

Readmission Risk Factors in Patients of General Surgery Wards in Shiraz Hospitals: Applying LACE Index as a Predictive Indicator

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Abstract

Background: Today, the effective use of limited health care resources is increasingly regarded. Reduction of the readmission is one of the key tools can improve health outcomes and considered as one of the control levers that reduces health costs. Identifying the causes of readmission to the hospital helps to utilize hospital beds and facilities a more efficiently.

Methods: This case-control study had been conducted in general surgery (GS) wards in 2011-2012. Using chi-square test, t-test, and multiple regressions, we studied risk factors associated with readmission in both groups of case and control. Finally, the predictive power of the Length of stay, Acuity of illness, Co morbidity of the patient, Emergency (LACE) index was evaluated using receiver operating characteristic (ROC) curve.

Results: About 20% of patients in GS wards were admitted within 30 days. There is a significant difference between the two groups in the following variables: age, sex, length of hospital stay, marital status, discharge season, congestive heart failure, diabetes and renal failure. The rate of readmission with LACE index which is compared with the ROC curve shows that it is significant ($P < 0.001$ and Kappa = 0.22).

Conclusions: Awareness of the prevalence and risk factors of readmission is effective in planning and decision making for using hospital facilities efficiently. Identifying patients at risk of readmission and performing training plan, discharging and following up medical programs can reduce the rate of readmission and costs of hospital. Predicting readmission can be very effective but identifying an effective index is very difficult.

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Introduction

Hospital readmission is a key tool that can evaluate health and results of health care system and review of readmission causes is an opportunity for diagnosis and meet patients' special needs and assessing problems with delivered services and patients' discharge programs (1). As hospital readmissions have negative economic, social and human effects on the community

and government, its evaluation is very considerable (2). Readmission is defined as admission in specific hospitals and the patient return to the same or other hospital during a certain time, with planned or unplanned surgical or medical treatment, which is generally defined as returning during 7, 15, 30 days or 1, 2, 4, 6, 12 months after discharge as readmission (3); however, the most common time for readmission is 30 days after discharge (4).

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Benbassat and Taragin (5) have notified that readmission rate, in general, hospitals during 30 days after discharge is 4-15%, and after 1 year it is 32-49%. According to the type of disease, 5-29% of adults readmit to hospital again during 1 month after discharge (6). A research in Iran indicates that 21.3% of patients have readmitted to the hospital due to the same primary problem (7).

In the United States (2004), 17% of American hospitals' Medical Care total costs (8) and also 24-25% of the patients' total costs in 2004 were related to readmission (9). Various research indicated that 31-50% of health costs is related to readmission (10).

According to demographical, social and diagnosis, readmission rate and its causes are different (3,11).

With regard to the effect of this factor on the delivered services and costs, hospitals are interested in prediction of readmission risk. This helps them to identify effective ways of treatment interventions and achieve hospital goals. This prediction helps the health care team to identify patients at risk of readmission so that they provide required services to prevent or decrease readmission during and after discharge (12).

Various models were used to predict the risk of readmission and compare the hospitals. These models should have the ability of accurate prediction and usability in large population and anticipating the use of valid, available and clinically relevant information (13).

Increasing attempts were made to describe and present reliable tools for predicting the risk of readmission (14).

van Walraven et al. (12), in a cohort research, evaluated 48 effective variables in readmission, among patient information in different levels, in a group of 4812 people and due to limitations in access to the information, they have recognized four factors and called them briefly Length of stay, Acuity of illness, Co morbidity of the patient, Emergency (LACE) department use index.

Among clinical wards of hospitals, surgery wards are one of the most strategic parts of hospitals and special attention should be paid to efficiency and output of these wards. Hence, identification of readmission reasons in these wards can help to decrease costs and increase the quality of services.

Assessment of readmission rate can help us to set educational and medical programs for decreasing readmission rate. We used patients' file and hospital information system (HIS) to identify the most effective factors in hospital readmission and also compare prediction power of readmission LACE index and logistic regression.

This research assessed the readmission rate and its cause's, in general, surgical wards of two general educational hospitals (Faghihi and Nemazi) in Shiraz.

Materials and Methods

This is a case-control study on patients admitted in

general surgery (GS) wards of two hospitals in Shiraz, (Faghihi and Nemazi hospitals) between March 21, 2011 and April 19, 2012.

The case group consisted of the patients readmitted in hospitals within 30 days after discharge and the control group consisted of patients who werenot. Transplant patients were excluded from the study because they are at risk of readmission for follow-up.

Use of a sample size formula indicated the need for 1000 samples in each hospital ($P = 18\%$, $d = 0.04$). 4500 patients were admitted to the GS wards of two hospitals during the study period on which 2000 medical records were selected by simple random sampling method using random number table and studied. A total of 400 patients readmitted during 30 days after discharge, 215 in "N" hospital and 185 patients in "F" hospital. Due to the limited number of cases, all patients were considered as case group (400) and control group consisted of 800 patients.

Required information for this study was collected by researchers from medical records and electronic HIS of hospitals using a data collection form. Finally, the results of the study were presented for the managers of hospitals for future planning.

Univariate analysis, chi-square, t-test ($\alpha = 0.05$), and multivariate logistic regression were used to identify and to compare effective factors in readmission in the case and control groups. The collected data were analyzed using SPSS-15 software (Chicago, IL, USA) and receiver operating characteristic (ROC) curve and cutoff point were used to assess the predictive power of LACE index.

Results

The results of this study show that out of 2000 medical records of hospitalized patients in GS ward, 400 (20%) patients were readmitted during 30 days after discharge due to different reasons. Furthermore, 59 patients were readmitted for the second time (14.75%) and 7 patients for the third time (11.86%).

In this study, the mean age in the case group was 41.30 ± 17.37 years old and in the control group was 49.56 ± 18.38 years old ($P < 0.001$). The mean length of stay in hospital in the case group was 4.85 ± 7.50 days, and in the control group as 6.3 ± 8.1 days ($P = 0.002$) (Table 1).

The findings of this study showed that among the patients with the first readmission, 33.5% was for continuing treatment plan, 28.75% due to uncompleted treatment and disease recurrence, 19.5% due to surgery complications, 10.5% because of surgery and wounds infections, and 7.75% due to unrelated disease with the first cause of admission.

Among patients with the second readmission, 32.20% was due to the continuous treatment plan, 32.20% due to uncompleted treatment and disease

recurrence, 22.03% due to surgical complications, 10.16% because of wounds infections and 3.38% due to unrelated diseases with the first cause of admission.

Patients who were readmitted due to continuous treatment plan and unrelated disease with the first cause of readmission were defined as an uncontrollable readmission. The distribution of uncontrollable readmission for readmitted patients was 41.25%, 35.6%, and 42.85% for the First to the third readmissions, consecutively. On the other hand, patients who were admitted in the hospital through 30 days after discharge due to complications of surgery, wound infection, uncompleted treatment and recurrent disease are known as a preventive readmission. The distribution of preventive readmission in the first time readmitted patients was 58.75%, in the Second time 64.4% and the third time 57.15%.

The results revealed that the mean length of stay in the first, second, and the third readmissions was 5.33 ± 7.76 days, 7.71 ± 11.06 days, and 6.75 ± 8.60 days.

There was a significant difference between the mean length of stay in the case and control groups in the first readmission, but the difference was not significant in the second and third readmissions ($P > 0.050$).

The statistical analysis of the results showed that the variables of age, sex and marital status in the case

and control groups were significantly different from each other; also, the length of stay in hospital, type of patient discharge, discharge season, specialist in the first admission and comorbidity disease like congestive heart failure (CHF), diabetes mellitus, metastasis cancer, hypertension and renal failure were significantly different (Table 1).

The analysis of multivariable logistic regression showed that readmission was affected by many factors such as female sex, increase in age, increasing length of stay in hospital, emergency department use in the previous 6 months and co-morbidity of CHF, diabetes, and renal failure showed significant differences ($P < 0.050$) (Table 2).

Four variables of LACE index, length of stay, acuity of illness, co-morbidity disease, and emergency department use were checked in the two groups of case and control. Results showed that only variable of "acuity of illness" in the two groups of case and control was not significant ($P > 0.050$).

The ROC diagram has checked all the points of LACE (0-19) and has selected the maximum point of sensitivity and specificity (sensitivity: 0.65, specificity: 0.55). Point 4 was identified as the cutoff point. Based on this analysis, patients having points more than 4 were readmitted (Figure 1).

Table 1. Comparison of characteristics of case-control

| Characteristic | Case (n = 400) N (%) | Control (n = 800) N (%) | P-value |
|-----------------------------------|----------------------|-------------------------|---------|
| Female gender | 186 (46.5) | 311 (38.9) | 0.013 |
| Marital status | | | |
| Single | 67 (16.8) | 210 (26.3) | |
| Marriage | 300 (75) | 563 (70.4) | |
| Widow and divorce | 33 (8.25) | 27 (3.4) | |
| Insurance status | | | 0.013 |
| Committee | 39 (4.9) | 22 (5.5) | |
| Health care | 493 (61.6) | 231 (57.8) | |
| Social security | 188 (23.5) | 108 (27) | |
| Military | 30 (3.8) | 23 (5.8) | |
| Free | | | |
| Specialist in the first admission | | | |
| General surgeon | 349 (87.25) | 756 (94.5) | |
| Internal medicine | 35 (8.75) | 26 (3.25) | |
| Urologist | 6 (1.5) | 3 (0.37) | < 0.001 |
| Cardiologist | 6 (1.5) | 10 (1.25) | |
| Other specialist | 4 (1) | 9 (0.77) | |
| Patient discharge | | | 0.006 |
| Allowing the physician | | | |
| Personal Satisfaction | | | |
| Death | | | |
| Discharge season | | | 0.011 |
| Spring | 109 (27.3) | 220 (27.5) | |
| Summer | 118 (29.5) | 180 (22.5) | |
| Autumn | 93 (23.3) | 181 (22.6) | |
| Winter | 80 (20) | 219 (27.4) | |
| Co-morbidity | | | |
| CHF | 53 (13.3) | 34 (4.3) | < 0.001 |
| HTN | 116 (29) | 176 (22) | 0.001 |
| DM | 107 (26.8) | 128 (16) | < 0.001 |
| Renal failure | 22 (5.5) | 14 (1.8) | 0.001 |
| Cancer metastasis | 28 (7) | 20 (2.5) | < 0.001 |

DM: Diabetes mellitus, CHF: Congestive heart failure, HTN: Hypertension

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Table 2. Multivariate logistic regression in case-control

| Patient variables | SE | Odds ratio | P-value | 95% CI |
|------------------------------|-------|------------|---------|------------|
| Sex*female | 0.147 | 1.55 | 0.003 | 1.16-2.08 |
| Age | 0.006 | 1.02 | 0.001 | 1.009-1.03 |
| Operation | 0.16 | 0.26 | < 0.001 | 0.18-0.35 |
| CHF | 0.27 | 2.5 | < 0.001 | 1.5-4.3 |
| DM | 0.19 | 1.5 | 0.030 | 1.03-2.1 |
| Renal failure | 0.43 | 2.36 | 0.047 | 1.01-5.5 |
| Long of stay | 0.011 | 1.02 | 0.027 | 1.003-1.04 |
| Emergency department use (E) | 0.1 | 1.8 | < 0.001 | 1.5-2.3 |

DM: Diabetes mellitus, CHF: Congestive heart failure, SE: Standard error, CI: Confidence interval

Table 3. Confusion matrix

| | | Actual | |
|-------------------------------------------|--------------------------|----------------|-------------------|
| | | Case (n = 415) | Control (n = 785) |
| Predicted by LACE and cut of point (= 4) | Case (n = 601) ≤ 4 | 142 (34.2) | 459 (58.5) |
| | Control (n = 599) > 4 | 273 (65.8) | 326 (41.5) |

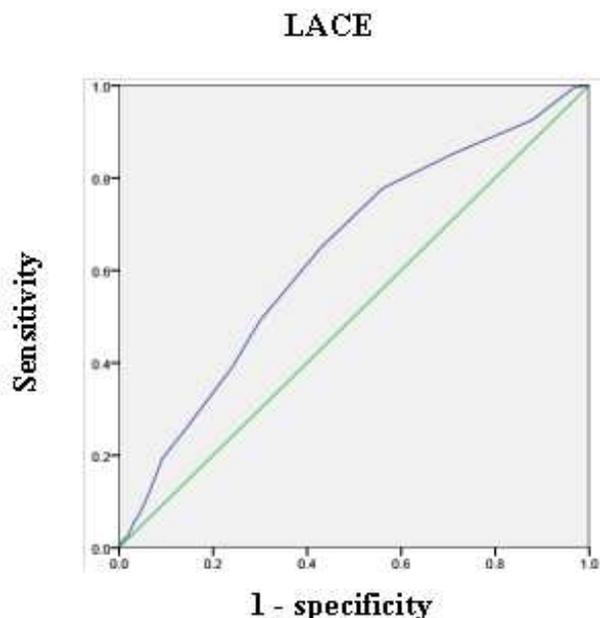


Figure 1. Determine the cut-off point in the index LACE with use receiver operating characteristic curve

Statistical analysis showed LACE score and cutoff point ROC curve were matched with each other ($P < 0.001$ and $\kappa = 0.22$) (Table 3).

Discussion

In recent years, some solutions like the attention to increasing efficiency and controllable costs are notable for dealing with hospital challenges (14). So that these limited facilities be used correctly and efficiently, hospital admissions and patients' length of stay are presented as a way to reach this goal.

In this regard, delivery of the right services at the first time is one of the effective factors in proper

medical care, because there might be no second time in this field or wrong practice of duties at the first time will have catastrophic effects.

On the other hand, readmission due to complications of treatment or improper delivery of care can lead to direct and indirect costs related to the individual's absence from work and delay in job duties (7).

In regard to these contents, the present research was conducted to determine the status of readmission in surgery wards of Faghihi and Nemazi hospitals in Shiraz. The results of this study showed that readmission in GS wards was 20% for the first time, 14.78% for the second time, and 11.86% for the third time.

Kent et al. (15) have declared 19.5% as the percentage of readmission in surgery wards in 2003-2004 in their study. Furthermore, Kassin et al. (16) has reported 11.3% as the percentage of readmission in GS ward and Goodney et al. (17) who studied 14 types of surgeries has reported 9.9-22% as the percentage of readmission.

In Iran, Tabibi et al. (2), Khoshkalam (18) and Khoshkalan and Fazlollahi (7) have reported 8.5-30.4%, 21.3%, and 36.4% readmissions respectively.

The survey of readmission in patients admitted in GS wards shows that 33.5% of patients have referred to the hospital to complete their treatment course, 7.75% of patients due to unrelated disease to their first cause of admission, 19.5% for complications of surgery, 10.5% due to wound infection, and 28.75% for incomplete treatment and disease recurrence.

In other words, we can say that 41.25% of readmissions in GS wards were due to unavoidable reasons, 30% of these due to infection or complications of surgery and 28.75% in GS were due to incomplete treatment.

Surgery patients are at risk of readmission because of some factors such as the risk of increasing infection, bleeding and thromboembolic events after surgery (19).

Complication of treatment and wound infection by Tabibi et al. (2), complication of surgery, disease recurrence and infection after surgery by Khoshkalam (18), disease recurrence and infection after surgery by Khoshkalan and Fazlollahi (7), wound infection by Kassin et al. (16) and Wick et al. (19) and complication of surgery by Schneider et al. (20) and Kable et al. (21) have indicated the most important reasons of readmission. Possibility of wound infection in patients undergoing surgery looks predictable because these patients are at risk of nosocomial infection due to surgeries and immunosuppression and also they are at risk of environmental pollution out of the hospital.

Holding training programs for patients on how to care for surgical locus, prevent adverse effects, and follow their treatment in the hospital can solve the mentioned problems. Studies done by researchers show that the performance of the system in processing the health care by an expert in community medicine for patients' training and the health care provided has led to patients' satisfaction in Nemazi hospital (22).

On the other hand, the results of this study showed that increasing the patients' length of stay in hospital has caused increase in their readmission ($P < 0.001$).

Moloney et al. (23), Benbassat and Taragin (5), Jencks et al. (24), and Schneider et al. (20) have reported increasing patient's length of stay in hospital related to increasing possibility of readmission for surgery patient, as well. In regard to increasing infections and side effects (21), this result is acceptable from complications of surgery like wound infection and readmission.

In the present study, the mean age in both groups of case and control was 49.52 and 41.64 years, respectively, showing that patients' age is a risk factor for readmission; this has also been reported in studies of Tabibi et al. (2), Schneider et al. (20), Stone and Hoffman (3), Khoshkalan and Fazlollahi (7), Moloney et al. (23) and Heggstad (14). It seems that ageing increases the possibility of individuals' injury, so the elderly who are discharged from hospital after treatment are at risk of readmission more than young people.

About sex effect on readmission, results of this study showed that females have more possibility of readmission. Female sex has been reported as effective in readmission in Ston's study (3), and male in studies of Schneider et al. (20), Tabibi et al. (2) Teixeira et al. (25), Moloney et al. (23), and Heggstad (14).

The difference between this study and other research is related to social quality and the endemic diseases. For example, Teixeira et al. (25) have studied patients suffering from femoral hip which is more likely to happen in men than women, because men are at risk of accidents more than women (25). Statistical analysis in GS showed that lace index is significant. This means $P < 0.050$ but correlation value in this index is low ($Kappa = 0.6$). Kreilkamp (26) in China

and Gruneir et al. (27) in six hospitals of Canada have reported LACE index as the proper means of anticipating readmission, but Cotter et al. (28) has assessed this index as inappropriate for anticipating mortality or readmission of old patient.

In general, we need to be cautious about the suitability of this index and its anticipating power in the society which is now under study and further studies are required to confirm our results. Probably, it would be better to attribute comorbidity in regard to the uniqueness of every area of individuals and disease-related properties.

The present study revealed that patients who have surgery and associated diseases are at risk of readmission more than other patients. Factors like aging enhance the length of hospital stay and increase the risk of readmission during 30 days after discharge in GS. Anticipating readmission is very hard in regard to diverse risk factors, and the effect of environmental conditions and it seems that LACE index is not proper for anticipation of readmission for use in hospitals under the study.

One of the limitations in this study was lack of linking HIS among the studied hospitals, so it was not possible to identify patients who have referred to another hospital during 30 days after discharge from the hospital.

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