3: Multivariate Logistics Regression between the covariates and hospital length of stay

	Categories	Exp(B)/Odds ratio	P value	CI 95%
Gender				
	Male	1.402	0	1.348-1.457
	Female	—	—	—
Ethnic				
	Han	1.051	0.012	1.011-1.093
	Minority	—	—	—

Age				
	≤14	—	—	—
	15-29	1.077	0.071	0.994-1.167
	30-44	1.033	0.337	0.967-1.104
	45-59	1.107	0.001	1.043-1.175
	60-74	0.915	0.007	0.858-0.976
	75-89	1.071	0.149	0.976-1.175
	≥90	3.459	0	2.842-4.211
Insurance			0	
	UEBMI	—	—	—
	URBMI	1.199	0	1.138-1.263
	NCMS	1.06	0.186	0.972-1.155
	Commercial Insurance	0.548	0.555	0.074-4.039
	Self-Paying	0.643	0	0.597-0.693
	Other	0.943	0.109	0.879-1.013
Admission Route			0	
	Emergency	0.743	0	0.635-0.870
	Outpatient	0.297	0	0.254-0.347
	Transferred from other institutions	—	—	—
Surgery				
	Yes	1.108	0	1.065-1.152
	NO	—	—	—
Admission Condition				
	Urgent	1.665	0	1.346-2.061
	Critical	1.522	0.149	0.861-2.693
	General	—	—	—
Mode of Discharge			0	
	Medical advice for discharge	1.271	0.072	0.979-1.650
	Medical advice for transfers	—	—	—
	Died	5.694	0	4.252-7.624
	Voluntary discharge	2.476	0	1.876-3.268

Table 4: Top 10 Primary Diagnoses for Patients with and Without Prolonged Hospitalizations

	Primary Diagnose for Hospital length of stay>30(d)	**Number (Percent)**	**Primary Diagnose for Hospital length of stay(d)≤30(d)**	**Number (Percent)**
Top-1	Z51.003 Radiotherapy for malignant tumor	1292 (11.33%)	Z51.103 Maintenance chemotherapy for malignant tumor	38394 (8.08%)
Top-2	D56.100x003 Heavy Thalassemia type β	342 (3.00%)	Z51.102 Postoperative chemotherapy of malignant tumor	15245 (3.21%)
Top-3	Z51.002 Postoperative radiotherapy for malignant tumors	197 (1.73%)	I20.000 Unstable angina pectoris	8433 (1.77%)
Top-4	C91.000 Acute lymphoblastic leukemia	184 (1.61%)	Z51.801 Targeted treatment of malignant tumor	6765 (1.42%)
Top-5	Z51.103 Maintenance chemotherapy for malignant tumor	182 (1.60%)	Z51.800x095 Immunotherapy for malignant tumors	6076 (1.28%)
Top-6	J15.903 Community-acquired pneumonia, severe	144 (1.26%)	C22.000 Hepatocellular carcinoma	5037 (1.06%)
Top-7	C91.002 Acute lymphocytic leukemia, type L2	133 (1.17%)	C73.x00 Thyroid malignant tumor	4685 (0.99%)
Top-8	C11.900 Malignant tumor of nasopharynx	117 (1.03%)	H25.900 Senile cataract	3930 (0.83%)
Top-9	C22.000 Hepatocellular carcinoma	115 (1.01%)	Z51.800x092 Interventional treatment of malignant tumor	3387 (0.71%)
Top-10	I61.004 Basal ganglia hemorrhage	108 (0.95%)	Z51.806 Isotopic therapy after tumor surgery	2876 (0.61%)

Table 5: Top 10 Primary Surgery for Patients with and without Prolonged Hospitalizations

	Primary Surgery for Hospital length of stay>30(d) N =3336	Number (Percent)	Primary Surgery for Hospital length of stay(d)≤30(d) N=206716	Number (Percent)
Top-1	50.5900x005 Allogeneic liver transplantation	130 (3.90%)	13.7100x001 Cataract extraction with primary intraocular lens implantation	5465 (2.64%)
Top-2	86.2200x011 Excision and debridement of skin and subcutaneous necrotic tissue	102 (3.06%)	74.1x01 Cesarean section	4352 (2.11%)
Top-3	86.6901 Blade thickness skin graft	83 (2.49%)	39.7903 Transcatheter hepatic artery embolization(THAE)	4203 (2.03%)
Top-4	50.2200 Partial hepatectomy	53 (1.59%)	32.4100 Thoracoscopic lobectomy of lung	3199 (1.55%)
Top-5	86.7400x026 Pediculated skin grafting	46 (1.38%)	14.7401 Posterior vitrectomy	3071 (1.49%)
Top-6	86.6906 Lower limb skin grafting	43 (1.29%)	75.6902 Recent repair of obstetric perineal laceration	3017 (1.46%)
Top-7	86.2202 Escharectomy	41 (1.23%)	13.4100x001 Phacoemulsification and aspiration of cataract	2496 (1.21%)
Top-8	52.7x00 Radical pancreatoduodenectomy(RPD)	38 (1.14%)	68.2915 Hysteroscopic endometrial lesion resection	2392 (1.16%)
Top-9	50.3x01 Right hemihepatectomy	36 (1.08%)	15.1100 Recession of one extraocular muscle	2156 (1.04%)
Top-10	77.2700x003 Tibial osteotomy	35 (1.05%)	68.2101 Hysteroscopic lysis of endometrial adhesion	2110 (1.02%)

4.4. Primary Diagnoses for Patients with and Without Prolonged Hospitalizations

As presented in the supplemental (Table 1), the most common disease for prolonged and non-prolonged hospitalization was malignant tumor, classification differ in the two groups. Radiotherapy for malignant tumors (n=1292, 11.33%) was the most frequent primary diagnosis in patients with prolonged hospital stay, however, maintenance chemotherapy for malignant tumors (n=38394, 8.08%) was the top 1 primary diagnosis in non-prolonged hospital stay patients.

4.5. Primary Surgery for Patients with and without Prolonged Hospitalizations

Among all the discharged surgery patients (210,052 in total), 3336 patients were in the LOS > 30 days group and 206716 patients were in the LOS ≤30 days group. As for discharged surgery patients, primary surgery was obviously different between the two groups. In the prolonged LOS group, patients tended to undergo major surgery, such as organ transplantation, skin grafting, and hepatectomy, which required more hospital stay.

Allogeneic liver transplantation(n=130,3.90%) was the most frequent primary surgery in patients with prolonged hospital stay, followed by excision and debridement of the skin and subcutaneous necrotic tissue(n=102,3.06%), and blade thickness skin graft(n=83,2.49%). Cataract extraction with primary intraocular lens implantation (n=5465, 2.64%) was the top 1 main surgery in non-prolonged hospital stay patients, followed by cesarean section (n=4352, 2.11%), and transcatheter hepatic artery embolization (THAE) (n=4203,2.03%). The most frequent top 10 main surgery for patients with and without prolonged hospitalization are listed in a supplemental (Table 2).

5. Discussion

Our study focused on prolonged inpatients stay in a tertiary public hospital in China. This study yielded several findings regarding the predictive capabilities of prolonged LOS. This study not only identified the demographic details of patients with prolonged hospital stay but also the main diagnosis, primary surgery, and possible reasons for delays in discharge. Having this insight will enable us to develop specific policies and services to support the safe and timely discharge of patients from the hospital to the community. In a sample of more than fourty-eight thousand patients admitted to FAH-GXMU between 2019 and 2022, we found that a small proportion (2.34%) of the patients had a very prolonged LOS (> 30 days). Prolonged hospitalizations contributed 0.93 days to an average tLOS of 7.76 days during the study period, close to what was reported in another study by Raquel Barba et al. In their study, a small proportion (3.2%) of patients have a very prolonged LOS (more than 30 days), and accounted for 17.4% of total inpatients days and contributed 0.5 days to an average LOS of 9.8 days during the study period [19]. Patients with prolonged hospitalizations were more likely to be transferred from other institutions. Our institution is a well-known and competent hospital in Southwest China, and most of its transferred patients coming to the hospital are complicated and severely ill patients from the surrounding primary hospitals. This is consistent with prior studies that have demonstrated increased length of stay among transfer patients, as well as fewer discharges to home, which may also contribute to

prolonged length of stay [20-21]. The characteristics of the disease itself have also become the main reason for hospitalization for more than 30 days. Given the characteristic of prolonged patients' primary diagnosis, hospital leaders in this institution strive to design LOS reduction strategies such as setting up an integrated medical center, an ambulatory chemotherapy center for tumor patients, and a maximum of 134 tumor patients per day who received chemotherapy without being hospitalized. The number of patients with prolonged LOS has declined 0.73 percent point in the last four years.

We sought to investigate which factors would be predictive of someone who would become a prolonged patient. We hypothesized that there would be certain predictive characteristics for patients with prolonged LOS. After conducting this study, we found that male sex, Han ethnicity, aged 45-59 and aged ≥90 years, history of surgery, URBMI, and urgent admission condition were all significantly predictive of prolonged LOS. When compared to the reference age groups, those aged 45-59 and aged ≥90 years were significantly associated with prolonged LOS. Subsequently, the odds of age were not significant in other age groups. One study noted that patient-specific factors, such as age and ASA classification, are predictors of prolonged stay [22]. Another study by Morgan et al. showed that the odds of being prolonged steadily increased with age increased [23]. A previous study also indicates that older patients are at higher risks of prolonged hospital stay because of the associated adverse events and complications of hospitalization, that is deconditioning, delirium and nosocomial infection [24].

Inpatients with prolonged LOS were predominantly males. This is similar to a study by Ke et al., which showed that males had a slightly longer LOS [25]. Another study that investigated the influence of sex on LOS in trauma patients revealed males were less likely to be discharged sooner [26]. Our findings are consistent with previously reported results. This may be due to their physiological and social roles. Men generally shoulder the dual responsibilities of society and family, and are under great pressure. At the same time, the probability of men engaging in high-risk industries is much higher than that of women, as are unhealthy dietary habits and irregular daily schedules, which lead to a higher prevalence of men than women. A history of surgery was associated with significantly increased odds of a prolonged LOS. Similar to a previous study that showed that patients who underwent surgical procedures were 5.36 times more susceptible to stay in hospital for one day more [27]. Another study revealed that long-term hospitalization exceeding 30 days was associated with a higher percentage of surgical operation [28]. In addition, a systematic review that contrasted with our findings indicated that the operative management of rib fractures and injuries was effective in reducing LOS [29]. By 2018, more than 97% of the Chinese population had social health insurance [30]. In our study, inpatients with prolonged LOS were more likely to have URBMI than those with other types of insurance. A previous study indicates that different types of health insurance have diverse effects on labor supply, URBMI encourages farmers to quit directly from the labor market [31]. URBMI was launched in 2007 and covers urban residents without formal employment, including children and the elderly. With the improvement of China's supplementary medical insurance policies, such as relief for serious diseases and chronic diseases, patients have borne less and less expenses. Without occupational stress and less individual payment, they were unwilling to transfer to community hospitals or nursing facilities, even though their condition was stable.

After conducting this study, we found that patients from the Han ethnic group tended to have prolonged LOS. China has 56 ethnic groups, with the Chinese Han comprising the majority. A previous study by Wang showed that, compared with Han people, Tibetan adults had a significantly lower prevalence of diabetes, leading to fewer hospital visits [32]. Further analyses with larger sample sizes are required to clarify the relationship between the mechanisms of ethnicity and prolonged LOS. In reference to other non-clinical factors, it was observed that the length of hospital stay was conditioned by the day of the week in which the patient was admitted. In addition, there are particular structural and organizational aspects of each center, even varying the stay according to the day of admission [33].

6. Strength and Limitation

This study analyzed the prolonged LOS based on objective DMIEAS data that include all medical events for each patient rather other some specific patients. Our findings have several potential implications for efforts aimed at decreasing the number and duration of prolonged hospitalizations. Firstly, although demographic and clinical factors such as gender, age, insurance, and surgery are generally not modifiable, they could particularly in combination, be used to trigger earlier and more intensive case management involvement. Secondly, as the main provider of medical services for the general public, the productivity changes in public hospitals directly reflect the development of the health care system. The model of care should shift towards vulnerable patients trying to minimize invasive procedures and shorten the hospitalization period to look for a nursing or post-hospitalization facility. Thirdly, an ambulatory chemotherapy center could provide an alternative to reduce prolonged LOS for tumor patients.

This study had several limitations. First, given the lack of consensus in the literature regarding the definition of prolonged LOS, it is difficult to directly compare these results with other existing studies [34-35]. Second, this was a single-center program evaluation. Although this limits generation to other hospital, we believe our approach may serve as a guide for others interested in reducing prolonged hospitalization. Further predictive, prescriptive, and multi-institution investigations are needed to determine the specific reasons for unnecessary hospital stays in this population. Last-

ly, the study was unable to report hospitalization cost data, which may have provided greater insight into the impact of predictors of prolonged LOS.

7. Conclusion

In this study, we focused on inpatients with stays greater than 30 days and characterized the predictors of prolonged hospitalizations among patients to guide future efforts aimed at optimizing health care resources in our institution. Awareness of the risk factors for a prolonged LOS might contribute to reducing hospitalization stay and its related negative consequence. Accurate prediction of prolonged LOS in different hospital may be more challenging and require variable that were not include in our study. Further research is warranted.

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9. Ethical Statement

This project was approved by the Research Ethics Committee of 2020-KY-202000340 by The First Affiliated Hospital of Guangxi Medical University.

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11. Declaration of Competing Interests

The authors have no identifiable conflicts of interest to declare. All authors disclose any financial or personal relationships with people or organizations that could inappropriately influence this paper.

12. Author's Contribution

Lan, Yang designed the study, performed statistical analysis, interpreted the data, and drafted the manuscript. Lu Yang conducted the literature search and analyzed the data. Dunke Jiang and Fanglan Wu reviewed and edited the manuscript. Junqiang Chen designed and coordinated the study. All the authors have read and approved the final version of the manuscript.

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