Reducing the admission rate of in-patients using a Multivariate Decision-Making Approach

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Abstract

Background and Objective: Despite managerial improvements in hospital services, patient admission to hospitals is still one of the problems of the health system which it wastes time in providing services to new patients, dissatisfaction of patients and staff in addition to imposing additional treatment costs and waste of materials and equipment depreciation. Accordingly, in this study, the effect of each of the factors of patient admission in Hasheminejad subspecialty hospital has been identified and determined.

Methods: To achieve the purpose of the study, first the files of 314 patients admitted in 2019 in hospital were reviewed and the main reasons for patient admission were extracted. Then, the effect of each of the identified causes was determined using Fuzzy Hierarchical Analysis Process (FAHP). In the next stage, the causes were identified based on brainstorming techniques with the presence of 20 experts in this field and fish bone technique. In the final stage, based on the opinion of experts and brainstorming techniques, the presented executive solutions to reduce patient admission were classified using the fuzzy hierarchical analysis approach from the point of view of 3 criteria, cost and time required for implementation and feasibility of implementation, priority.

Results: In this study, 5 main causes of disease recurrence, treatment follow-up, nosocomial infections, cancellation of surgeries, disease complications and medication for patient admission were identified in three groups: urology, nephrology and vascular surgery. It was found that: Nosocomial infections with an effect of 0.285 and follow-up treatment with an effect of 0.229 had the highest effect on patients' return to the hospital, also the cancellation of surgery had the least effect on other factors based on the output of the hierarchical analysis approach. Seven practical solutions were presented. Recording and tracking hospital infections with the help of the Internet of Things, the development of specialized nutritional training programs by hospital nutrition experts, with scores of 0.182 and 0.165, had the highest executive priority.

Conclusion: The use of strategies proposed in this study to reduce patient admission in the hospital is recommended to senior hospital managers.

Keywords: Patient acceptance, Fuzzy Hierarchical Analysis Process (FAHP), Referral reasons

Background and Objective:

Hospitals are the most important institution in the field of health services[1] and traditionally receive the largest portion of available health care funds, so arrangements must be made that patients need to be hospitalized be reduced[2]. Readmission is defined as readmission to a hospital for a specific period of time with or without a previous surgical or medication schedule[3]. Readmission is as a key tool for evaluating the health care system. Reviewing the causes of readmission provides an opportunity to evaluate patient service problems and discharge plans[4]. Readmission has a significant negative economic, social and human impact on society and governments[5] and can also have a negative impact on patients' health costs[6,7]. Therefore, prevention of readmission has a great impact on the patient's quality of life and costs in the health care system[8].

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On the other hand, while delving into the factors related to readmission Identifies the unmet medical, educational and psychological needs of patients, will reduce their readmission rate[9]. Investigating and predicting factors related to readmission such as prioritizing nursing care, allocating more care to patients at risk of readmission, early detection of complications from diseases and procedures performed, treatment evaluation New staffing, adjusting the occupancy rate of hospital beds, efficient use of resources, and improving the quality of nursing and medical services can improve the consequences of readmission of patients. However, although a significant proportion of readmission cases are preventable[10,11], but there is no general agreement on the factors of readmission[12]

In studies, several factors have been cited as causes of readmission. Age over 70 years[13], exacerbation and recurrence of the disease[14,15]. Defects in the complete implementation of the treatment and care process[13,14-16], the presence of underlying diseases[17], nosocomial infections, the duration of hospitalization in the intensive care unit, the duration of connection to the ventilator, the intervals of discharge Endotracheal tube until transfer from intensive care unit, rapid transfer of patient from intensive care unit due to limited beds[13,14,18], type of surgical procedure, patients with diagnosis of internal disorders and transfer of patient from intensive care unit to non-intensive care unit Related[16,19,20] are among these factors.

The results of the study by Jenks et al. Stated that readmission was common and costly among the beneficiaries of insurance benefits and the average stay of patients with readmission was 0.6 days longer than the length of hospitalization of other patients with the same medical diagnosis. Harmarajan et al. Stated that a reduction in the readmission rate of patients within 30 days was associated with a reduction in mortality 30 days after discharge[21]. The results of research by Salehi Tali et al. Showed that educational and continuous care interventions at home have a positive effect on reducing patient readmission[22]. This case is consistent with the follow-up strategy of patients in the present study. The results of Kariman et al. Showed that the most common causes of readmission were relapse, pain persistence and incorrect diagnosis[23] .

The study by Tabibi and his colleagues showed that the reasons for patients' return to the surgical ward respectively were: 23.3% complications, 23% follow-up, 13.4% incomplete treatment, 10.2 temporary discharge, 9.5% recurrence, 9.2% infection, cancellation. Surgeries 4.6% Uncertain 4.6% and Misdiagnosis 2.1%.[24]. Haji Kazemi examined the effect of home visits on the readmission of patients with heart failure discharged from health centers of Iran University of Medical Sciences. Researchers in this study concluded that home visits for patients with heart failure reduce their readmission[25].

Karimi and his colleagues showed that: recurrence of the disease was 20.3%, complications of the disease were 15.5%, new disease was 10.4%, incomplete treatment was 7.1%, surgical complications were 1, and complications were 0.2%. The researchers said that 56.9% of the reasons that led to the return of patients, which can be equipped with the necessary facilities for outpatient surgery and non-invasive surgery, development of outpatient clinics and improving the quality of clinical services, visiting patients at home[26] Hekmatpoo et al. Showed that: factors such as insensitivity to readmission factors, health misconceptions and patient expectations, incomplete education, inadequate compliance with the

medication regimen. Improper diet and lifestyle, lack of a consistent treatment system, distrust of the physician and lack of communication with the patient, patient's mental problems and family-patient challenges affect patient acceptance[27].

The results of the US Medicare and Census study show that correction of hospital clinical and social factors reduces the readmission rate by 9.6%[28]. Asavka et al. They concluded that discontinuation of drugs due to intolerance to oral drugs had the greatest effect on patients returning to the hospital[29]. Jonathan et al. Stated that providing translation and interpretation services for patients of different ethnicities would reduce their readmission rates[30].

Agana et al. Developed a creative approach to determining the return patterns of ICU patients based on data mining. In this study, researchers categorized patients into three categories of readmission after 1 day, after two days and no return, and observed that the rate of return of patients after 2 days is higher and the rate of return of patients with chronic diseases is relatively Patients have more acute disease[31].

According to the above, the present study was designed to identify and determine the effect of the causes of readmission of patients referred to the inpatient wards of Hasheminejad Hospital and also to provide practical solutions to reduce the causes and prioritize the implementation of strategies.

Method

To facilitate the understanding of the research method, the research steps are shown step by step in Figure 1.
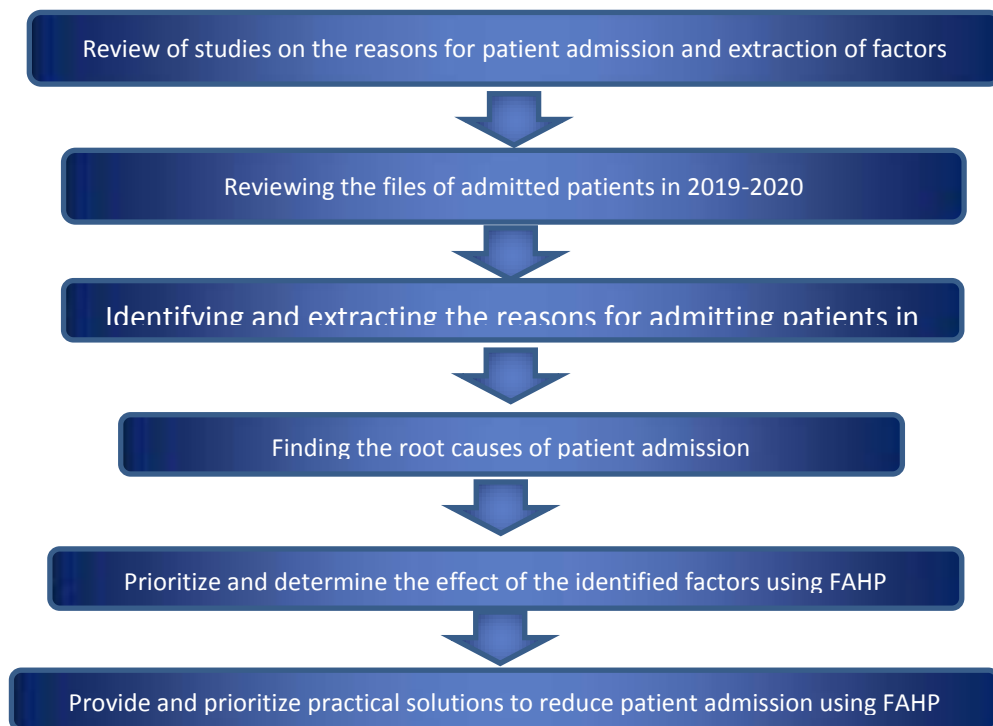
Investigating the files of readmitted patients during 1398 and identifying and extracting the reasons for readmission of patients

At this stage of the study, 314 records of patients admitted to Hasheminejad Hospital available in the hospital's medical records and hospital HIS were reviewed and the reasons for patients' return were reviewed with the help of the project clinical consultant and their frequency was recorded. After extracting the identified agents, the agents were classified into three groups: urological surgeries, nephrology and vascular surgeries.

Determining the importance and effect of identified factors

Fuzzy hierarchical analysis technique was used to determine the effect and importance of each of the identified factors. Based on this technique, the following steps were performed.

Designing a hierarchical model of prioritizing factors

After identifying the re-admission of patient's reasons to the hospital, a hierarchical diagram was determined to determine the importance and effect of each factor based on the hierarchical analysis approach. The designed diagram consists of 3 levels: First level: The highest level and decision level At this level, the causes are prioritized and the most important and effective cause is identified. The second level: Third level: is the level of options that includes the identified causes. The designed hierarchy diagram is shown in Figure 2.
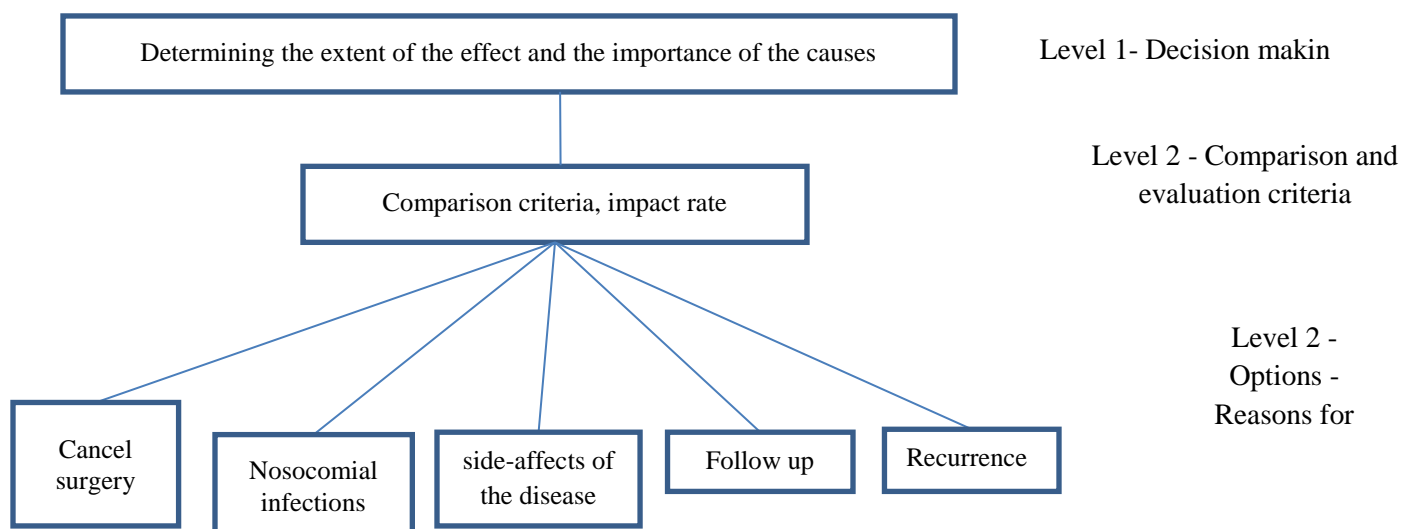

Figure 2. Hierarchical analysis of prioritizing the reasons for patient admission

Defining fuzzy numbers for paired comparison

Fuzzy numbers used in this study are shown in the following table.

Fuzzy number	$\overset{\circ}{9}$	$\tilde{7}$	$\tilde{5}$	$\tilde{3}$	$\tilde{1}$	1
Definition	Absolute importance	Very strong importance	Strong importance	Low importance	Equal important	Exactly equal importance
Triangular fuzzy scale	(7,9,9)	(5,7,9)	(3,5,7)	(13,5)	(1,1,3)	(1,1,1)

Then paired matrices were designed based on criteria and hierarchical model and were given to 15 hospital experts, managers and officials in Tehran

Step 4: FAHP Calculations

Step 1: The fuzzy composition value of $\tilde{s}_i$ is calculated than i criteria using equation 1.

$$\tilde{s}_i = \sum_{j=1}^{m} M_{gi}^j \otimes \left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^j\right]^{-1}, \quad i = 1,2,3, ..., n \qquad (1)$$

In which $\otimes$ means wide multiplying of two fuzzy numbers and each of fuzzy numbers obtained represents a relative weight of a criterion (or option) to other criterion.

Step 2. If $\widetilde{M_1}$, $\widetilde{M_2}$ are two triangular fuzzy numbers, greatness degree of $\widetilde{M_2} = (l_2, m_2, u_2) \geq (l_1, m_1, u_1)$ is defined using the following equation.

$$\mu(d) = \begin{cases} 1 & m_2 \geq m_1 \\ \dfrac{u_1 - l_2}{(u_1 - m_1) - (m_2 - l_2)} & otherwise \\ 0 & l_1 \geq u_2 \end{cases} \qquad (2)$$

In the above equation, $\mu(d) = v(\widetilde{M_2} \geq \widetilde{M_1}), \widetilde{M_1} = (l_1, m_1, u_1), \widetilde{M_2} = (l_2, m_2, u_2)$.

Step 3: the possibility degree of a convex fuzzy number is greater than the possibility

degree k of convex fuzzy number$\widetilde{M_\iota}(i = 1,2, ..., k)$.

$$V(\tilde{M} \geq \widetilde{M_1}, \widetilde{M_2}, ..., \widetilde{M_k})$$
$$= V(\tilde{M} \geq \widetilde{M_1}) \text{ and } V(\tilde{M} \geq \widetilde{M_2}) \text{ and } .... \text{ and } V(\tilde{M} \geq \widetilde{M_k}) = \min V(\tilde{M} \geq \widetilde{M_k}), i = 1,2, ..., k \qquad (3)$$

Step 4: Following normalization of $\acute{W}$ normalized weight vector is calculated according to the following formula in which W is a non-fuzzy number.

$$W = \left(d(A_1), d(A_2), ... d(A_n)\right)^T \qquad (4)$$

Compatibility of paired comparison matrices in AHP is one of the most important issues that should always be considered in the decision process. If the incompatibility is less than 0.1 judgments are acceptable. In this study, to check the compatibility of judgments, at first, inconsistency of all Paired Comparison Matrices was calculated in Expert choice software.

Finding the root causes of patient admission

At this stage of the research, the root causes of patients 'referrals were performed with the help of a brainstorming session attended by 20 process owners (Table 2) in addition to a detailed and analytical review of the admitted patients' files.

Table 2. Details of participants in brainstorming sessions, completion of pairwise comparison matrices

Number	participants	participants
3	Responsible and medical records experts	medical documents
12	Nurses and Nosocomial Infection Control Liaison, Physicians	Clinical
5	Quality Manager, Metron, Clinical Supervisor, Educational Supervisor, Patient Safety Officer, Nutrition Officer	Senior hospital officials
20	Total	

Provide practical solutions to reduce patient admission and prioritize them using FAHP

After determining the effect of the reasons for patient admission, the final solutions were presented in the brainstorming session, which is based on the identified causes in the presence of the owners of the process (participants in the previous stage), the proposed practical solutions are collected. After analyzing the content of the brainstorming session,.

Executive prioritization of solutions

At this stage, the proposed solutions are prioritized using the FAHP technique based on the evaluation criteria, feasibility, cost of implementation, effectiveness of the solution,.

Result

Identification and extraction of factors affecting on patient admission in Hasheminejad Hospital
To identify and extract the causes of readmission of patients in the hospital, first 314 files of readmitted patients out of 13279 patients admitted to the hospital were reviewed. About 2% of the patients referred to the hospital are admitted patients who have referred to the hospital for various reasons. The number and percentage of patient admissions in 3 groups are presented in Tables 3 and 4 as well as Figure 1.

Table 3. Frequency of patient admission in 3 groups: urology, nephrology and vascular surgery

Percentage	Number	Group
45	142	Urology
39	121	Nephrology
61	51	Vascular surgery

The classification of patient admission rates based on demographic characteristics is shown in the table 4.

Table 4. Patient acceptance rate based on demographic characteristics

marital status		Age				Sex		Property
Married	Single	>60	40<age<40	20<age<40	<20	man	Woman	
58	42	40	25	20	15	65	35	**Percentage**

Each group's share of patient admission
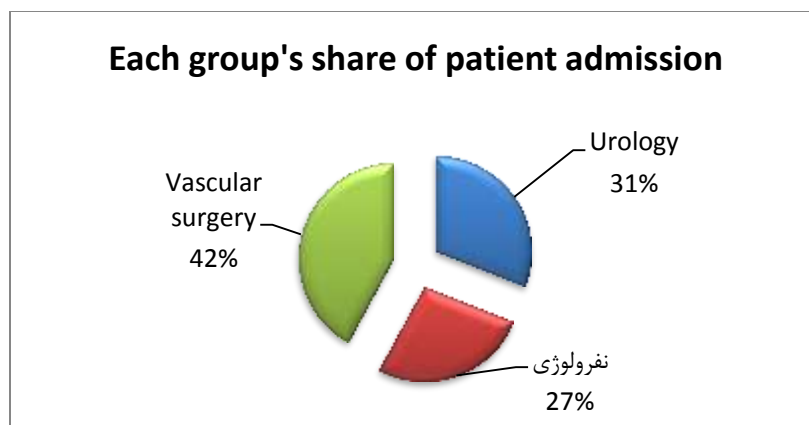
Vascular
surgery
42%

Urology
31%

نفرولوژی
27%

Figure 1. Frequency of patient admission in 3 groups: urology, nephrology and vascular surgery

Reasons for referral of patients by each group are presented in Table 5.

Table 5. Reasons for referral of patients by each group

Reasons for recurrence	Symptoms of patients accepted	Group	
Follow-up treatment, relapse, nosocomial infection, complications, cancellation of surgery	Hematuria[1], Office infection, Wound infection and secretions, Fever, Pyelonephritis, Hydronephrosis, Eurosepsis, Epidemiuritis	Urology	
	Fever, weakness and lethargy, high creatine	Kidney transplant	Nephrology
	Catheter infection, edema, high creatine, sepsis	Other patients	
	Catheter repair and replacement	Vascular surgery	

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[1] The presence of blood in the urine

Prioritize the causes of recurrence of patients with FAHP

Fuzzy hierarchical analysis technique (FAHP) has been used to prioritize and determine the effectiveness of each of the identified causes. This technique in the field of health and hospital, like other fields, is very popular and efficient for prioritization, and many researchers have used this technique to prioritize in their research[32-41]. For this purpose, a pairwise comparison matrix was first designed and provided to 20 experts for completion.

The characteristics and composition of the participants in this part of the research are presented in Table 6.

Table 6. Details of participants in brainstorming sessions, completion of pairwise comparison matrices

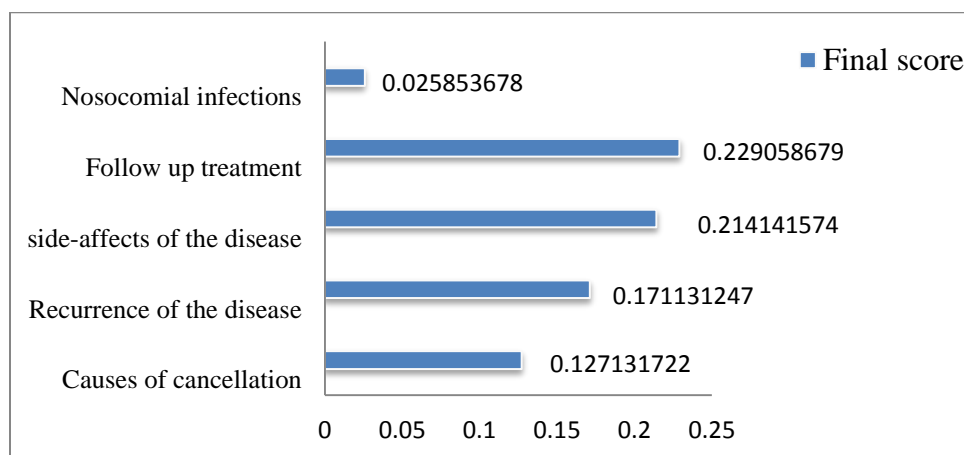| Number	Combination	participants
3	Responsible and medical records experts	medical documents
12	Nurses and head nurses and nosocomial infection control interface, physicians	Clinical
5	Quality Manager, Metron, Clinical Supervisor, Educational Supervisor, Patient Safety Officer, Nutrition Officer	Senior hospital officials
20	Total	

Figure 2. The effect of each of the reasons for patient admission

As can be seen in Figure 2, nosocomial infections with an effect of 0.285 and follow-up treatment with an effect of 0.229 had the highest effect on patients 'return to the hospital, and cancellation of surgeries had the least effect on patients' return to the hospital compared to other factors.

Finding the causes of patients' return to the hospital

In order to find the causes of patients 'return to the hospital, a brainstorming session was held with the participation of the participants in the study. In this session, in addition to the reasons for patients' return, participants were given a card and asked them separately note the reason for each of them on the cards. After the meeting, the content of the cards was categorized and analyzed. Finally, the root causes were determined by fish bone diagram and plotted in visio software. The fish bone diagram of the reasons for

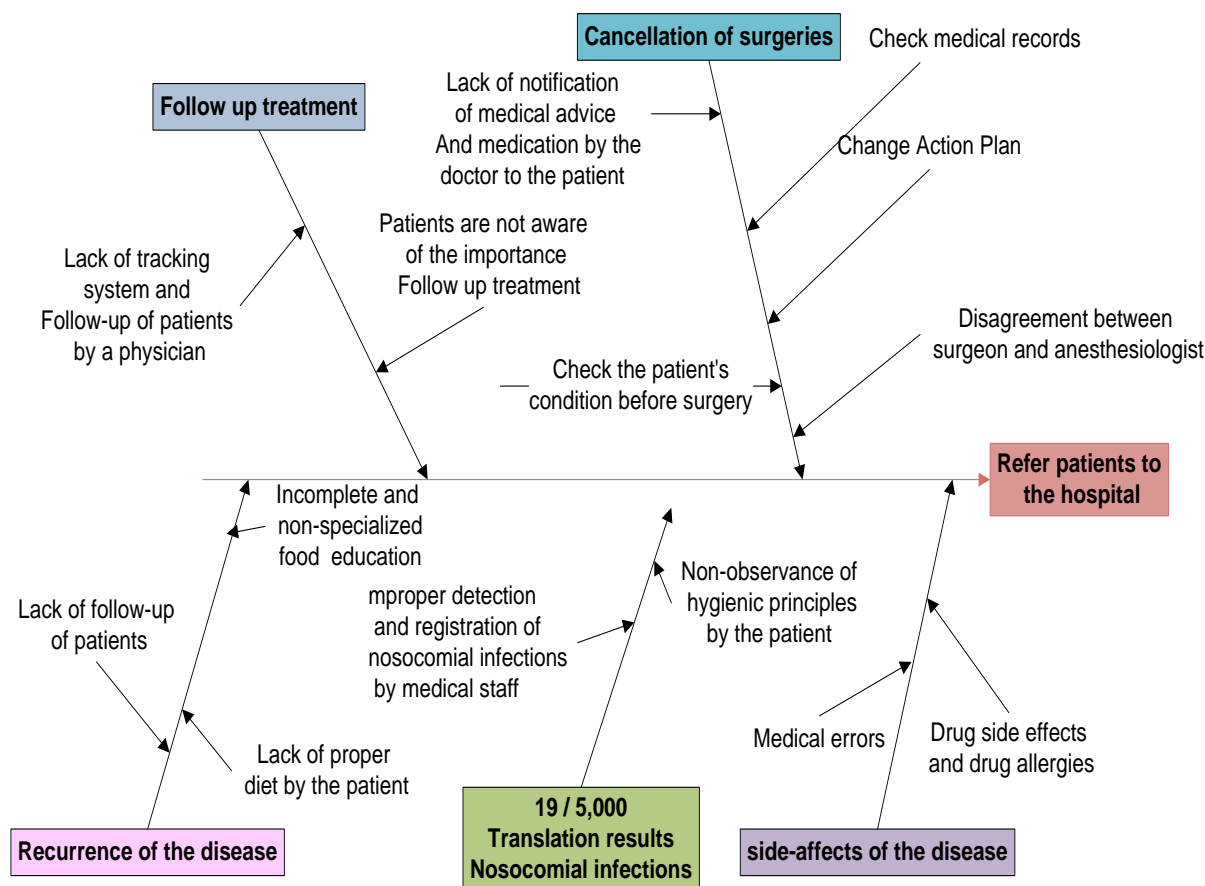patients returning to the hospital is shown in   Figure 3.

Figure 3. Fish bone diagram and root causes of admission of patients admitted to Hasheminejad Hospital

Provide practical solutions to reduce patient admission

After identifying the reasons for admission of hospitalized patients and finding their roots, a brainstorming session was held with the presence of research experts. One of the reasons is to write down their 10 suggested ways to reduce these causes in the cards that were already provided to them.

After collecting data, the content of the cards was reviewed and finally, based on the frequency of solutions, 7 solutions were selected (Figure 3.(

Prioritize the proposed Strategies using fuzzy hierarchical analysis technique

Due to time and costs constraints, it is not possible to implement all strategies for the hospital. It is necessary to prioritize the proposed strategies based on implementation priority, required cost, required implementation time. For this purpose, fuzzy hierarchical analysis technique was used. Because the opinion of experts is not definitive, fuzzy logic was used.

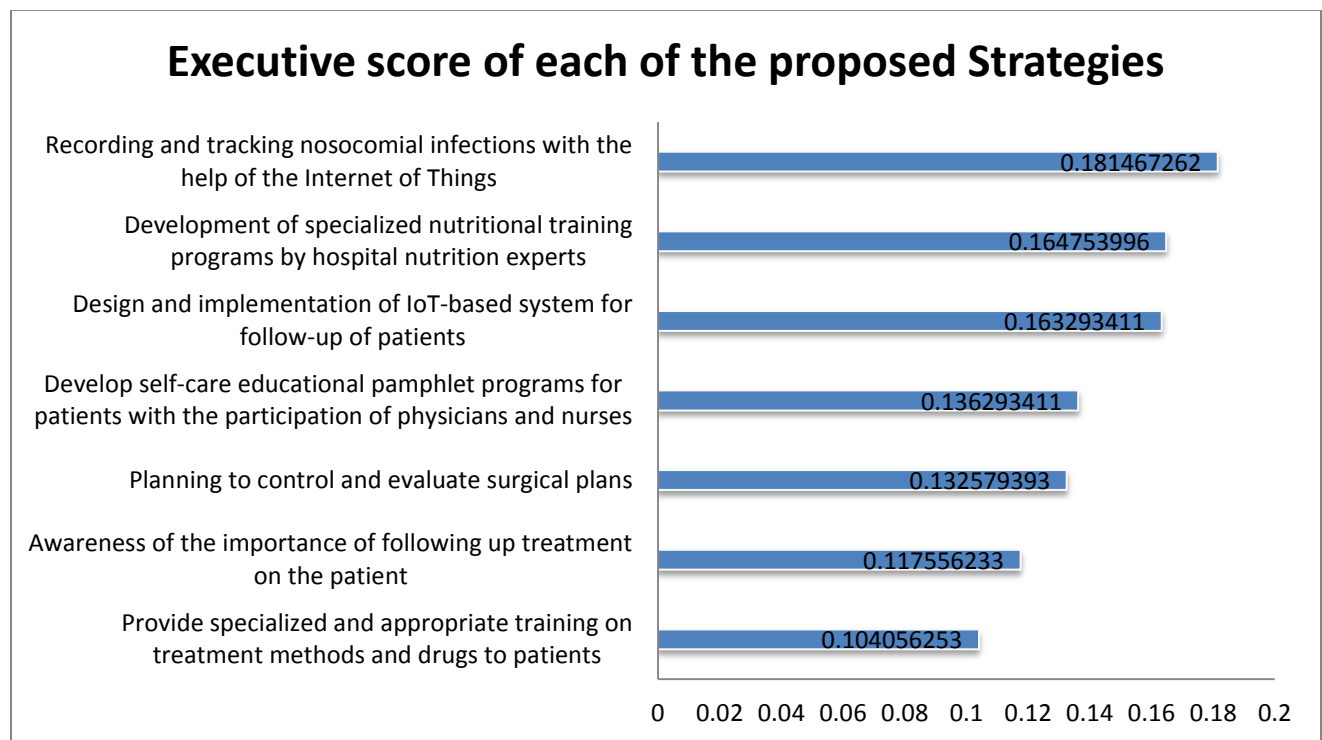The results of prioritizing the proposed solutions are shown in Figure 3.

Figure 3. Prioritization of proposed solutions

As can be seen in Figure 3. Strategies for recording and tracking nosocomial infections with the help of the Internet of Things with a score of 0.181 and the development of specialized nutritional training programs by hospital nutrition experts with a score of 0.165 gained the highest executive priority from the participants.

Conclusion

In this study, based on the review of patients admitted to Hasheminejad Hospital in 2020-2021, 5 main reasons for follow-up treatment, disease recurrence, treatment complications, nosocomial infections and cancellation of surgeries were identified.

Then, the 5 factors presented were prioritized using the opinion of experts and based on the FAHP technique, and the extent of the impact of each of them was determined. Based on the results, nosocomial infections with the highest priority were identified among the identified factors. Then, using fishbone and brainstorming techniques, the causes of recurrence were found. Finally, in the brainstorming session with the presence of 20 research experts, practical solutions to reduce the reasons for patient admission were identified and presented. Since not all of the proposed solutions can be implemented due to time and financial constraints, these strategies were prioritized based on the FAHP technique, which was

the highest implementation priority for the detection and registration of nosocomial infections based on the Internet of Things (IOT).

As observed in previous studies, disease recurrence, treatment follow-up, disease complications and nosocomial infections are among the factors that have been cited in most studies as reasons for patient admission, which have also been mentioned in the present study. Abolition of surgeries, which has been introduced in the research as one of the reasons for patient admission, has been mentioned in some studies, including medical research, et al., And is consistent with the results of this research.

In line with the strategy of reducing patient re-admission, most studies agree on the positive effect of visiting the patient at home on reducing patient re-admission, which in the study was followed up and follow-up of patients using the Internet of Things.

Conflicts of Interest:

The author declares that, there is no conflict of interest.

Refrences

1.Arab M., Eskandari Z., Rahimi A., Abolghasem Pour R., Dargahi H., Reasons for patients' readmission in Tehran University of Medical Sciences Hospitals. Journal of hospital. 2010; 9(2):47 -55.[Persian]

2. Dobkin C., Finkelstein A., Kluender R., Notowidigdo M., The economic consequences of hospital admissions. Am Econ Rev 2018; 108(2):308 -352.

3. Stone J.L., Hoffman G., Medicare hospital readmissions: issues, policy options and PPACA. 2010: Congressional Research Service Washington, DC.

4. outcome. Indian Journal of Critical Care Medicine 2003; **7**(1):14-20.

5. Tabibi S.-J., Tourani S., Sadeghi M., Ebrahimi P., Factors involved in further reference of patients to the surgery wards of general teaching hospital. The Journal of Qazvin University of Medical Sciences 2002; 6(1):42-48.[Persian] .

6. patient survey. Social work in health care 2015; 54(1):1-15.

7. Hamner J.B., Ellison K.J., Predictors of hospital readmission after discharge in patients with congestive heart failure. Heart & lung 2005; 34(4):231-239.

8. systematic review. Annals of internal medicine 2011; 155(8):520-528.

9. Benbassat J., Taragin M., Hospital readmissions as a measure of quality of health care: advantages and limitations. Archives of internal medicine 2000; 160(8):1074-1081.

10.administrative pattern. journal of tabriz university of medical science 2000.[Persian] .

11.Tavalaee A., Sh A., Karimi A., A descriptive Study of psychological rehospitalization in Baghiatalah and Noorafshar hospitals. Tebe Nezami 2005; 7(2):161-166.[Persian] .

12. Kristensen S.R., Bech M., Quentin W., A roadmap for comparing readmission policies with application to Denmark, England, Germanyand the United States. Health policy 2015; 119(3):264-273.

13.Badawi O, Breslow MJ. Readmissions and death after ICU discharge: development and validation of two predictive models. PloS one 2012;7(11): e48758.

14. Chen LM, Martin CM, Keenan SP, Sibbald WJ. Patients readmitted to the intensive care unit during the same hospitalization: clinical features and outcomes. Crit Care Med 1998;26(11): 1834-41.

15 unit patients readmitted in the same hospitalization. J Crit Care 2009;24(2): 267-72.

16. Charles G Durbin J, Kopel RF. A casecontrol study of patients readmitted to the intensive care unit. Crit Care Med 1993;21(10): 1547-53.

17. Rosenberg AL, Hofer TP, Hayward RA, Strachan C, Watts CM. Who bounces back? Physiologic and other predictors of intensive care unit readmission.   Crit Care Med 2001;29(3): 511-8.

18. Rosenberg AL, Watts C. Patients readmitted to ICUs*: a systematic review of risk factors and outcomes. CHEST J 2000;118 (2): 492-502.

19. Kaben A, Corrêa F, Reinhart K, Settmacher U, Gummert J, Kalff R, et al. Readmission to a surgical intensive care unit: incidence, outcome and risk factors. Crit Care 2008;12 (5): R123.

20. Chaboyer W, Thalib L, Foster M, Ball C, Richards B. Predictors of adverse events in patients after discharge from the intensive care unit. Am J Crit Care 2008: 17 (3): 255-63.

21. Dharmarajan, Kumar, et al. "Association of changing hospital readmission rates with mortality rates after hospital discharge." Jama. 2017. 318(3): 270-278.

22. Salehi Tali Sh, Hosseinpour Dehkordi A, Hosseini Hafshjani S M, Jafari A Gh. The effect of educational and home care interventions on hospital readmission, physician referral and treatment costs in a 6-month period in patients with heart failure discharged from the hospital. Journal of the School of Nursing and Midwifery, Tehran University of Medical Sciences (Hayat). 2009. 15(4): 43-49.

23. Kariman H, Shahrami A, Nimak Do S. Causes of readmission in patients referred to the emergency department: a cross-sectional study. 1399. Iranian Journal of Emergency Medicine, 2020. 7(1).

24. Tabibi S J, Turani So, Sadeghi Mo, Ebrahimi P. Reasons for patients' referral to the surgery department of Shahid Beheshti University of Medical Sciences. Journal of Qazvin University of Medical Sciences and Health Services. 2002. 21: 42-48.

25. Haji Kazemi Iftikhar al-Sadat, Asemi Sedigheh, Hosseini Fatemeh. The effect of home visit on readmission of patients with heart failure discharged from health centers of Iran University of Medical Sciences in 2001, M.Sc. Thesis. Iran University of Medical Sciences and Health Services, School of Nursing and Midwifery. 2001.

26. Karimi A, Mehdipour Y, Dehghan J, Erfan Nia Leila, Pouralipour Jahan, Khmernia Mohammad, Nouri Tayebeh. Reasons for patients' re-referral to teaching hospitals of Zahedan University of Medical Sciences. Hakim Research Journal, 2013. 236-242.

27. Hekmat Po D, Mohammadi I, Ahmadi F, Arefi S H. Barriers to readmission control in patients with congestive heart failure: A qualitative study. Journal of Arak University of Medical Sciences. 11(4): 49-58.

28.Eric T. Roberts, Alan M. Zaslavsky; Michael L. Barnett; et al. Assessment of the Effect of Adjustment for Patient Characteristics on Hospital Readmission RatesImplications for Pay for Performance. JAMA Intern Med. 2018;178 (11):1498-1507.

29. Raito A, Taiichi K, Rie Makuuchi, Tomoyuki Irinosanori Terashima. Risk factors for 30-day hospital readmission after radical gastrectomy: a single-center retrospective study.. Gastric Cancer. 2019. 22: 413-420.

30. Patient length of stay, patient readmission rates and the provision of professional interpreting services in healthcare in Australia. 2020. Jonathan Beagley BA(Hons) Jim Hlavac BA(Hons), PhD Emiliano Zucchi BA(Hons). Health and social care journal. 2020. 28(5): 1643-1650. Pages 1643-1650

31. Striley F.G, Cook C.W. R.L. et al. A Novel Approach to Characterizing Readmission Patterns Following Hospitalization for Ambulatory Care-Sensitive Conditions. J Gen Intern Med. 2020. 35: 1060–1068. https://doi.org/10.1007/s11606-020-05643-2.

32. Asadi R, Etemadian M, Shadpour P, Semnani F. Designing a model of selection and assessment of hospital outsourcing services based on approach hierarchical possess (AHP) in Hospitals. Journal of Hospital, 2018, 16 (4), 9-18

33.Asadi R, Shadpour P, Semnani F. Factors influencing prioritization of hospital services for outsourcing: a fuzzy analytic hierarchy process ranking model. International Journal of Hospital Research,2017, 6 (2), 97-103.

34. Asadi R, Shadpour P. Designing the Hybrid Model of Balanced Scorecard and Analysis of Hierarchical Process for Evaluation of the Outsourced Services Suppliers in Supply Chain

of Teaching Hospital. International Journal of Hospital Research, 2017, 6 (4), 49-62.

35. Asadi R, Shadpour P, Hashemi M. Selection and Assessment of Outsourcing Service Suppliers in Hospitals by Multi-criteria Decision Making (FAHP-FTOPSIS) and Balanced Scorecard (BSC) Combined Model. International Journal of Hospital Research, 2017, 6 (4), 49-62.

36. Taherkhani N, Khasha R. A hybrid multi-criteria decision making model for kidney allocation. 2018, 7(3): Pages 62-79.

37. Bagherifard M, Maleki N, Gholamian MR . An Assessment of Chemotherapy Drugs with Incomplete Information using the Analytic Hierarchy Process and Choquet Integral. 2018, 7(2).

38. Ahmadi H, Rad MS, Nazari M, Nilashi M. Evaluating the factors affecting the implementation of hospital information system (HIS) using AHP method. Life Science Journal 2014;11(3).

39 Shafii M, Hosseini SM, Arab M. Performance analysis of hospital managers using fuzzy AHP and fuzzy TOPSIS: Iranian experience. Glob J Health Sci. 2016, 8(2): 137–155.

40. Gupta H. Selection of best hospital for surgery using AHP - IUP Journal Of Operations Management, 2015 . IUP Journal of Operations Management; Hyderabad, 2015, 14(3): 18-32

41. Elham Afzal, Rouhangiz Asadi. Designing a system for succession clinical management jobs for public hospitals. Int J Hosp Res. 2019,;8 (2).