



Performance Evaluation of Hormozgan University of Medical Sciences (HUMS) hospitals based on Pabon Lasso Model

Tayebeh Baniasadi¹, Farid Khorrami^{2*}, Mohamad Jebraeily³, Fahime Khamzade⁴, Fateme Ghovvati Kisomi⁵

¹ Department of Health Information Management, Tehran University of Medical Sciences, Tehran, Iran

² Department of Health Information Technology, Hormozgan University of Medical Sciences, Bandar Abbas, Iran

³ Department of Health Information Technology, Urmia University of Medical Sciences, Urmia, Iran

⁴ Fasa University of Medical Sciences, Fasa, Iran

⁵ Statistics and information technology center, Hormozgan University of Medical Sciences, Bandar Abbas, Iran

ARTICLE INFO

Article History:

Received: 14 Jul 2018

Revised: 16 Sep 2018

Accepted: 18 Dec 2018

***Corresponding Author:**

Farid Khorrami
School of Health Management
and Information Sciences, Iran
University of Medical
Sciences, No. 6, Rashid
Yasemi St., Vali-e-asr Ave.,
1995614111 Tehran, Iran.

Email:

khorrani.farid@gmail.com

Tel:

+98-9171982334

ABSTRACT

Background: Hospitals need a system for evaluating and monitoring performance for promotion the efficiency and effectiveness of their services and outcomes. Pabon Lasso model is a graphical chart that can be used to identify the current status and performance level of hospitals by combining hospital indicators, simultaneously. Therefore, this study aimed to evaluate the performance of Hormozgan University of Medical Sciences (HUMS) hospitals during a six-year period using this model.

Methods: This descriptive study includes all teaching and non-teaching hospitals affiliated with the HUMS. After gathering the required information related to three indices: Bed Occupancy Rate, Bed Turnover Rate and Average Length of Stay for the years 2009 to 2014 from the statistical systems and yearbooks, the situation of hospitals in terms of indices by drawing Pabon Lasso graphical charts using SPSS version 16, were analyzed.

Results: The results showed that during a six-year period, on average, 26 percent of hospitals were placed in zone I, that is the inefficient area, 28 percent in zone II, 30 percent in zone III which is an efficient area of the model and 16% in zone IV of the Pabon Lasso model.

Conclusion: The findings indicated that the utilization of hospitals beds is relatively desirable. Periodic monitoring of province centers and determining their status in the model, and also, performance assessment from another dimension is suggested in order to achieve more comprehensive and more accurate results.

Keywords: Hospital Performance, Productivity Evaluation, Indicators Monitoring, Pabon Lasso Model

Citation

This paper should be cited as: Baniasadi T, Khorrami F, Jebraeily M, Khamzade F, Ghovvati Kisomi F. **Performance Evaluation of Hormozgan University of Medical Sciences (HUMS) hospitals based on Pabon Lasso Model.** Evidence Based Health Policy, Management & Economics. 2018; 2(4): 249-57.

Copyright: ©2017 The Author(s); Published by Shahid Sadoughi University of Medical Sciences. This is an open-access article distributed under the terms of the Creative Commons Attribution License (<https://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.



Introduction

Hospitals have a significant role in delivery of healthcare services therefore, its productivity and efficiency will have a significant impact on improving health system performance (1). Hospitals need a performance evaluating system for development and competition in order to measure efficiency and effectiveness of programs, processes and their human resources (2). The results of the evaluation indicate how activities and resource utilization are conducted in every hospital (3). Hospital performance can be assessed in different areas which shortly include: efficiency, productivity, quality and access (4). Efficiency and appropriate productivity are necessary both for countries' economy and for the survival of organizations and institutions such as health centers (5).

Providing desirable health services based on related indicators requires managers and planners' awareness of hospitals performances. Moreover, determining trends and patterns in administrative data can inform decision makers in health services management (6, 7). In order for efficient management and monitoring patient care, the hospitals should create an information management system which leads to generating types of indicators such as performance indicators that are helpful in measuring, determining progress and improving organization decision-making (8,9). These indices indicate vital and significant factors in the organizational success and concentrate on the critical aspects of organizational performance nowadays and also in the future reflecting efficiency and effectiveness of organizational units (10-12).

In hospitals, indicators such as the hospital bed occupancy rate, average patient stay, bed turnover rate, bed turnover interval, and mortality are among the most important and effective performance indicators that should be examined on a regular basis (13, 14). Health experts also state that, a day bed expense, bed occupancy rates, average of patient stay, bed turnover and average of interval in bed occupancy are the main economic indices to measure the performance and

the most common efficient indices of hospital which indicate the optimal use of resources to transform inputs into outputs (12-15).

Researches show that there are different indicators for measuring hospitals Productivity in which the most significant and the most practical ones are: Bed Occupancy Rate (BOR), Bed Turnover Rate (BTR) and the Average Length of Stay (ALS) in the hospital. Accordingly, using an approach which can apply these indices simultaneously and in a mixed model provides the possibility to draw several conclusions in a single comparison and evaluate the hospital services in diverse situations (14-16). Lacking a descriptive model and using a single index could lead to inaccurate perception about the total performance of a hospital (17). In the same vein, one of the efficient techniques of performance comparison of health centers and evaluation of their efficiency is using graphical plots such as Pabon Lasso which can compare the above-mentioned indicators at the same time (18). This model can provide a quick assessment of the overall performance of hospitals by combining three indices of BOR, BTR, and ALS in the right way. This graphical model was for the first time introduced by Pabon Lasso in 1986 to determine the relative performance of hospitals (19). As shown in figure 1, the horizontal axis of this rectangular graph is BOR, and the vertical axis is BTR. The average point of the length of stay is determined by connecting each hospital coordinate point to the center coordinate and extension to the opposite sides. This graph divides the hospitals into four groups:

1- The first group is the hospitals with low bed turnover rate and low bed occupancy rate which indicate extra bed compared to demand.

2- The second group is the hospitals with high bed turnover rate and low bed occupancy rate which indicate unnecessary beds, an oversupply of beds or use of beds for examining patients.

3- The third group involves high bed turnover rate and high bed occupancy rate which illustrate hospitals in which have reached a proper



level of productivity and have relatively a few numbers of empty beds.

4- Finally, the fourth group, hospitals with high bed occupancy rate and low bed turnover rate which indicate hospitalized patients with chronic diseases or unnecessary long-term hospitalization.

Combining indices of bed turnover rate, bed occupancy rates and the average length of stay in hospital form the basis of each hospitals location in the model mentioned above (20-22). Accordingly, the present study examined the hospitals affiliated with Hormozgan University of Medical Sciences (HUMS) in a six-year period to monitor the trends of the centers and review their probabilistic change and the possibility of comparing them during the considered years simultaneously.

Materials and Methods

This descriptive study was conducted in 2016. The ethical considerations of this research were to obtain an authorization from the vice- chancellor for research and technology to get the required information from the statistics and information technology management and hospitals.

The study population included 13 hospitals of Hormozgan University of Medical Sciences in Iran, including 1) Shahid Mohammadi, 2) Kodakan, 3) Ibn Sina and 4) Shariati in Bandar Abbas city, 5) Hazrat Abolfazl; Minab, 6) Hazrat Ali Ibn Abitaleb; Roodan, 7) Hazrat Fateme Zahra; Gheshm, 8) Hazrat Fateme Zahra; Haji Abad, 9) Shohada; Bandar Lengeh, 10) Fekri; Bastak, 11) Rostamani; Parsian, 12) Niapour; Bandar Khamir 13) Khatam Anbia; Jask.

The data collection tool was a form that was designed according to the objectives of the study in order to collect the data needed to draw Pabon Lasso graph. The form included, three performance indicators, namely, bed occupancy rate, bed turnover and patient stay average, and also the number of active beds and hospitals wards for each of the 13 hospitals under study, during 12 months

from 2009 to 2014 (from March 2008 to March 2014). The required information was collected from the Statistical Yearbooks and the Management Information System (MIS) of the Statistics and Information Technology department of HUMS. Then, the average of their annual performance was calculated and based on the mentioned indices; the Pabon Lasso graph was drawn for every six years separately using SPSS software (Version 16). Regarding the average of the indices, the studied hospitals were divided into four areas shown in Figure 1. Then, each of these hospitals was located in one of the areas in the graph based on the bed turnover and bed occupancy rate. Finally, the data were evaluated according to the location of each hospital specified in the graph. This study was adapted from the proposal number 9273 approved by HUMS, Bandar Abbas, Iran.

Results

Four hospitals out of the 13 hospitals, which were located in Bandar Abbas city are educational, and the rest are non-educational hospitals.

The average of three indicators, including BOR, BTR and patient stay from 2009 to 2014 related to all studied hospitals is represented in Table 1. The highest BOR and BTR were in 2013, and the highest average LOS was in 2009. Based on the Pabon Lasso model, hospitals location from 2009 to 2014 in the four areas determined in this model are shown in Figure 2.

The hospital's code specified in the graphs is based on the numbers defined in the methods section. The percentage of hospitals located in each quarter is shown in Table 2. According to this table, in 2009 more hospitals (36%) were located in the first quadrant, in 2010 46% in the second quadrant, in 2011 more hospitals (33%) in the first and the third quadrant, in 2012 and 2013 39% in the third quadrant, and in 2014 more hospitals (31%) in the second and the -third quadrant.

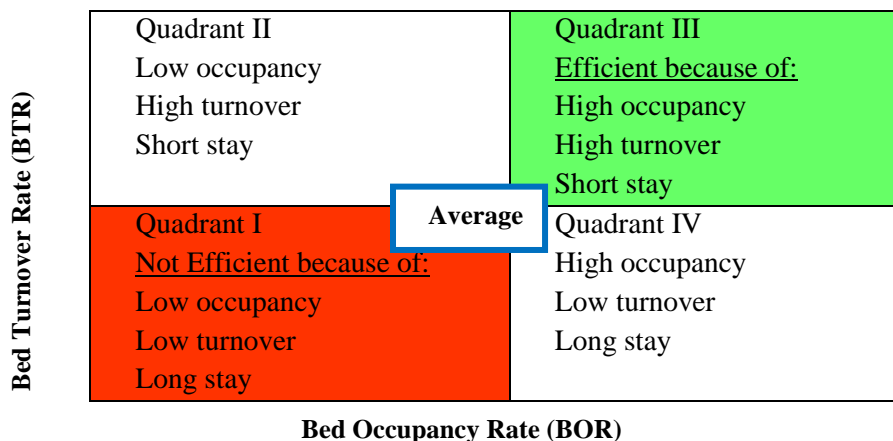


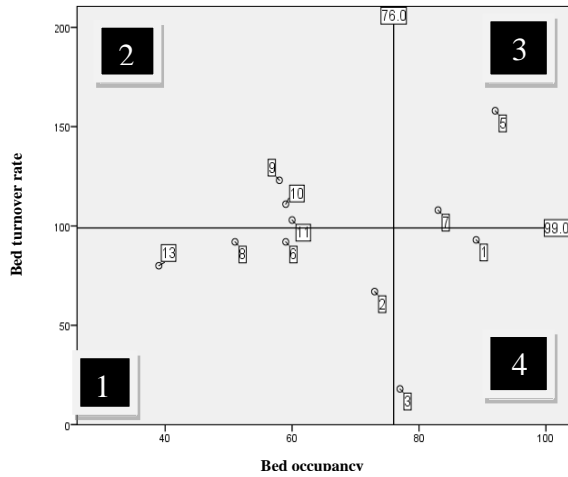
Figure 1. The condition of performance indicators of hospitals in four areas of Pabon Lasso model (23, 18)

Table 1. The average of performance indices of all hospitals in HUMS from 2009 to 2014 (from March 2008 to March 2014)

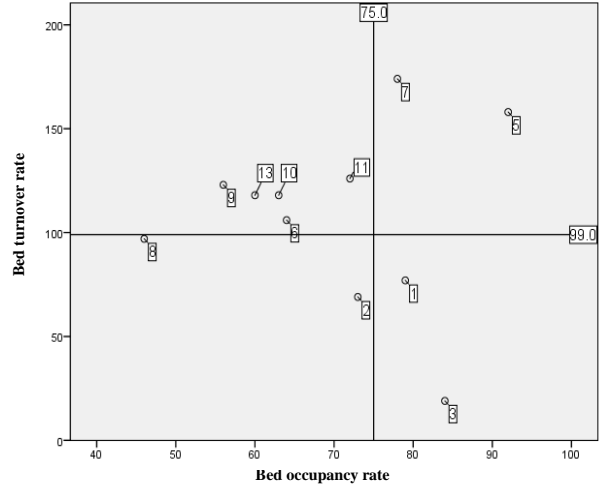
| Indices Year | Bed occupancy rate (percent) | Bed turnover (per year) | Patient stay average (day) |
|--------------------------------------|------------------------------|-------------------------|----------------------------|
| 2009 (from March 2008 to March 2009) | 76.5 | 99 | 2.82 |
| 2010 (from March 2009 to March 2010) | 74.6 | 99 | 2.74 |
| 2011 (from March 2010 to March 2011) | 74 | 98 | 2.76 |
| 2012 (from March 2011 to March 2012) | 75.3 | 103 | 2.66 |
| 2013 (from March 2012 to March 2013) | 77.5 | 106 | 2.67 |
| 2014 (from March 2013 to March 2014) | 76.8 | 104 | 2.70 |

Table 2. The percentage of hospitals located in four areas of Pabon Lasso graph separated from 2009 to 2014

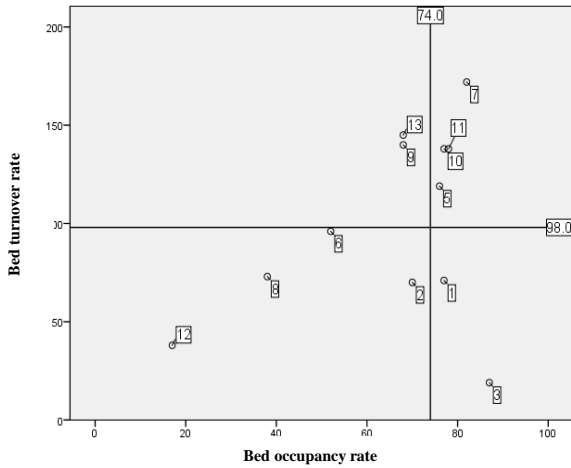
| Area Year | Number of studied hospitals | First quadrant percent/Number | Second quadrant percent/Number | Third quadrant percent/Number | Fourth quadrant percent/Number |
|-----------|-----------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
| 2009 | 11 | (36%) / 4 | (27%) / 3 | (18%) / 2 | (18%) / 2 |
| 2010 | 11 | (18%) / 2 | (46%) / 5 | (18%) / 2 | (18%) / 2 |
| 2011 | 12 | (33%) / 4 | (17%) / 2 | (33%) / 4 | (17%) / 2 |
| 2012 | 13 | (23%) / 3 | (23%) / 3 | (39%) / 5 | (15%) / 2 |
| 2013 | 13 | (23%) / 3 | (23%) / 3 | (39%) / 5 | (15%) / 2 |
| 2014 | 13 | (23%) / 3 | (31%) / 4 | (31%) / 4 | (15%) / 2 |



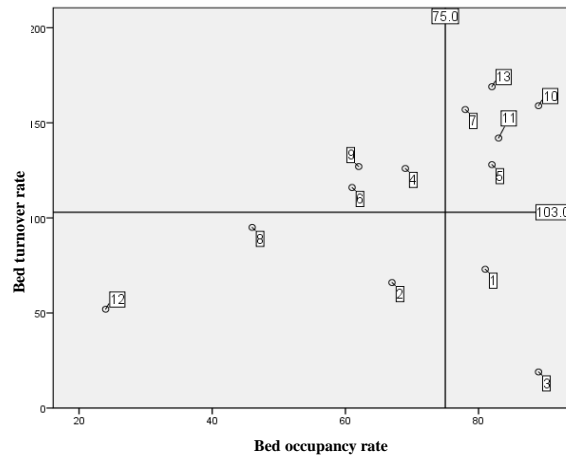
Position of HUMS hospitals in 2009, according to Pabon Lasso graph



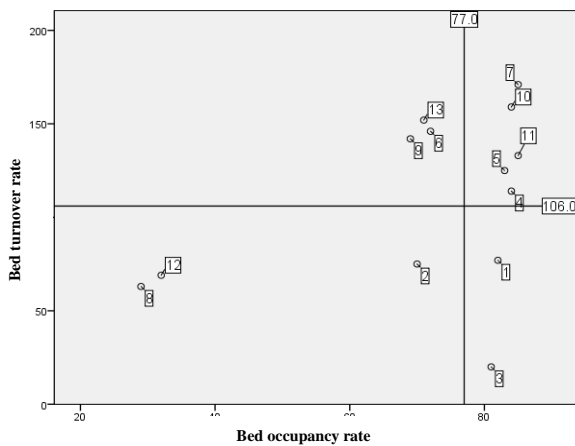
Position HUMS hospitals in 2010, according to Pabon Lasso graph



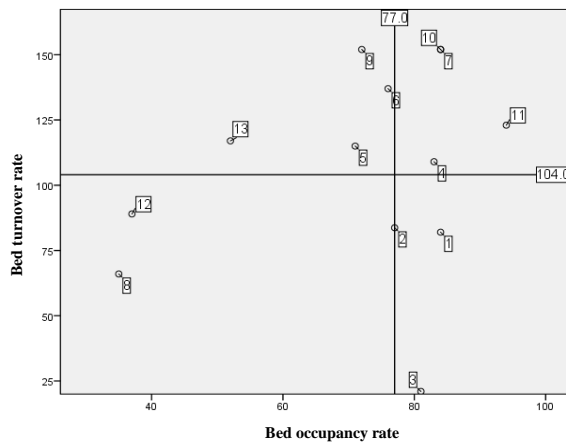
Position of HUMS hospitals in 2011, according to Pabon Lasso graph



Position of HUMS hospitals in 2012, according to Pabon Lasso graph



Position of HUMS hospitals in 2013, according to Pabon Lasso graph



Position of HUMS hospitals in 2014, according to Pabon Lasso graph

Figure 2. Pabon lasso graph of hospitals affiliated with HUMS during 2009 to 2014



Discussion

According to the result, in HUMS hospitals during the six years, the ALOS was 2.7 days, BOR 75.8% and bed turnover index was 101 per year. Comparing indices of the hospitals of HUMS, with country standards for a total of the six years, the province condition was desirable.

In the present study, the percentage of the centers, which were located in zone 3 in 2009 and 2010 was 18%, in 2011 33%, in 2012, 2013 39% and 2014 was 31%. Based on the previous studies, the percentage of hospitals located in Zone 3 is as follows: in studies of Forootan 14.3% (24), Bahadori 39.1% (9), NekoeiMoghadam 50% (19), Sajadi in 2006 and 2007 45% and 43% respectively (21), Arzamani 50% of hospitals (25), in a study by Motaghi in 2010, 15% and in 2011, 43% (17) and Younsi during 2011-2012, 11 hospitals that is 27.5% of 40 hospitals in Tunisia were in Zone 3 of Pabon Lasso graph (13).

According to the results of this study, in the total of six years, 26% of the hospitals have been found in the first area i.e. the inefficient area, 28% in the second area, 30% in the third area that is the efficient area of the model and the rest 16% in the fourth area of Pabon Lasso model.

Some of the studies investigated the centers in a one-year period, and other studies examined the hospitals in more than a one-year period. For example, Lotfi et al. (23), investigated the range of efficient hospitals from 2007 to 2013 among 16 hospitals of Iran Universities of Medical Sciences. Their findings showed that among the examined centers in every seven years, the number of hospitals located in zone 1, 2 and 4 was more than the number of efficient hospitals in Zone 3. Also, Emamgholipour et al. (26), in a five-year period evaluated the trend of hospital performance in all 21 hospitals affiliated to Guilan University of Medical Sciences (GUMS) using Pabon Lasso model within 2010-2015. Based on the findings, the performance of GUMS hospitals has been on an increasing trend in recent years. The number of hospitals in zone 1 has decreased from 6 to 3, and the number of hospitals in zone 3 has increased from 5 to 6 from 2010 to 2015. Based on Pabon

Lasso graph in this study and other studies conducted with the same goal, there are different statistics for the number of efficient hospitals. Since several variables such as the type of specialization, type of ownership, being a public and private center as well as being an educational and non-educational hospital, hospital geographic location and other factors can have an impact on their performance, thus more attention should be paid comparing the centers and the results of the similar studies using the mentioned model. Considering and comparing the graphs of the study during the six-year period, the distribution of hospitals among the first, second and third area of the model were not significantly different. However, based on the results, the highest percentage of hospitals are located in the third area with a small percentage difference compared to other areas. Since this area represents the ideal and optimal performance of the centers, therefore, managerial strategies should be taken into account in order to maintain the current position.

The centers have been found in the first area, with lower bed occupancy and turnover were more than average, indicating the lack of optimal use of resources. Thus improving the efficiency of these centers is an essential part of managers and planners program in the deputy of treatment.

Hospitals that were located in the second and fourth areas, reflects the relative efficiency, therefore, there is a need for managerial follow-up and corrective actions to improve performance indicators.

Although during the study years, the hospital's performance indicators have been in a state of moderate to good compared to national standards, comprehensive evaluation of the centers is necessary in order to achieve maximum efficiency and productivity. In this regard, evaluating the center's performance from other aspects such as quality, the level of access to services, human resources, productivity and so on, along with the use of other statistical and mathematical techniques is recommended which can be beneficial to achieve more comprehensive and accurate results.



As a challenge in this study, it is notable that the lack of confidence in some of the indicators led to the extraction of raw data and the recalculation of indicators in order to obtain more accurate information. Since the real and correct information can be a great help to hospital managers for decision making, therefore, direct and specialized monitoring of related centers on the performance of statistical units and, if necessary, training new staff is recommended.

Conclusion

Pabon Lasso model is a graphic chart which can be applied to identify hospitals efficiency rate in line with improving the productivity of existing facilities of health services.

In this study, it seems hospitals that have poor performance can help to reduce patient referral to other centers, which is the main reason of reducing bed occupancy by recruiting medical specialist and deploying advanced diagnostic and therapeutic equipment. Also, it seems essential to provide diagnostic-therapeutic services for hospitalized patients as an outpatient treatment as far as possible in the centers which have unnecessary hospitalizations.

It is suggested that periodic monitoring and comparing with standard by the graphical models be done in order to determine their distance with desirable conditions and provide solutions to eliminate causes of inefficiency.

As mentioned, one of the strengths of this study

was the simultaneous review of all university hospitals over a six-year period and a fast review of the trend of changes in indicators during this period.

Finally, large organizations like hospitals need to be complemented by efficient managerial systems, which it is almost impossible without the use of IT capabilities.

In order for an optimal use of the potential of ICT, design and utilization from structured and integrated dashboards as an effective tool to monitor operations of the hospital on existing information systems, based on important indicators and charts with the aim of quick and timely access to required information, are suggested.

Conflicts of interest

The authors declared no competing interests.

Acknowledgments

This research was financially supported by the Deputy of Research and Technology of HUMS in 2014, grant no. 9273.

Authors' contributions

Baniasadi T and Khorrami F, designed research; Ghovvati Kisomi F and Khamzadeh F. analyzed data. Baniasadi T, Khorrami F, Jabraeili M. wrote the paper. Baniasadi T, Khorrami F. had primary responsibility for final content. All authors read and approved the final manuscript.

References

- 1) Macinati MS. The relationship between quality management systems and organizational performance in the Italian National Health Service. *Health policy*. 2008; 85(2): 228-41.
- 2) Purbey S, Mukherjee K, Bhar C. Performance measurement system for healthcare processes. *International Journal of Productivity and Performance Management*. 2007; 56(3): 241-51.
- 3) Mehrtak M, Yusefzadeh H, Jaafaripooyan E. Pabon Lasso and Data Envelopment Analysis: a complementary approach to hospital performance measurement. *Global journal of health science*. 2014; 6(4): 107-16.
- 4) Du T. Performance measurement of healthcare service and association discussion between quality and efficiency: Evidence from 31 provinces of mainland china. *Sustainability*. 2017; 10(1): 74.
- 5) Kruk ME, Freedman LP. Assessing health system performance in developing countries: a review of the literature. *Health policy*. 2008; 85(3): 263-76.



- 6) Kalankesh LR, Pourasghar F, Jafarabadi MA, Khanehdan N. Depiction of Trends in Administrative Healthcare Data from Hospital Information System. *Materia socio-medica*. 2015; 27(3): 211-4.
- 7) Zahiri M, Keliddar I. Performance evaluating in hospitals affiliated in Ahvaz University of Medical Sciences based on Pabon Lasso model. *Hospital*. 2012; 11(3): 37-44. [In Presian].
- 8) Rahimi B, Safdari R, Jebraeily M. Development of hospital information systems: user participation and factors affecting it. *Acta Informatica Medica*. 2014; 22(6): 398.
- 9) Bahadori M, Sadeghifar J, Hamouzadeh P, Hakimzadeh SM, Nejati M. Combining multiple indicators to assess hospital performance in Iran using the Pabon Lasso Model. *Australasian Medical Journal*. 2011; 4(4): 175-9.
- 10) del-Rey-Chamorro FM, Roy R, van Wegen B, Steele A. A framework to create key performance indicators for knowledge management solutions. *Journal of Knowledge management*. 2003; 7(2): 46-62.
- 11) Parmenter D. Key Performance Indicators (KPI): Developing, implementing, and using winning KPIs. Philadelphia: John Wiley & Sons; 2007. p. 3.
- 12) Rüter A, Nilsson H, Vilksström T. Performance indicators as quality control for testing and evaluating hospital management groups: A pilot study. *Prehospital and disaster medicine*. 2006; 21(6): 423-6.
- 13) Younsi M. Performance of Tunisian Public Hospitals: A Comparative Assessment Using the Pabon Lasso Model. *International Journal of Hospital Research*. 2014; 3(4): 159-66.
- 14) Bastani P, Vatankhah S, Salehi M. Performance ratio analysis: A national study on Iranian hospitals affiliated to ministry of Health and Medical Education. *Iranian journal of public health*. 2013; 42(8): 876-82.
- 15) Belciug S, Gorunescu F. Improving hospital bed occupancy and resource utilization through queuing modeling and evolutionary computation. *Journal of biomedical informatics*. 2015 ;53 (1): 261-9.
- 16) Mehrolhasani M, Yazdi Feyzabadi V, Barfeh Shahrabak T. Assessing performance of Kerman provinces hospitals using pabon lasso diagram between 2008 and 2010. *Journal of Hospital*. 2014; 12(4): 99-108.
- 17) Motaghi M, Gholizade L, Ahmadi AM, Delgoshaei B. Comparison of Efficiency in Kashan Medical Science University Hospitals, Using Indicators of Hospital Efficiency: 2010-2011. *Journal of Basic and Applied Scientific Research*. 2012; 2(12): 12417-25.
- 18) Bahadori M, Izadi AR, Ghardashi F, Ravangard R, Hosseini SM. The Evaluation of Hospital Performance in Iran: A Systematic Review Article. *Iranian journal of public health*. 2016; 45(7): 855-66.
- 19) Nekoei-Moghadam M, Rooholamini A, Yazdi Feizabadi V, Hooshyar P. Comparing Performance of Selected Teaching Hospitals in Kerman and Shiraz Universities of Medical Sciences, Iran, Using Pabon-Lasso Chart. *Journal of Health & Development*. 2012; 1(1): 11-21.
- 20) Pabón Lasso H. Evaluating hospital performance through simultaneous application of several indicators. *Bull Pan Am Health Organ*. 1986; 20(4): 341-57.
- 21) Sajadi H, Sajadi Z, Hadi M. Is There any Method to Compare Key Indicators of Hospital Performance Simultaneity? *Health Information Management*. 2011; 8(1): 71-81. [In Presian].
- 22) Goshtasebi A, Vahdaninia M, Gorgipour R, Samanpour A, Maftoon F, Farzadi F, et al. Assessing Hospital Performance by the Pabon Lasso Model. *Iranian J Publ Health*. 2009; 38(2) :119-24.
- 23) Lotfi F, Bastani P, Hadian M, Hamidi H, Motlagh S, Delavari S. Performance assessment of hospitals affiliated with Iran University of Medical Sciences: application of economic techniques in health care area. *Journal of Health Administration*. 2015; 18(59): 43-54. [In Presian].
- 24) Forootan S, Arab M, Hoseini M, Khosravi B. Determining the efficiency of social security hospitals of Tehran based on Pabon Lasso Model. *Journal of Health Administration*. 2015; 18(59): 7-18. [In Presian].



25) Arzamani M, Pournaghi SJ, Syed katooli SM, Jafakesh moghadam A. The Comparison of performance indicators in educational hospitals of North Khorasan Universities of Medical Sciences with the standards of the country in 2011-2012. Journal of North Khorasan University of Medical

Sciences. 2012; 4(4): 513-21. [In Presian]
26) Emamgholipour S, Afkar A, Eskandari M, Tavakkoli M. Trend of Hospital Performance in Northern Iran: A 5-year Assessment Using Pabon Lasso Model. International Journal of Hospital Research. 2015; 4(4): 177-81.