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RESEARCH ARTICLE

ANALYZING HOSPITAL HIGH LENGTH OF STAY OUTLIERS IN TURKEY

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ABSTRACT

Purpose: The study aims to examine the length of stay (LOS) outliers by analyzing the hospital administrative database.
Material and Methods: The Turkish Ministry of Health DRG grouper database was utilized to obtain hospital administrative data on discharges for 15 training and research hospitals in 2012. For each diagnosis-related group (DRG), the geometric mean plus two standard deviations were calculated to identify the outliers. According to the recent data, demographic, clinical, and DRG-specific characteristics influence LOS outliers. Analyses were conducted using descriptive statistics and logistic regression using generalized estimating equations (GEE).
Results: High LOS outliers were found to be 4.4 % of the cases. Even though they made up only 4.4 percent of the patients, outliers accounted for 24.50 percent of all discharge days. The top three specific DRGs with the highest LOS outliers were neonatal cases. According to the multivariate model, alcohol, drug use disorders, burns, and ear, nose, mouth, and throat diseases influenced high LOS outliers the most. Furthermore, DRG weight, DRG type, discharge type, and age groups were other significant factors related to high LOS outliers.
Conclusion: A quarter of all inpatient days are made up of LOS outliers. Burns, neonate cases, and alcohol/drug use cases should be carefully evaluated. To improve clinical quality and effectively manage hospital resources, hospital administrators and health policymakers should consider the length of stay outliers.

Keywords: case mix, diagnosis-related groups, DRG outliers, hospital financial management, length of stay

INTRODUCTION

Considering the growing share of the older population, rising healthcare costs, and decreasing resources, many nations have recently started using case-mix payment techniques like DRGs (Diagnostic Related Groups) for hospital reimbursement. The fundamental concept behind DRG systems is that patients that are meant to be clinically significant and reasonably uniform in their resource consumption patterns are divided into smaller groups. DRGs were first developed in the 1960s at Yale University. The original motivation of developing the method was to make the hospital management and financing easier by enabling the measurement and evaluation of hospital performance (1).

Hospitals receive a fixed payment for each patient treated in a DRG apart from a few "outliers" (1). Outliers are cases where resource utilization is much higher (or lower) than average. Therefore, all case mix applications related to management must

incorporate the study and review of outlier cases. Besides, the outlier payment policy is a critical component of case mix-based funding arrangements (2). The case-mix reimbursement systems examine the cost of outliers separately and implement additional payments for them (3–5). If the outliers are excluded or definitions of outliers are modified, different values will be produced for the vital evaluation statistical criteria. Eliminating the outlier observations and especially high outlier values in an evaluation study is crucial since it is the cause of most of the problems (6).

Length of stay (LOS) is a significant indicator measure of resource utilization, specifically when the cost of hospital stays is not predictable in the hospitals (2,7-12). LOS by DRG is also a metric for monitoring inpatient care quality and efficiency and comparing peer institutions (3). Therefore, analyzing LOS outliers is crucial in managing and financing the hospitals. It will be an advantage for both the patients and hospitals to establish a separate reimbursing policy for them (8,13).

There have been various studies which reports LOS outliers. In a study, Freitas et al. (8) reported 3.9 % outliers in Portuguese representing 19.2 % of total inpatient days. On the other hand, high deficit cost outliers account for about 5 % of the cases but produce 11–20% of inpatient costs, according to researchers from Spain and Belgium, while 10 % of cases account for 41% of all inpatient costs in Switzerland (7,11,14).

In Turkey, the DRG system was developed by a sub-project of Hacettepe University (Hacettepe University Research Project-HUAP) in cooperation with the Ministry of Finance, Ministry of Health and Social Security Institution between 2005 and 2009. The Turkish DRG system is based on the Australian DRG system. ICD10-AM (International Classification of Diseases, Australian Modification) and AR-DRG (Australian Refined Diagnosis Related Groups) version 4th update and 5.1 were used. In 2010, a DRG-based payment system was implemented as a pilot program in 50 public hospitals. Within a year, the number of hospitals rose progressively to 555. 10% of the reimbursement of these hospitals was made through DRG system (15,16). Based on the data of 2011, a cost analysis study was carried out in 81 pilot hospitals and the Turkish DRG relative weights for 2012 were developed. Licenses of ICD 10-AM (7.0) and AR-DRG 6.0 versions were purchased in 2014. The reimbursement, according to DRG system, was utilized in 2013 and continued through 2015. The payment based on DRG has been eliminated since 2016, and the system has been used for statistical data collection. Until now, there has been no study in Turkey about the length of the stay outliers. The study aimed to find the high length of stay outliers in training and research hospitals using the available electronic administrative DRG database. The study also analyzed influencing factors with LOS outliers.

MATERIAL AND METHODS

The data consists of 693,283 discharges with 2,716,772 inpatient days from 15 Training and Research Hospitals in three big provinces in Turkey in 2012. The electronic administrative DRG database of the Turkish Ministry of Health was used upon permission. There was no missing value in the data. Patient-level inpatient data were anonymized. No discharges were excluded, zero length of stay were also included in the study. The study was approved by the Istanbul Medipol University Non-Invasive Clinical Research Ethics Committee (Protocol number: E-10840098-772.02-4485, Decision No: 652, Approval date: 26.07.2022).

DRG Assignment

Factors determining the DRG assignment can be listed as principal and secondary diagnoses, procedures, age, sex, discharge status, complication and comorbidities, and birth weight for neonates. Initially, the appropriate Major Diagnostic Category (MDC) based on the principal diagnosis was assigned to determine the correct DRG. Each MDC was constructed to correspond to a major organ system. There were 666 DRGs distributed across 24 MDCs. In this data, the classification of all discharges using AR-DRG V.5.1 resulted in 664 DRGs in which 283 DRGs were surgical, 344 DRGs were medical and 37 DRGs were other procedures.

Case-mix index (CMI) for each hospital was calculated. In hospital payment systems based on DRGs, the hospital payment rate is established using the DRG weights and their conversion to monetary values. DRG weights are the average cost of treating patients within a DRG. In addition, case-mix and CMI are essential terms for DRG-based hospital reimbursements. The case-mix is equal to the sum of the cost weights of all DRGs produced by the hospital within a time period (usually a year). The CMI is a significant indicator of the cost of cases handled by a particular hospital because it is equal to that hospital's

average DRG cost weight (10). It measures clinical complexity and resource consumption of patients within a hospital. On the other hand, CMI was created for hospital payments, not to monitor disease severity (17).

Data Preprocessing

The factors influencing LOS outliers including gender, age, DRG weight, DRG type, the reason for discharging, comorbidity, insurance, DRG resource consumption, and MDCs were monitored. All variables were converted into dummy variables.

LOS Outliers-In case mix analysis, length of stay outlier implies inpatient length of stay that is much longer or shorter than the average length of stay (ALOS). It was used as a dichotomous variable: "yes" (LOS outlier) or "no" (not LOS outliers). Various methods in the literature determine the length of stay outliers trim point (8,9,12,18,19). The geometric mean + 2SD (2*standard deviation) approach was used in this study to estimate the length of stay outliers (LOSO) threshold because we focused on detecting high outliers, not low outliers (inliers). The universal trimming point is applied 60 days for length of stay outliers (9,20). When determining the length of stay outliers within a DRG, relatively high trimming points were achieved because the hospitals in the study were training-research hospitals. Because of this, if a trimming point within a DRG was longer than 60 days, it was limited to 60 days.

Age-Age was divided into eight groups: 0-10 ages, 11-15 years, 16-20 years, 21-30 years, 31-40 years, 41-50 years, 51-65 years, and older than 65 years.

A DRG complexity was determined by using DRG weights. A DRG relative weight was recoded into three groups (8,11). Those with a DRG relative weight less than the 1st quartile was classified as low, those between the 1st and 3rd quartiles as medium, and those with higher than the 3rd quartile as high.

DRG type- The AR-DRG Classification system divides diagnosis and procedures into surgical, medical, and others. This classification was also used in the present study.

Discharge status was turned into a dichotomous variable as: "died" (died in hospital) or "discharged alive".

Comorbidity- The complications and comorbidity codes (CCs) were applied within the AR-DRGs. The data did not contain ICD-10 codes or any additional clinical data. Because of this, CC cases were assumed as the definition in the DRG codes. If the code includes CCs, it was accepted as a comorbidity DRG. It was used as a dichotomous variable: "yes" or "no".

Insurance- It was coded as "yes" "if the person had any health insurance or as "no".

Resource Consumption- There are characters of each AR-DRGs, which is used as a separate indicator to show the relative importance of DRGs within adjacent DRG for resource consumption. A, stays for the "highest consumption of resources within the adjacent DRG", B, for "second highest consumption of resources", C, for "third highest consumption of resources" and Z for "no split for adjacent DRG". MDCs were also used as independent variable.

Statistical Analysis

Descriptive statistics, logistic regression, and multivariable logistic regression were used for statistical analysis. It was computed odds ratios and adjusted odds ratios and their respective 95% confidence intervals with logistics regression models. Generalized estimating equations (GEE) were used to fit each logistic regression to account for the observations' dependence on the clustering effect by the hospital. The statistical analysis was performed using R studio 2022.02.3+492.

RESULTS

Descriptive Statistics

The mean (standard deviation) of LOS was 3. 92 (8.66) days, and the median (interquartile range) of LOS was 2.00 (5.00) days. 4.4 % high LOS outliers were found. Despite accounting for only 4.4 % of the cases, outliers accounted for 24.50 % of all discharge days. The median – mean LOS for the high outliers was 16 / 21.94 and 2.0 / 3.09 days for non-outliers.

The research hospitals, their CMI, ALOS, and high LOSO is demonstrated in Table 1, in order of CMI. The three most visited hospitals in 2012 were İstanbul Bağcilar, Ankara Numune, and Istanbul Haydarpaşa Numune Training and Research Hospitals. The CMI of hospitals ranged from 0.97 to 2.20; for outliers, from 2.4% to 7.3%. ALOS were between 2.10 days and 6.34 days. The average CMI was 1.74.

In Table 2, specific DRGs with higher percentages of high LOSO is demonstrated. The top three specific DRGs with the highest LOSO were neonatal cases: P62Z, PO3Z, and P61Z (36.71%; 31.25%; 24.56%, respectively) which was followed by Y02A with

Table 1. Number of cases, case-mix index and length of stay outliers for the research hospitals

Hospital	Total Discharges	CMI	ALOS	LOSO (%)
Ankara Diskapi Yildirim Beyazit Training and Research Hospital	36,405	2.20	4.83	4.9
Ankara Ataturk Training and Research Hospital	32,280	2.05	6.34	7.3
Ankara Numune Training and Research Hospital	75,123	1.67	3.84	5.1
Izmir Ataturk Training and Research Hospital	60,295	1.63	4.38	5.0
Izmir Tepecik Training and Research Hospital	56,679	1.52	4.12	4.3
Ankara Kecioren Training and Research Hospital	19,384	1.50	2.10	2.5
Izmir Bozyaka Training and Research Hospital	45,220	1.38	2.52	2.4
Istanbul Umraniye Training and Research Hospital	23,179	1.37	4.19	5.1
Istanbul Sisli Etfal Training and Research Hospital	43,107	1.35	2.87	3.2
Istanbul Okmeydani Training and Research Hospital	35,374	1.33	5.31	6.8
Istanbul Haseki Training and Research Hospital	32,470	1.18	5.06	6.5
Istanbul Training and Research Hospital	51,193	1.15	3.98	5.3
Istanbul Bagcilar Training and Research Hospital	77,089	1.01	4.80	5.1
Istanbul Haydarpasa Numune Training and Research Hospital	63,414	1.01	3.69	3.4
Ankara Training and Research Hospital	42,071	0.97	3.74	3.3
Total	693,283	1.74	3.92	4.4

23.91% outliers. DRGs had the highest total LOS were P03Z, P62Z and I02A, respectively.

Information on the variables examined and how they affected LOS outliers is provided in Table 3. Males had more outliers (4.6 %) than females (4.2%). LOSO increased with age which reached about 5.3% for patients more than 65 years. With 6.2%, the highest DRG weight group had more outliers than the other two groups. Considering DRG types, surgical DRGs had more outliers (4.8%) than medical DRGs (4.3%) and other DRGs (2.5%). Comorbidity and hospital discharge status were all linked to an increase in the proportion of outliers. Within DRG resource consumption, DRGs with D had the highest outliers (5.4%), while A codes had 4.9 % outliers. The greatest volume of MDC, MDC 6 (Digestive System), by MDC 8 (Musculoskeletal sys and Conn Tissue) and MDC 2 (Eye diseases and disorders) (11.2 %, 8.2%, respectively). MDCs with the three highest percentages of outliers were MDC 22 (Burns), MDC 19 (Mental Disease and Disorders) and MDC 24 (Error DRGs).

Logistic Regression Models

The relationship between outliers and influenced variables were examined for both non-adjusted and adjusted models. In multivariate analysis, we discovered a significant influence regarding MDCs, higher DRG weights, type of DRGs, discharge status, older ages, DRGs resource consumption, comorbidity, insurance, and gender on being a LOS outlier, respectively.

Males had more outliers (adjusted OR = 1.09, 95% CI [1.06, 1.12]) when compared with females. Age categories younger than 50 years were similar (also not statistically significant) and different from the other 2 categories (with adjusted ORs of 1. 25 and 1.40). In the variable of DRG complexity, the OR of medium and high complex DRGs were a significantly higher probability of LOSO than small DRG weights. The non-adjusted and adjusted ORs revealed that gender, age, and DRG weight directly influenced the probability of a patient being an outlier: male, the older patients, and high complexity DRGs, the greater the probability of outliers.

In surgical and medical DRGs, the estimated effects in the adjusted model were lower than those in the non-adjusted model. However, in the non-adjusted model, the effect of surgical procedures on the probability of outliers was higher, while the effect of medical procedures was greater in the adjusted model. In the adjusted model, there was no significant difference in the odds of outliers between medical and surgical procedures (surgical: OR = 1.49, 95% CI [1.40, 1.58], medical: OR = 1.66, 95% CI [1.56, 1.76]). Comorbidities influenced outliers (adjusted OR = 1.20, 95% CI [1.14, 1.26]. For discharge, “dead" adjusted OR was 1.44 (95% CI [1.34, 1.55], that is,

Table 2. DRGs with higher percentages of high LOS outliers

DRG	DRG Description	Total Discharge	Number of Stays	% LOSO	DRG Weight
P62Z	Neonate. AdmWt 750-999g W/O	79	3,495	36.71	28.61
P03Z	Neonate. AdmWt 1000-1499g W	96	4,775	31.25	25.07
P61Z	Neonate. AdmWt <750g W/O	57	1,528	24.56	46.05
Y02A	Skin Grafts for Other Burns. Major Complexity	46	1,691	23.91	6.85
P67A	Neonate. AdmWt>=2500g W/O Sig GI or Vent>=96hrs. <37 Comp Wks Ges	114	1,080	20.18	3.81
V64Z	Other Drug Use and Dependence	129	1,963	16.28	0.93
I02A	Microvascular Tissue Transfers or Skin Grafts. Excluding Hand	103	3,075	14.56	11.46
P63Z	Neonate. AdmWt 1000-1249g W/O	121	1,522	14.05	11.94
P64Z	Neonate. AdmWt 1250-1499g W/O	97	1,534	12.37	7.77
G01A	Rectal Resection. Major Complexity	81	1,675	12.35	8.06
F60A	Circulatory Dsrd. Adm for AMI W/O Invas Card Inves Intervention	188	1,147	12.23	1.93
F09B	Other Cardiothoracic Interventions W/O CPB Pump. Minor Complexity	230	1,643	12.17	6.08

high LOS outliers were more likely to happen in discharges that resulted in "dead". The category "insurance" in variable ‘‘no insurance" was clearly less propitious for having outliers (OR = 0.85, 95% CI [0.81, 0.90].

Considering resource consumption, DRGs with D code had significantly more outliers than other groups (OR=1.47), whereas in the adjusted model DRGs with Z code had the highest estimated effect on outliers (adjusted OR= 1.34, 95% CI [1.28, 1.40] compared to other groups.

Taking MDCs into account, MDC 16 was chosen as the reference category with an OR equal to 1 because of its lowest outlier percentages. The non-adjusted ORs revealed that MDC 22, MDC 20, MDC 24, and MDC 19 had the highest probability of outliers, respectively. On the other hand, the relationship between MDCs and outliers, when the model was adjusted with other research variables, MDC 20, MDC 22, and MDC 03, the estimated effects were the highest ORs, respectively. The categories MDC 23, MDC 17, MDC 4, MDC 11, MDC 09, and MDC 16 were not significantly different for outliers compared with the reference category MDC 16.

DISCUSSION

Since LOS outliers are directly related to hospital expenses, it is of great importance to be investigated. The management of cost outliers is a challenge for every DRG system. Case-mix outliers' studies show that these patients do not adequately belong in the class they are first classified. They might be data errors, unexpected combinations of clinical conditions, and misadventures of hospital-acquired complications (20,21). This study describes the length of stay outliers in training and research hospitals and associated factors by analyzing an administrative, electronic database.

In this study, the proportion of outliers was found to be only 4.4%, but they account for 24.50 % of all discharge days. According to the specific DRGs, six out of 12 DRGs which had the highest LOSO were neonate (MDC 15) cases. MDCs of specific DRGs with highest outliers were found to be burns (MDC 22), alcohol/drug use disorders (MDC 20), musculoskeletal sys and conn tissue (MDC 8), digestive system (MDC 6) and circulatory system (MDC 5). The MDCs with the highest outliers are: burns (MDC 22), mental diseases and disorders (MDC 19), and error DRGs (MDC 24). Mehra et al. (14) used cost data to analyze high deficit and high-profit outliers for SwissDRGs. While psychiatric diagnoses were predicted as higher deficit outliers, burns were predicted as high-profit outliers.

CMIs were found between 2.20 and 0.94, an average of 1.74 for the research hospitals. Geissler et al. (10) found that the rural hospital's CMIs are well below the average of 1, and university hospitals might have more than 1.5 CMIs in Germany. Özkan et al. calculated 49 CMIs of training and research hospitals in Turkey, finding between 0.83 and 1.88 and an average of 1.10 (22). Cots et al. reported a positive

Table 3. Variables related with high LOSO

LOS outlier	Cases (%)	Outliers (%)	Unadjusted OR	Adjusted OR (AOR)	95 % CI for AOR
Not outlier	95.6				
Outlier	4.4				
Gender					
Female	51	4.2	1	1	
Male	49	4.6	1.12	1.09	1.06 - 1.12
Age					
0-10	11.6	4.4	1	1	
11-15	2.5	3.8	0.93	1.02	0.93 - 1.12
16-20	4.2	3.7	0.88	0.96	0.88 - 1.03
21-30	11.8	3.8	0.87	0.96	0.90 - 1.02
31-40	12.7	3.8	0.87	0.98	0.92 - 1.04
41-50	13.8	4.0	0.92	1.06	1.00 - 1.12
51-65	22.4	4.6	1.08	1.25	1.19 - 1.32
65+	21	5.3	1.26	1.40	1.33 - 1.48
DRG weight					
Lower than 0.48	26	2.4	1	1	
From 0.49 to 1.33	49.2	4.5	1.74	1.66	1.60 - 1.73
Higher than 1.33	24.8	6.2	2.40	2.19	2.08 - 2.30
DRG type					
Other	8.6	2.5	1	1	
Surgical	42.8	4.8	1.99	1.49	1.40 - 1.58
Medical	48.6	4.3	1.81	1.66	1.56 - 1.76
Discharge					
Discharged alive	98.4	4.3	1	1	
Dead	1.6	9.1	2.09	1.44	1.34 - 1.55
Comorbidity					
No	92.1	4.2	1	1	
Yes	7.9	6.0	1.43	1.20	1.14 - 1.26
Insurance					
No	6.2	4.8	1	1	
Yes	93.8	4.3	0.87	0.85	0.81 - 0.90
Resource consumption					
A	9.6	4.9	1.39	0.95	0.89 - 1.01
B	41	4.3	1.27	1.16	1.11 - 1.20
C	17.8	3.5	1	1	1
D	2.9	5.4	1.47	1.14	1.01 - 1.28
Z	28.7	4.7	1.39	1.34	1.28 - 1.40

Table 3. Continued

MDC		Cases (%)	Outliers (%)	Unadjusted OR	Adjusted OR (AOR	95 % CI for AOR
01	Nervous System	5.6	5.1	1.72	1.23	1.10 - 1.39
02	Eye Diseases & Disorders	8.2	3.1	1.16	1.20	1.06 - 1.36
03	Ear, Nose, Mouth & Throat	7.9	5.2	2.08	1.96	1.74 - 2.21
04	Respiratory System	4.0	4.7	1.56	1.12	0.99 - 1.27
05	Circulatory System	6.4	5.2	1.89	1.38	1.22 - 1.55
06	Digestive System	13.2	3.5	1.25	1.33	1.18 - 1.50
07	Hepatobiliary System & Pancreas	4.1	5.8	2.02	1.53	1.35 - 1.73
08	Musculoskeletal Sys & Conn Tissue	11.2	5.2	1.86	1.50	1.34 - 1.68
09	Skin, Subcutaneous Tissue & Breast	6.6	3.1	1.11	1.02	0.90 - 1.16
10	Endocrine, Nutritional & Metabolic	3.5	4.8	1.71	1.25	1.10 - 1.42
11	Kidney & Urinary Tract	6.2	3.8	1.30	1.05	0.93 - 1.18
12	Male Reproductive System	2.2	4.5	1.57	1.31	1.14 - 1.50
13	Female Reproductive System	3.5	3.6	1.25	1.27	1.11 - 1.45
14	Pregnancy, Childbirth & Puerperium	5.0	3.8	1.26	1.49	1.31 - 1.69
15	Newborns & Other Neonates	3.9	5.5	1.85	1.65	1.41 - 1.92
16	Blood, Blood Form Organs, Immunolog	1.8	2.8	1		
17	Neoplastic Disorders	1.2	4.6	1.61	1.14	0.98 - 1.32
18	Infectious & Parasitic Diseases	0.8	7.1	2.35	1.62	1.39 - 1.89
19	Mental Diseases & Disorders	0.5	7.6	2.66	1.89	1.59 - 2.24
20	Alcohol/Drug Use Disorders	0.1	8	2.80	2.27	1.67 - 3.07
21	Injury, Poison & Toxic Effect Drugs	2.4	4.2	1.63	1.72	1.50 - 1.97
22	Burns	0.3	8.2	3.25	2.08	1.70 - 2.54
23	Factors Influencing Health Status	1.6	3.4	1.35	1.16	0.99 - 1.36
24	Error Drgs	0.1	7.4	2.38	1.89	1.33 - 2.70

correlation between the proportion of outliers and hospital complexity (11). In the present study, CMIs of the hospitals were high, so the proportion of outliers could be higher. Still, the threshold points were calculated from the studied training and research hospitals which was a limitation of this study.

According to the multivariate model, we concluded that alcohol, drug use disorders (MDC 20), burns (MDC 22), and ear, nose, mouth, and throat (MDC 3) were diseases influencing high LOSO the most. Furthermore, DRG weight, DRG type, discharge type, age groups were other significant factors which are related to high LOSO.

Various studies were reporting LOS outliers. Palmer (6) suggested that outliers could not be more than 10% in hospitals in the USA. Felder (23) claimed that outliers' trim point ought to determine according to providers and their risks. Cots (10) reported the outliers for 10 European countries between 0.4 and 22 according to various methods. Freitas et al. (8) reported 3.9 % in Portuguese and it represents 19.2 % in total inpatient days. Camilleri et al. (9) used five different methods to find LOSO in Maltese, and found the proportion between 0.3 and 10. Ghaffari et al. (24) found the proportion between 5.2 and 9.8 according to three different methods in Iran. Medarevic (19) who calculated separately for general and university hospitals with three different methods found the value between 6 and 24. Because every nation employs different techniques (parametric or non-parametric) to identify outliers or have various health policy laws, it is challenging to explain discrepancies in hospital case mixes between researches (8). Also, implementing the DRG system in a country is a dynamic process, so countries must update the regulations continuously to provide efficient, qualified, and sufficient health care (19,25).

Comorbidity and mortality were found to be statistically significant factors for LOSO in this study. The results of Kuwabara et al. (26) ,Freitas et al. (8) and Cots et al. (11) are in accordance with this result who reported that mortality and the number of comorbidities increased LOS and LOSO. Kuwabara et al. (26) also demonstrated that number of comorbidities in neonatal and pediatric diseases was mainly related to LOSO.

Although Pirson et al. (7) and Cyganska (27) did not find any significant difference between gender in outliers, we found that men had significantly more outliers than females. We also confirmed that age and DRG weight are critical influences on LOSO (7,8,11,27).

Limitations of the present study includes, the data contains information from patients discharged in 2012 in 15 training and research hospitals and data quality and coding accuracy were not checked. Besides, essential factors directly related to LOSO were not considered, like admission type (planned or emergency), emergency department, intensive care unit (ICU), mechanic ventilation stayings, readmissions, and the number of comorbidities.

A sizable amount of clinical and administrative data were electronically collected in hospital systems throughout routine patient care (28). Therefore, electronic administrative data were used in this study. Using these kinds of databases may be a drawback. They may vary in accuracy and information because they are often used for financial and administrative management rather than research reasons. In addition, it might include errors in assigning records (ICD codes, clinical data..etc.) in hospital data (8,29).

CONCLUSION

Present study is the first to examine the relevance of DRG data and length of stay outliers in hospitals in Turkey. Burns, alcohol/drug use disorders, and specific DRGs with high outliers should all be carefully considered for the length of stay (especially neonatal cases). According to the studies, the duration of stay outliers grew steadily each year (3,8). Also, implementing case-mix systems in a country's model is a dynamic process. These factors indicate that outliers should be examined yearly to improve the conditions for better clinical care and efficient reimbursement in hospitals. Further studies should be conducted to investigate the relationship between outliers and time, admission type, type and number of comorbidities, resources use, and readmissions. It is also mandatory to measure case-mix performance and determine outliers using different methods to reach effective DRG system in Turkey.

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