Iranian Heart Journal; 2021; 22 (2)

Original Article

Bed Management System Can Increase Hospital Revenues: Experiences of a Referral Cardiovascular Center

Mahtab Aghababaei[1], MS; Feridoun Noohi[1], MD; Majid Kyavar[1], MD; Hooman Bakhshandeh[1*], MD

ABSTRACT

Background: Cardiovascular diseases are the leading cause of death worldwide; therefore, the importance of cardiac care hospitals is on the rise day by day. The efficient use, optimal allocation, and maximum utilization of resources are the inseparable components of modern management. Given the scarcity of resources, especially beds, and the complexity of the existing processes in the hospital revenue system, the establishment of systematic bed management is the right solution to this problem. The present study aimed to determine the relationship between increased revenues and bed management.

Methods: This cross-sectional study was conducted in Rajaie Cardiovascular Medical and Research Center, Tehran, Iran. Data of 613 adult patients that had undergone coronary bypass grafting and heart valve surgery were collected from the hospital medical records. Diagnosis-Related Group (DRG)-2015 was used for the standard hospital length of stay (LOS), and hospital indices were recalculated and compared with their observed values. Data were analyzed using the Spearman correlation coefficient, the Mann–Whitney test, the Wilcoxon test, and the Kruskal–Wallis test. A *P* value of less than 0.05 was considered significant.

Results: Significant differences existed between the mean LOS and its standard values. The results showed that by the implementation of bed-management, the current LOS was halved, the bed turnover increased from 10.57 to 21.14 times, and the revenue increased by 33%.

Conclusions: A potential increase in revenues was observed after considering the standards of the bed management system in our hospital. According to the results obtained, revenues can be increased with higher patient admission and shortening patient queues by establishing systems that define a standard to control LOS, without increasing the number of beds. ***(Iranian Heart Journal 2021; 22(2): 6-16)***

KEYWORDS: Financial management, Hospital, Income, Diagnosis-Related Group, Length of stay, Cardiac surgical procedures

[1] Rajaie Cardiovascular Medical and Research Center, Iran University of Medical Sciences, Tehran, IR Iran.

*** Corresponding Author:** Hooman Bakhshandeh, MD; Rajaie Cardiovascular Medical and Research Center, Iran University of Medical Sciences, Tehran, IR Iran.
Email: hooman.bakhshande@gmail.com **Tel:** +98-21-23922339

Received: January 16, 2020 **Accepted:** May 9, 2020

Today, a substantial share of the gross domestic product (GDP) pertains to the service sector in many countries, [1] and the health system is no exception to this rule. The main function of a health system is to provide services, and the main problem in

providing health services is the economy. [2] The cost of healthcare is a serious concern for authorities and patients, and a major financial challenge for governments. [3] Decision-makers in the health system, especially in hospital environments, are faced with limited resources and unlimited public demands. [4] A major proportion of the health-system budget is spent on hospitals, which as the largest and costliest operational unit of the health system, aim to improve the quality of treatment, optimize patient admission, and reduce hospital length of stay (LOS). [5] Therefore, it is important to attend to the efficiency of their inputs. Ethical, political, and socioeconomic considerations make the efficient use of resources an inseparable part of modern management because available resources are scarce and demands for healthcare are constantly increasing. [6]

One common way to address the above question has been to apply management theories.

Identifying resources is among the important responsibilities of hospital directors. [5] Two basic strategies are usually introduced for improving productivity in organizations. The first strategy is based on further investment, which is highly costly and time-consuming, and the second is based on better management methods and models that are generally cheaper with greater financial benefits. Thus, adopting a proper management model is the most effective solution to organizational productivity. [7] The results of a study conducted on 47 hospitals in Norway suggested that contrary to the opinion of policy-makers who believe greater access to services leads to financial growth, by implementing activity-based financing models, the modification of the hospital processes could increase efficiency and subsequent financial reforms. Hence, the manner whereby resources are managed is a major barrier to improved productivity in teaching medical centers and hospitals. [8]

Bed management is considered one of the most notable processes that could improve efficiency, finances, waiting lists, and the quality of hospital management. [5]

The optimal allocation of hospital beds affects health management and satisfies the objectives of bed planning and control with respect to increased patient satisfaction, optimization of the efficacy of wards, and improved productivity in providing services. [9] Considering that hospital bed capacity is a vital yet limited resource, the optimal allocation of beds means reduced waiting times, reduced cancelations of admissions, and high percentages of bed occupancy, and entails increased hospitalization revenues. Given the above facts, the importance of a bed manager to plan admission and allocate beds to non-emergency patients, which is among the key responsibilities of the strategic and operational management of a hospital, has recently become a central subject of research. [10] The World Health Organization estimates that nearly three-quarters of the healthcare budget in developing countries is used by hospital expenses, and hospital beds are not efficient. [11]

In addition, considering that beds are among the costliest hospital inputs, such that on average, each bed costs a hospital 300 million Iranian rials a year, while the revenue from each bed does not exceed 200 million Iranian rials and the difference is added to hospital debts. [12] Reducing unnecessary days of LOS leads to improved productivity and reduced waiting times, which entails reduced costs incurred to patients and hospitals. Managerial and systemic factors are significantly associated with unnecessary stays, reflecting the importance of attention to the management of the health system and its secondary systems, including hospitals. [3]

Since the establishment of the Diagnosis-Related Group (DRG)-based hospital- funding model in Germany, much attention has been paid to bed management to find a suitable

admission date, taking into account the priority of patients and available bed capacity. [10] Bed management can be considered a supporting factor for decisions about the length of patients' stay, and improper bed management at discharge prolongs the process of discharge and consequently delays the admission of queuing patients. [13]

In Iran, many steps have been taken to optimize the use of medical facilities, and the experiences gathered have formed a plan called "Modern Hospital Administration System-Autonomy Plan", whereby hospitals are required to manage their own affairs based on revenues generated, without relying on public funding. [14]

Some hospitals affiliated with the Ministry of Health and Medical Education of Iran are faced with a paucity of revenues to meet their own fixed, current, and development costs. Further, directors have difficulty understanding the quality of financial performance in terms of revenues generated for services provided in the context of the complexity of the existing processes in the hospital cost-revenue system. Consequently, if hospital directors do not comply with scientific models, their interventions will not improve financial management processes or increase revenues. [14]

Considering the many factors associated with hospital revenues, by assuming the quality of treatment and patient satisfaction constant, the present study aimed to investigate the relationship between the systematic management of hospital beds and greater patient admission, resulting in increased revenues.

In general, foreign researchers have more than domestic scholars investigated the relationship between bed management and revenues. In the domestic studies conducted in this area, the focus of research is on the relationship between bed management, on the one hand, and cost reduction and capital preservation (equipment and human), on the other. In addition, they have assessed the effects of the bed-management process on other treatment processes. The question is, therefore, how health centers in Iran can help their revenues through the existing facilities, without raising beds, and maintain the quality of treatment.

METHODS

Design and Setting

This cross-sectional study was conducted in 2018 in Rajaie Cardiovascular Medical and Research Center (RHC), a tertiary care hospital for cardiovascular diseases in Tehran, Iran. The study protocol was approved by the Institutional Review Board of RHC. The 2 main components of the study were bed management systems and hospitalization revenues. According to definitions and models in other studies, a bed management system comprises 3 parts: before hospitalization, during hospitalization, and discharge. [15] For this study, first, the revenue process concerning surgical patients was defined in RHC (Fig. 1). Different conceptual models in the field of bed management such as the guidelines of the Iranian Ministry of Health and Medical Education, the conceptual model of bed management by Khurma, [15] the concept of patient circulation, and the role of bed management by Proudlove et al [16] were reviewed. In the field of hospital revenues, the conceptual model of the income cycle by Patrick Christopher [17] and the hospital revenue flow chart of the Iranian Ministry of Health and Medical Education, as well as the relationship between the bed management system and revenues at the research center (Fig. 1), were mapped out for the conceptual model (Fig. 2).

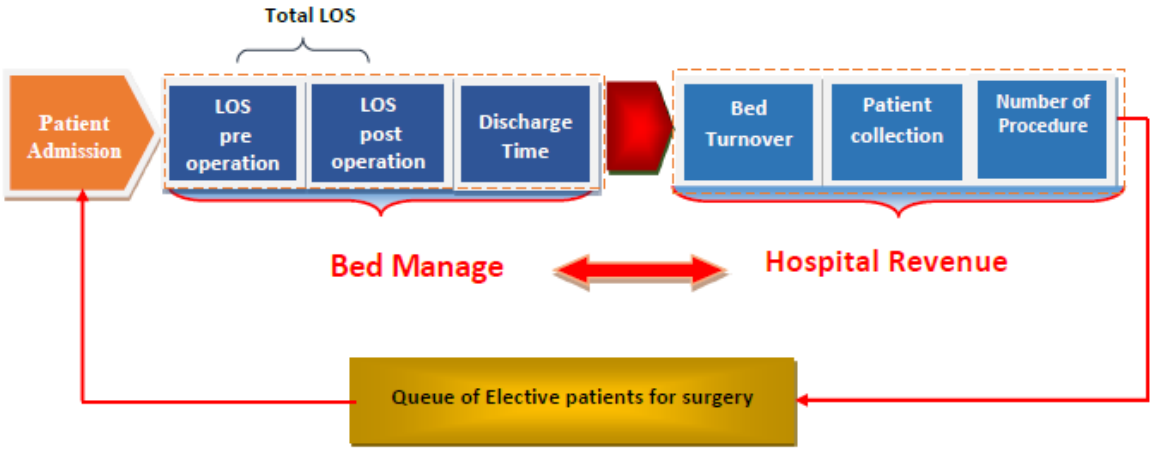

Figure 1: The relationship between bed management and revenues concerning surgical patients in the study center is presented herein.

LOS, Length of stay

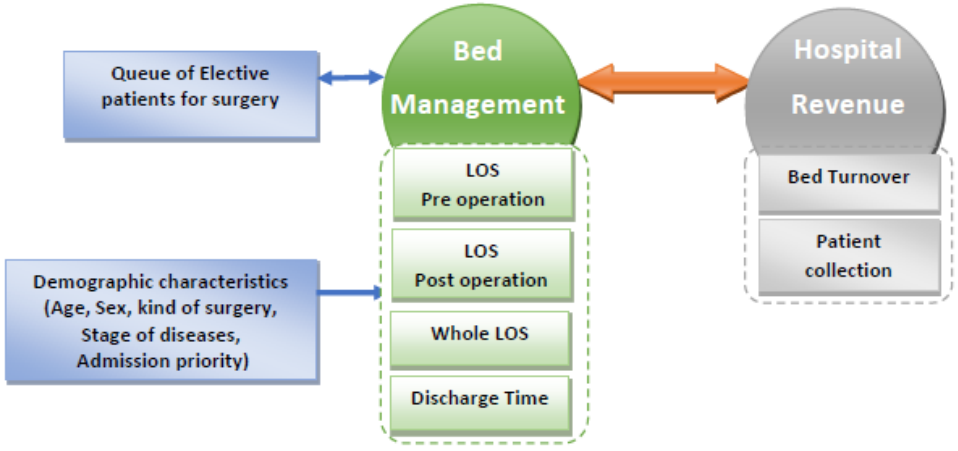

Figure 2: The image illustrates the conceptual model for the present study.

LOS, Length of stay

Study Population

The reference population consisted of discharged, children, and adult patients from the internal and surgical departments of RHC. The study population was defined as adult patients undergoing elective cardiac surgeries (coronary artery bypass graft [CABG], any heart valve surgical procedures, or both). The total number of the patients was 6007 patients, and more than 10% of them based on their medical records were randomly selected as the sample size of the study (N=613).

Procedures

The rate of bed management at RHC was determined via DRG-2015 (published by Medicare and Medicaid). A data collection form was designed to gather the patients' demographic and background information (age, gender, admission priority, type of surgery, and severity of illness), waiting time for surgery, waiting time for angiography (current and standard of our hospital), waiting time between angiography and surgery (current and DRG standard), time between

surgery and discharge (current and DRG standard), total LOS (current and DRG standard), time of discharge (current and standard of our hospital), revenue from the hospitalization of each patient, procedure costs for each patient, daily costs of the patients' stay, and finally, revenues from each patient based on the DRG standard stay.

With the aid of the available information in medical records (extracted from our hospital information system [HIS]), some information such as age, date of discharge, and the final diagnosis code was obtained. CABG and valve surgery codes were extracted from the ICD-9-CM manual (third edition), and patients discharged with these codes were extracted from the system.

Type of surgery was divided into 3 groups of CABG, valve, and both concurrently. The determination of standard LOS required an assessment of the severity of illness. According to the DRG definition, the severity of illness is Stage I for the involvement of 1 organ, Stage II for the involvement of 2 organs, Stage III for the involvement of 3 or more organs, and Stage IV if the patient is deceased. The clinical records of these 613 patients were reviewed. According to experts, consultations performed were the criterion for the involvement of organs. Patients undergoing CABG, without exception, receive consultations by cardiologists, cardiac surgeons, and pulmonologists. Accordingly, the lung was considered an involved organ if pulmonology consultation was repeated. Other consultations were considered an involved organ each. Surgical valve patients as a routine have medical and surgical cardiology consultations, and every consultation other than these was considered an involved organ. Vis-à-vis the severity of illness, type of surgery, and whether or not angiography was performed, standard LOS for each patient was determined according to LOS in the DRG table.

For the determination of the cost of standard stay per patient, the total cost of current hospital stay and the cost of procedures (including surgery and angiography) were reported. The daily cost of patients' hospital stay was calculated from these 2 items as follows (equation 1):

$$cost\ of\ hospital\ stay\ per\ day = \frac{(total\ hospital\ cost - procedures\ cost)}{length\ of\ stay} \qquad \text{equation 1}$$

The following equation was used to find the cost of standard stay per patient and the cost of each day's stay in the standard period for the same patient (equation 2):

$$cost\ of\ standard\ hospital\ stay = procedures\ cost + (cost\ of\ hospital\ stay\ per\ day \times standard\ LOS)$$

equation 2

Revenues generated from the patients' current and standard hospital stays were compared through the use of the bed rotation/ turnover index, which leads to greater patient admission/discharge rates and subsequently greater numbers of procedures as follows (equation 3):

$$bed\ turnover\ rate = \frac{number\ of\ discharges\ (including\ deaths)\ in\ a\ given\ time\ period}{number\ of\ active\ beds\ during\ that\ time\ period} \qquad \text{equation 3}$$

Finally, revenue increase after the implementation of bed management was determined with the following indices (equations 4 and 5):

$$mean\ revenue\ increase\ ratio = \frac{mean\ revenue\ after\ bed\ management}{mean\ revenues\ before\ bed\ management} \quad \text{equation 4}$$

And

$$percentage\ of\ increased\ hospital\ revenue = \frac{mean\ revenue\ after\ bed\ management - mean\ revenues\ before\ bed\ management}{mean\ revenues\ before\ bed\ management} \times 100 \quad \text{equation 5}$$

Statistical Analysis

MS Excel and IBM SPSS Statistics 20 for Windows (IBM Inc, Armonk, NY) were applied for the statistical analyses. The data were described as the mean ± the standard deviation (SD) and frequencies (percentages). The distribution of interval variables was assessed by using the Shapiro–Wilk test, which showed the non-normal distribution of the data. Thus, nonparametric tests were utilized. The Spearman correlation coefficient (rho) was used to assess the correlations between interval variables, the Wilcoxon sign ranks test was applied to determine the difference between the current LOS and the DRG standard, and the Mann–Whitney *U* test and the Kruskal–Wallis test were employed for the comparison of non-normal interval variables between 2 and 3 independent groups. A *P* value of less than 0.05 was considered statistically significant.

RESULTS

Patient Characteristics

The data records of 613 patients were used in the present study. The study population comprised 402 men (65.6%) and 211 women (34.45%) at a minimum age of 15 years and a maximum age of 86 years (mean±SD: 56±13.5 y). Other descriptive characteristics are presented in Table 1.

Bed Management Findings

The indices of bed management are described in Table 2. The median LOS before surgery was 5 days in the current stay and 1 day in the standard stay. After surgery, the median LOS was 8 days in the current stay and 5 days in the standard stay. In general, the median LOS in the whole period was 14 days in the current stay and 6.75 days in the standard stay. According to the results, the average discharge time was close to 2 PM. The shortest length of stay was 4 days in men and 2 days in women, and the longest was 69 days in men and 85 days in women. The average waiting time for surgery in elective patients was 30 days. It is clear that the current LOS was significantly greater than the standard LOS in all the periods (*P*s<0.001). However, in patients with Stage IV severity (ie, dead patients, about 5.9% of the total) and in patients who had both CABG and valve surgeries with angiography, with Stage III severity (about 7.2% of the total), the current LOS was similar to the standard LOS (*P*>0.05).

Another component of the bed management appraisal was to find the proportion of patients with standard hospital stays out of the total study population. This finding can resemble the implementation of the bed management program in patients. The proportion of patients with the standard LOS was assessed in different stages during

hospitalization (before surgery, after surgery, and total) and according to the important parameters that affect LOS (angiography and type of surgery). The results are presented in Table 3. The results indicated that a minor portion of the hospitalized patients had LOS similar to the standard LOS with the bed management program.

The results showed that the median LOS before and after the implementation of the DRG standard was significantly different. The Wilcoxon test revealed that the mean discharge time was significantly different from the standard time (P<0.001).

Revenue Findings

Using hospital data extracted from the information system, the costs of the patients' current stay and the costs of procedures were defined and the cost of hospital stay per day was estimated accordingly (equation 1). Afterward, the cost of standard hospital stay was calculated using the standard LOS. The results are presented in Table 4.

The hospital revenue depends on the bed turnover rate (equation 3), which was about 10.57 considering the fact that the standard LOS was almost half of the current LOS The bed turnover rate after the implementation of the bed management system was computed to be about 21.14. Therefore, the mean hospital revenue was calculated (Table 4). Considering equations 4 and 5, the mean revenue increase ratio was approximately 1.37 and the percentage of increased hospital revenue was about 37%, indicating a significant increase in the hospital income after the implementation of the bed management program.

Table 1: Characteristics of the study patients (N=613)

Variable		Absolute Frequency	Percentage
Gender	Female	211	34.45%
	Male	402	65.6%
Age (y)	Younger than 27	22	3.6%
	27-46	107	17.5%
	47-66	364	59.4%
	67-86	120	19.6%
Type of surgery	CABG	375	61.2%
	Valve	189	30.8%
	CABG and valve	49	8.0%
Severity of illness	Stage I	251	40.9%
	Stage II	190	31.0%
	Stage III	135	22.0%
	Stage IV	37	6.1%
Type of admission	Emergency	195	31.8%
	Elective	418	68.2%

Table 2: Bed management indices in the study population (N=613)

	Median	Mean±SD	Min-Max
Current hospital stay, total (d)	14	15.6 ± 9.3	2 – 85
Standard hospital stay, total (d)	6.75	7.8 ± 3.2	5 – 21
Current hospital stay, before surgery (d)	5	5.5 ± 4.1	0 – 24
Standard hospital stay, before surgery (d)	1	1.3 ± 0.5	0 – 2
Current hospital stay, after surgery (d)	8	10.1 ± 8.1	0 – 80
Standard hospital stay, after surgery (d)	5	6.5 ± 3.1	4 – 19
Waiting time for surgery (d)	15	30.4 ± 40.1	1 - 207

Table 3: Proportion of the patients with the standard length of stay among the study population (N=613)

Stage of Hospitalization	Number of Patients	Number of Patients With the Standard Stay	Percentage
Before surgery			
without angiography	434	45	10.36%
with angiography	179	11	6.14%
After surgery			
CABG	375	97	25.86%
valve surgery	189	40	21%
CABG and valve surgery	49	14	28.57%
Total period			
CABG	375	19	5.06%
Valve surgery	189	10	5.29%
CABG and valve surgery	49	5	10.2%
Discharge by 10 AM	613	26	4.2%

CABG, Coronary artery bypass grafting

Table 4: Revenue indicators before and after the implementation of the bed management program

	Median	Mean±SD	Min-Max
Total current hospital cost * (revenue before bed management)	217	257 ± 157	117 - 1758
Procedures cost *	65	68 ± 18	16 - 192
Cost of hospital stay per day *	12	13 ± 5	6 - 66
Cost of standard hospital stay *	149	171 ± 105	80 - 1143
Revenue after bed management *	298	342 ± 210	160 - 2286
Revenue increase ratio	1.37	1.33 ± 0.3	1.27 – 1.42
Percentage of increased hospital revenues	37%	33% ± 3%	27% - 42%
* Numbers indicate million Iranian rials			

The relationships between the revenue and the current stay and between the revenue and the standard stay were assessed via the Spearman test. A positive correlation (>0.3; P<0.001) suggested a direct and acceptable relationship. Nonetheless, this relationship was stronger between the revenue and the current stay (ratio=0.705) than between the revenue and the standard stay (ratio= 0.640).

According to the data obtained from HIS, the mean revenue from the current stay was 257 million Iranian rials (minimum 117 and maximum 1758 million Iranian rials), and the mean revenue from procedures was 68 million Iranian rials (minimum 16 and maximum 192 million Iranian rials).

Thus, the mean revenue from each day's patient stay was 13 million Iranian rials (minimum 6 and maximum 66 million Iranian rials). Based on the standard patient stay, the mean revenue from each patient was 171 million Iranian rials (minimum 80 and maximum 1143 million Iranian rials).

Based on math and standard bed-rotation formulas, the intended index was found. As was discussed above, the participating patients accounted for 10% of the patients discharged in autumn 2015. The mean bed occupancy rate in these 3 months was 584 beds, of which 10% were allocated to these patients (58 beds).

After the implementation of the bed management and standard stay program, the admission rate doubled for patients in similar conditions and LOS. Bed rotation with the current stay and the standard stay was found using the above formula, and the revenue from these new numbers of patients (1226

patients) was found. The rate of bed rotation increased from 10.57 times to 21.14 times.

DISCUSSION

The significant difference between the stay before surgery in the study hospital and the standard stay suggests the absence of bed management in this stage. According to the results of the present study, the mean stay after surgery was 8 days, which was significantly different from the standard stay. With respect to the total stay, the mean usual stay was 14 days and the mean standard stay was 6.75 days. According to the Wilcoxon test, the difference between them was significant and showed the absence of proper bed management after surgery and during the entire stay. Supporting the effect of the DRG standard regarding LOS, Mathaure and Wittenbecher [19] argued that the implementation of this system in hospitals in the former Yugoslav Republic reduced the number of hospital beds and the median LOS of patient stay. This system also reduced LOS in Croatia and had no adverse effects on the quality of treatment.

We found that bed management was not implemented at discharge time, and there was a significant difference between the standard discharge time (10 AM) and the mean discharge time (2 PM), suggesting a lengthy discharge process in this hospital.

We sought to find whether revenues increased after the implementation of the bed management program. The answer to this question depends on the level of bed rotation and patient admission. The results obtained by Riahi et al [20] and Kronemana et al [21] also confirmed an inverse relationship between LOS and bed rotation, showing that bed management led to increased bed rotation. Ultimately, the adoption of the standard stay could double bed rotation after the implementation of the bed management program, which could double patient admission.

The implementation of the bed management program before surgery, after surgery, and at discharge time reduced total unnecessary LOS and increased the hospital's revenues. Proper bed management augmented patient admission to 100%; accordingly, the average hospital revenue was increased by 33.29% and resulted in an average revenue increase rate of 1.33. Bystrova et al [22] also used DRG to standardize LOS, which resulted in a significant rise in patient admission. They considered the DRG standard to be a strong incentive for service providers in healthcare systems. Since 2003, dramatic organizational changes have taken place in hospitals in Germany in order to end personal payments to hospitals, and instead, hospital bills are based on the DRG classification. The current bills show the cost of treatment according to the mean LOS based on the DRG standard. Hence, if LOS exceeds the average LOS, the hospital will be at a loss. To assess the efficacy and optimal use of resources, [10] Rahimi et al [23] found that the largest excess use of resources or additional inputs in 2009 were associated with active beds. With 58.4% of resources, hospitals studied had created the same current level of output. The mean management efficiency of hospitals was 0.782%. In other words, efficiency can be increased to 21.8% through proper bed management without increasing inputs. Kokangul [24] kept LOS constant through standard and reported that patient/day, which is the main parameter affecting revenues, would increase 1.44 times.

CONCLUSIONS

According to the results of the present study, reflecting the importance of proper bed management in terms of augmented hospital revenues and patient admission, it is

recommended that hospitals address this matter and consider bed management as the utmost priority of their strategic objectives. In addition to periodical assessments of the effect of bed management on unnecessary stays and revenues, hospitals should have a proper scientific model based on international standards to determine the appropriate LOS for every patient. Clearly, it is impossible to predict patient stay 100%; still, considering that nearly 70% of patients have elective admissions, it is feasible to lessen the length of unnecessary stays in stages before and after surgery through careful and systematic planning. Apart from the implementation of the bed management program, attitudes should be altered from mere accounting to healthcare economics in hospital financial systems. The presence of an individual or department of health economics (not just an accountant) in financial affairs could bring hospitals closer to the increased revenue target.

The improvement of resource efficiency in the health system of Iran through the utilization of modern and scientific methods is one of the requirements of this system. According to the results obtained, revenues can be increased with higher patient admission rates and shortened patient queues by establishing systems that define a standard to control LOS, without increasing the number of beds.

Acknowledgments

This article is the result of an MS thesis. The authors wish to express their gratitude to the authorities of Rajaie Cardiovascular Medical and Research Center for making data available.

REFERENCES

1. Suleiman Awwad M, Mohammad Agti DA. The impact of internal marketing on commercial banks' market orientation. International Journal of Bank Marketing. 2011; 29(4):308-32.
2. Zare M, Ali S, Asefzade S, Alijanzadeh M, Sanei F. Assessment of specific income and cost of 22 Aban hospital of Lahijan, Iran, in 2012. International Journal of Current Life Sciences. 2014; 4(11):9524-9528. Available at: http://www.bretj.com (accessed 3 January 2016).
3. Nabilo B. Superior organizational pattern in health sector, Tadbir magazine. 2007; 145:102- 105.
4. Karimi I. Health economy", Tehran Gap Publishing, Iran. 2004.
5. Oliveira S, Portela F, Santos MF, Machado J, Abelha A. Hospital bed management support using regression data mining models. IWBBIO. 2014; 1651-1660.
6. Ghaffari S, Jackson TJ, Doran CM, Wilson A, Aisbett C. Describing Iranian hospital activity using Australian refined DRGs: A case study of the Iranian social security organization. Health Policy. 2008; 87(1):63-71.
7. Hariri M, Sajadi H, Sadat. Improve the productivity of hospital. 2016. available at: www.hospitalmanagment.ir, (accessed 10 July 2016).
8. Biørn E, Hagen TP, Iversen T, Magnussen J. How different are hospitals' responses to a financial reform? The impact on efficiency of activity-based financing. Health care management science. 2010; 13(1):1-16.
9. Ataollahi F, Bahrami M, Abesi M, Mobasheri F, Khani S. A Goal programing Model for reallocation of inpatient beds in Educational Shahid MohamadiI Educational Hospital of Bandar Abbas, IRAN. Health care management. 2014; 5(1):59-68.
10. Schmidt R, Geisler S, Spreckelsen C. Decision support for hospital bed management using adaptable individual length of stay estimations and shared resources. BMC medical informatics and decision making. 2013; 13(1):3. Available at: http://www.biomedcentral.com/1472-6947/13/3, (accessed 20 February 2016).
11. D'Alessandro D, Coppola M, Chiarello P. Energy consumption in Hospital:

preliminary results of the ICEOs Project. Proceedings of Clima 2007 Wellbeing Indoors. 2007. Available at: http//www.inive.org/members_area/medical, (Accessed 14 Mar 2016).

12. Hatam N, Pourmohammadi K, Bastani P. Javanbakht M. The survey of hospital size effect on technical efficiency in social security hospitals. Journal of Razi Medical Sciences. 2012; 20(108):56-64.

13. Kebriaei A, Kazemi M, Khosravi E, Comparative Assessment of Discharge Process in Ali-ebne Abitaleb and Quaem Hospitals. Journal of Health Informatics management. 2009; 7(1): 24-33.

14. Amiri M. The effect of autonomy plan in the performance of public hospitals and the University of Medical Sciences Iran's Health Services. Medical Record Master Degree, Faculty of Management and Information Research of Iran. 1997.

15. Khurma N. Analysis, Modeling and Improvement of Patient Discharge Process in a Regional Hospital. Electronic Theses and Dissertations. 2009. 155. Available at: http://scholar.uwindsor.ca/etd/155, (Accessed 10 Mar 2016).

16. Proudlove N, Gordon K, Boaden R. Can good bed management solve the overcrowding in accident and emergency departments? Emergency Medicine Journal. 2003; 20(2):149-55.

17. Patrick Ch. Revenues cycle phases and process. BHM, Health care solutions. 2013. Available at: http://bhmpc.com/2013/12/healthcare-revenue-cycle/, (Accessed 11 January 2016).

18. Mathauer I, Wittenbecher F. Hospital payment systems based on diagnosis-related groups: experiences in low-and middle-income countries. Bulletin of the World Health Organization. 2013; 91(10):746-56A.

19. Riahi L, Hajinabi K, Aghamohammadi F. The Relation of Hospital Bed Indicators with Electricity Consumption rate in Hamedan University of Medical Science Hospitals. Healthcare Management. 2010; 2(11): 59-66.

20. Kroneman M, Siegers JJ. The effect of hospital bed reduction on the use of beds: a comparative study of 10 European countries. Social science & medicine. 2004; 59(8):1731-40.

21. Bystrov V, Staszewska-Bystrova A, Rutkowski D, Hermanowski T. Effects of DRG-based hospital payment in Poland on treatment of patients with stroke. Health Policy. 2015; 119(8):1119-25.

22. Rahimi B, Yusefzade H, Khalesi N, Valinejadi A, Gozali A, Akbari S, et al.

23. Analysis of the efficiency and optimal consumption of resources in selected hospitals in Urmia province through data envelopment analysis. Journal of Health Administration. 2012; 15(47):91-102.

24. Kokangul A. A combination of deterministic and stochastic approaches to optimize bed capacity in a hospital unit. Computer methods and programs in biomedicine. 2008; 90(1):56-65.