European Journal of Trauma and Emergency Surgery (2019) 45:365–371
https://doi.org/10.1007/s00068-018-0919-6

ORIGINAL ARTICLE

Unplanned readmission after hospital discharge in burn patients in Iran

Zakiyeh Jafaryparvar[1] · Masoomeh Adib[2] · Atefeh Ghanbari[2] · Ehsan Kazemnezhad Leyli[3]

Received: 4 October 2017 / Accepted: 31 January 2018 / Published online: 21 February 2018

Abstract

Introduction Burns are considered as one of the most serious health problems throughout the world. They may lead to adverse consequences and outcomes. One of these outcomes is unplanned readmission. Unplanned readmission has been commonly used as a quality indicator by hospitals and governments. This study aimed to determine the predictors of unplanned readmission in patients with burns hospitalized in a burn center in the North of Iran (Guilan province, Rasht).

Methods This retrospective analytic study has been done on the medical records of hospitalized patients with burns in Velayat Sub-Specialty Burn and Plastic Surgery Center, Rasht, Iran during 2008–2013. In general, 703 medical records have been reviewed but statistical analysis was performed on 626 medical records. All data were entered in SPSS (version 16) and analyzed by descriptive and inferential statistics.

Results Among 626 patients with burns, the overall readmission rate was 5.1%. Predictors of readmission included total body surface area (OR 1.030, CI 1.011–1.049), hypertension (OR 2.923, CI 1.089–7.845) and skin graft (OR 7.045, CI 2.718–18.258).

Conclusion Considering the outcome, predictors following burn have a crucial role in the allocation of treatment cost for patients with burns and they can be used as one of the quality indicators for health care providers and governments.

Keywords Burns · Complications · Inpatients · Readmission · Iran

Introduction

Burns are one of the most important health problems across the world, particularly in developing countries [1]. These injuries in both developed and developing countries cause long-term disability, mortality, and socio-economic costs that are imposed on patients, families, and societies [2]. For example, in our country, it is the 8th leading cause of loss of life, and the 13th most common cause of disability-adjusted life years (DALY) lost. In Iran, about 100,000–150,000 patients with burn seek medical attention annually, with about 6% of them admitted to burn hospitals, so it has a huge economic burden on patients, their families, insurance companies and health care systems [1]. Despite major advances in the treatment of burn patients, such as resuscitation, wound coverage, infection control and treatment of inhalation injury, burns still lead to complex metabolic changes that can adversely affect the whole bodysystem [3, 4]. Burns also lead to unpleasant consequences that can impact on all aspects of life, such as esthetic problems and communication with others. It can also affect psychological, social and physical functioning [5].

An outcome is the result of an action or a situation. In fact, awareness of the consequences and outcomes of a disease or situation determine the gap between what was done and what should be done. They are utilized for research and for improvement of clinical practice as well as providing higher quality care in a cost-effective approach [5–7].

This study is a part of a Master Science of Critical Care Nursing thesis that has been documented with the number of 9055.

✉ Atefeh Ghanbari
at_ghanbari@gums.ac.ir

[1] Razi Clinical Research Development Center, Guilan University of Medical Sciences, Rasht, Iran

[2] Department of Nursing (Medical-Surgical), Social Determinants of Health Research Center (SDHRC), School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran

[3] Department of Bio-statistics, Social Determinants of Health Research Center (SDHRC), School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran

Measuring the outcomes of burns identify the health status of an individual or a group of patients after receiving burn treatment. Aims of measuring outcomes include comparing and monitoring services at national and international levels, assisting in the delivery of services, interpretation of research and evaluation of findings to improve quality of care, cost-effectiveness purposes, facilitating patient assessment and clinical management [5]. One of the burn's outcomes is hospital readmission. Hospital readmissions have been commonly used as a measure of quality of care provided by hospitals and government agencies over the past decade [8]. The popularity of this measurement increased with the Hospital Readmission Reduction Program introduced by the Affordable Care Act of 2010. This program punished hospitals with excess of hospital readmission for certain conditions by reducing their medicare reimbursements with an aim to encourage them to improve the quality of care. The financial consequences of this program create multiple strategies to reduce avoidable readmissions to hospitals [9]. Despite the importance of measuring readmission rates and its predictors in patients such as patients with burns and heterogeneity of burns patients in age, mechanism of injury, depth and site of burn and different comorbidities [10]. In Velayat Sub-Specialty Burn and Plastic Surgery Center as the only Burn Center in Guilan province (the north of Iran), studies like this have not been done yet and there is a lack of information about it. Thus, we designed this study to measure the unplanned readmission rate and identified its predictors in patients with burn in Guilan Province. Guilan Province is one of the 31 provinces of Iran. It lies along the Caspian Sea. Its population in 2011 was approximately 2,480,874 people [11]. Velayat Sub-Specialty Burn and Plastic Surgery Center is the only Burn Center in this province which has 57 beds (18 beds dedicated to Very Important Person, 13 beds dedicated to Plastic Surgery, 13 beds dedicated to burn surgery, three beds dedicated to ICU, five beds dedicated to Emergency) and admits approximately 1000 burned patients annually. It seems that this is the first study which has been conducted to measure this outcome after burn in Guilan.

Methods

This cross sectional analytic study has been done to determine the predictors of unplanned readmission after burn in Velayat Sub-Specialty Burn and Plastic Surgery Center in Guilan province, Rasht, Iran (the north of Iran). Velayat Sub-Specialty Burn and Plastic Surgery Center is the only burn center in Guilan province. It admits not only Guilanian burn patients, but also patients from other provinces.

We examined medical records of patients hospitalized with burns in Velayat Sub-Specialty Burn and Plastic Surgery Center over a 5-year period from 2008 to 2013. Inclusion criteria were age ≥ 18 years old, lack of approved mental diseases and mental retardation, lack of hearing and visual impairments, hospitalizing in Velayat Center because of burns. According to this classification, these were taken into consideration; partial thickness burns, full thickness burns, burns involving eyes, ears, face, feet or perineum that are likely to result in cosmetic or functional impairment, high-voltage electrical burns, burn injuries complicated by major trauma, inhalation injuries, poor risk patients with burn injuries [7]. Self-inflicted burn patients and toxic epidermal necrolysis or Steven–Johnson syndrome were excluded.

We recorded the following variables for each patients: age, gender, residential area, marital status, education level, (as sociodemographic factors) and medical insurance, percentage of Total Body Surface Area (TBSA), location of burn, causes of burn injury, burn degree, skin graft, Baux index (age + TBSA), length of hospital stay, length of ICU stay, length of mechanical ventilation, concomitant diseases and unplanned readmission (as burn-related factors).

Unplanned readmission was defined as non-elective admission to the Velayat Center during the study period. We documented early and late non-elective readmission following burn.

To obtain patients medical records, we used Health Information System (HIS) software. By HIS we could prepare a list of burn patients hospitalized in Velayat Center from 2008 to 2013. After selecting them systematically, we retrieved their medical records retrospectively. In total, 703 medical records were evaluated, out of which 77 were excluded (six due to auditory and visual impairment, 28 due to self-inflicted burn, 38 because of mental disorders, and five because of mental retardation); therefore, final analysis was performed on 626 records (Fig. 1). We had to call some patients to fill some variables because of some incomplete medical records, but among 626 patients who were included in this survey, 444 answered to the researcher's questions, so in some parts we could not complete some variables.

Finally, statistical analysis was performed using SPSS (version16.0), Chi-square, Mann–Whitney U and Logistic regression tests. The significance level was considered $p < .05$. Ethics approval was obtained from the Guilan University of Medical Science Research Ethics Committees with this code: IR.GUMS.REC.1394.331.

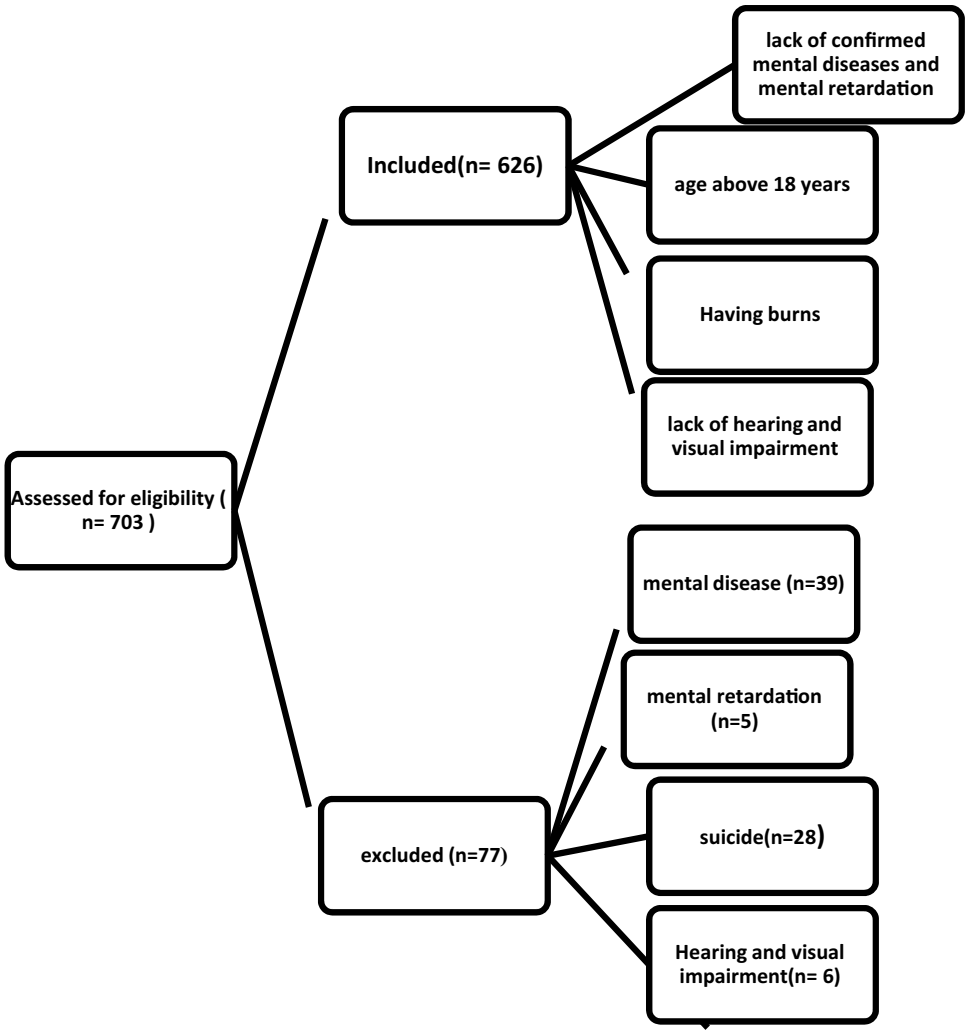

Fig. 1 Diagram of selecting patients

Results

Of 626 patients, 491 were male (78.4%), 304 (50.2%) patients living in village and thermal burn was the most common kind of burns (87.1%). Also, most of patients 268 (43.4%) had second and third degree burn simultaneously (partial thickness and full-thickness burn). 6.9% of the patients died following burn injuries (Table 1).

The mean age of the patients was 41.02 ± 17.31 (min 18, max 94 years). 32 patients (5.1%) had unplanned readmission.

Patients experienced unplanned readmission 3–369 days after discharge (minimum = 3 days, maximum = 369 days, mean ± SD = 64 ± 107).

27 patients (84%) undergone surgery after unplanned readmission (Fig. 2).

According to Fisher exact test, the relationship between skin graft ($p = .0001$) and surgery (escharotomy, fasciotomy or skin graft, $p = .013$) with unplanned readmission was statistically significant (Table 2).

To compare quantitative variables between two groups (with and without unplanned readmission), first data distribution was examined by KS test. Because quantitative variables were not normally distributed ($p < .05$), Mann–Whitney U Test was used. When comparing distribution of unplanned readmission in patients according to burn-related factors, we found that there are significant differences between two groups of patients. Patients who had unplanned readmission, had higher Baux index, higher TBSA, higher length of hospital stay, higher length of ICU stay and higher length of mechanical ventilation (Table 3).

Table 4 presents the predictors of unplanned readmission. Three variables of TBSA ($p = .002$, OR = 1.030, CI = 1.011–1.049), HTN ($p = .033$, OR = 2.923, CI = 1.089–7.845), and skin graft ($p = .0001$, OR = 7.045, CI = 2.718–18.258) were the predictors of unplanned readmission.

Each 1% increase in TBSA increased unplanned readmission by 1.03 times. HTN increased unplanned

Table 1 Sociodemographic and burn-related factors in the studied samples

%	*N* (%)
Gender	
Male	491 (78.4)
Female	135 (21.6)
Residential area	
City	301 (49.8)
Village	304 (50.2)
Insurance	
Yes	600 (96.5)
No	22 (3.5)
Marital status	
Single	161 (25.9)
Married	450 (72.5)
Divorced	3 (0.5)
Widow	7 (1.1)
Education	
Illiterate	93 (20.9)
Incomplete high school diploma	195 (43.9)
Diploma	109 (24.5)
Collegiate	47 (10.6)
Location of burn	
Home	245 (49.5)
Workplace	154 (31.1)
Other	96 (19.4)
Cause of burn	
Thermal	545 (87.1)
Chemical	37 (5.9)
Electrical	42 (6.7)
Other	2 (0.3)
Skin graft	
Yes	244 (39.2)
No	379 (60.8)
Burn degree	
1st	2 (0.3)
2nd	172 (27.9)
3rd	87(14.1)
4th	16 (2.6)
1st and 2nd	3 (0.5)
2nd and 3rd	268 (43.4)
3rd and 4th	62 (10.0)
1st and 2nd and 3rd	2 (0.3)
2nd and 3rd and 4th	5 (0.8)
Inhalation injury	
Yes	15(30.6)
No	611 (69.4)
Mortality	
Yes	43 (6.9)
No	583 (93.1)

readmission by 2.923 times, and skin graft increased unplanned readmission by 7.045 times (Table 4).

Discussion

Velayat Sub-Specialty Burn and Plastic Surgery Center is the only burn center in Guilan province. This survey aimed to identify the unplanned readmission rate and its predictors following burn in this center. This is the first study that investigated unplanned readmission in above mentioned center.

Survival after burns has steadily improved over the last few decades [12]. Improvements in acute survival with modern burn care mandate that we examine outcomes on a long-term basis for all patients [13]. One of the outcomes of burn is unplanned readmission. However, mortality and length of hospital stay remain as the most important and valid measurements of quality of health care, there is a need to increase the value of them with other measurements. In many countries, such as the USA and the UK, the agenda has moved towards the production of new metrics for both safety and performance. For example, the ability to perform a technically successful surgery and discharge patients without needing a surgical re-intervention and without unplanned hospital readmissions may be considered as markers of high quality services [14].

In this survey, unplanned readmission was considered as non-elective readmission (early and late) to the Velayat Sub-Specialty Burn and Plastic Surgery Center from 2008 to 2013. In our study, the rate of hospital readmission after burns was 5.1% (32 patients), whereas in Mandell and his colleague's survey in Washington it was 45% (1077 patients) [13]. Lower unplanned readmission rate in this study compared to the survey conducted in Washington is perhaps due to the different inclusion criteria. We included burn patients ≥ 18 years old but Mandell and his colleagues included burned patients ≥ 45 years old in their survey. By increasing the age of patients, the rate of readmission might increase due to underlying diseases.

The most common reason for readmission in our study was infection in burned area and then cosmetic problems such as hypertrophic scars, keloid and contracture which led to more readmission. Cutaneous scarring remains the pathognomonic feature after burns to the skin and characteristically underlies post-burn physical and psychosocial morbidity. The most common cicatrix formed after a burn is the hypertrophic scar, the prevalence of which is reportedly as high as 70%. Two types of pathological scars can arise from the burn wound—a hypertrophic scar or a keloid [15]. A possible explanation for these findings might be either not using new techniques to manage and cure burn wounds in

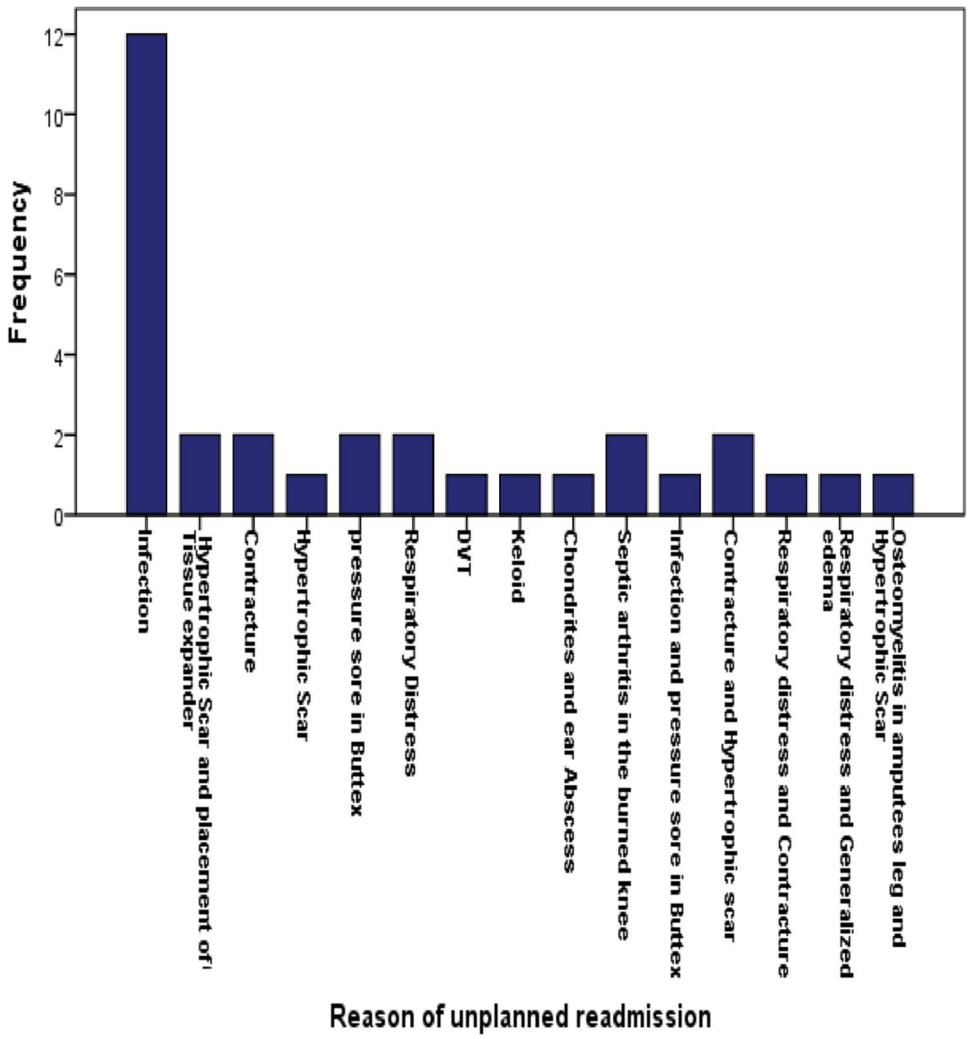

Fig. 2 Reasons of unplanned readmission

Table 2 Relationship between burns related factors with unplanned readmission

Variables	Unplanned readmission		
	No	Yes	
	N (%)	*N* (%)	*p* value*
Skin graft			
Yes	219 (89.8)	25 (10.2)	
No	372 (98.2)	7 (1.8)	0.000
Surgery			
Yes	394 (93.4)	28 (6.6)	
No	200 (98.0)	4 (2)	0.013

*Fisher exact test

the early years of establishing Velayat Center or the depth of burns in our samples.

Total Body Surface Area, hypertension and skin graft were the predictors of unplanned readmission in the patients admitted to Velayat Sub-Specialty Burn and Plastic Surgery Center. In this survey, age was not the predictor of unplanned readmission while in Mandell and his colleague's survey in Washington it was. In their study, the older patients had a high likelihood of rehospitalization [13]. This difference may be due to different inclusion criteria, since we included burned patients ≥ 18 years old while they included burned patients ≥ 45 years old in their survey.

Despite advances in medical and surgical techniques, older adults tend to be at risk for adverse outcomes following traumas [8, 16, 17], and burns are the fourth most common type of trauma worldwide following traffic accidents, falls, and interpersonal violence [18].

Previous studies have shown that TBSA and medical comorbidities are associated with increased risk of unpleasant outcome of burns [16]. Everett and his colleagues found that polypharmacy and higher Charlson Comorbidity Index scores at admission predict readmission risk for 30-day readmission [19]. Lundgren and his colleagues' study also has shown that patients age and TBSA burn are the most significant factors impacting in-hospital mortality risk following

Table 3 The distribution of unplanned readmission in patients according to burn-related factors

Variables	Unplanned readmission		*p* value*
	No	Yes	
Age			
Mean ± SD	41.07 ± 17.31	40.03 ± 17.74	0.601
Median	37.00	34.50	
TBSA			
Mean ± SD	15.57 ± 17.18	23.83 ± 16.22	0.001
Median	10.00	22.00	
Baux			
Mean ± SD	56.67 ± 24.50	63.86 ± 21.66	0.027
Median	52.00	65.50	
Length of hospital stay			
Mean ± SD	11.36 ± 10.03	36.13 ± 29.80	0.000
Median	9.00	23.00	
Length of ICU stay			
Mean ± SD	1.14 ± 4.31	6.88 ± 12.72	0.000
Median	0.00	0.00	
Length of mechanical ventilation			
Mean ± SD	0.50 ± 2.45	2.25 ± 5.92	0.049
Median	0.00	0.00	

*Mann–Whitney U Test

burn injury as one of the outcomes of burn. Higher numbers of medical comorbidities were also associated with increased mortality risk within 1 year following discharge [16]. Thombs and his colleagues' study has shown that a number of preexisting medical conditions influence outcomes in acute burn injury [20]. These studies suggest that medical comorbidities can affect the outcome of diseases. In our study, HTN was also one of the predictors of unplanned readmission. The possible explanation for this finding may be the fact that patients with underlying diseases such as HTN need more medical attentions. They may be readmitted to hospitals due to the deterioration of their physical conditions, so the rate of readmission could be higher in this group of patients.

The effect of skin graft on readmission is perhaps because of the reason that grafts usually have been done in patients with deep burns like deep partial thickness or full-thickness. By increasing depth of burns, the risk of hypertrophic scars, infection and keloid will increase. Superficial burns usually heal completely with minimal scarring during 14 days. In deep partial thickness, as well as full-thickness burns, healing occurs through the processes of re-epithelialization and contraction. In deeper burns, healing occurs from the edges rather than the center of the wound, so the probability of contraction is more [21]. Because keloids and hypertrophic scars can be esthetically disfiguring, functionally debilitating, emotionally distressing, and psychologically damaging [22], patients have to return to the burn center to receive more treatments.

We found that patients with unplanned readmission had higher Baux index (age + TBSA), higher TBSA, higher length of hospital stay, higher length of ICU stay and higher length of mechanical ventilation. Possible explanation for this findings may be the depth of burns in our samples, because second and third degree burns (partial thickness and full-thickness burns), according to the medical records of patients, were the deepest burns in our samples. Deeper burns result in longer hospital stay to receive more medical attention. Previous studies have shown that Baux index (age + TBSA) is associated with an increased hospital mortality [10, 23] as one of the burn outcomes and that it is a predictor of unplanned readmission, but in our study, Baux index (age + TBSA) was not the predictor of unplanned readmission, while TBSA was. It may be due to the fact that age was also not the predictor of unplanned readmission. The other explanation for this finding is the low sample size of readmitted patients.

This study had some limitations. The retrospective nature of this study and using medical records to identify the reason of unplanned readmission were some of the limitations. We do not have a database to gather burn patients′ information and use it to do more research about them in Velayat Center and Velayat Sub-Specialty Burn and Plastic Surgery Center. It is not an educational Center so the patients' information is not well documented and often is incomplete in the demographic history of previous diseases and history of burn section. We included adult burned patients in this survey, so it is suggested that future surveys should focus on determining the predictors

Table 4 Predictors of unplanned readmission

Predictors	*B*	S.E	Wald	*df*	*p* value	Exp (*B*)	95% CI	
							Lower limit	Higher limit
TBSA	0.030	0.009	10.017	1	0.002	1.030	1.011	1.049
HTN	1.073	0.504	4.534	1	0.033	2.923	1.089	7.845
Skin graft	1.952	0.486	16.145	1	0.0001	7.045	2.718	18.258
Constant	−4.888	0.539	82.321	1	0.000	0.008		

TBSA total body surface area, *HTN* hypertension

of unplanned readmission in burned children to investigate the effects of the new techniques in the management of burn wound on the outcome of burns.

Conclusion

This is the first survey which has been conducted in Velayat Sub-Specialty Burn and Plastic Surgery Center to identify the rate of unplanned readmission and its predictors in burn patients in Guilan province. According to the results of this study, TBSA, HTN and skin graft were the predictors of unplanned readmission and most of burned patients readmitted to the Velayat Center due to infection and cosmetic problems in the burned area. It seems that following burned patients after discharge and frequent examinations in an outpatient's clinic can help health care providers and governments to reduce the rate of readmission, control costs and improve the quality of care.

Acknowledgements The authors wish to appreciate the Deputy for Research of Guilan University of Medical Sciences for the financial support of the study, Social Determinants of Health Research Center (SDHRC), and all the staff of Velayat Sub-Specialty Burn and Plastic Surgery Center especially Dr. Cyrus Emiralavi (the President) for their help.

Funding This study was funded by Guilan University of Medical Sciences (Grant number: پ/4/132/3718).

Compliance with ethical standards

Conflict of interest Zakiyeh Jafaryparvar, Masoomeh Adib, Atefeh Ghanbari, and Ehsan Kazemnezhad Leyli declare that they have no conflict of interest.

Informed consent For this study formal consent was not required.

References

1. Seyed-Forootan K, Karimi H, Motevalian S, Momeni M, Safari R, Ghadarjani M. LA50 in burn injuries. Ann Burns Fire Disasters. 2016;XXIX(1):14–7.
2. Matin BK, Matin RK, Joybari TA, Ghahvehei N, Haghi M, Ahmadi M, et al. Epidemiological data, outcome, and costs of burn patients in Kermanshah. Ann Burns Fire Disasters. 2012;25(4):171.
3. Herndon DN, Tompkins RG. Support of the metabolic response to burn injury. The Lancet. 2004;363(9424):1895–902.
4. McCowen KC, Malhotra A, Bistrian BR. Stress-induced hyperglycemia. Crit Care Clin. 2001;17(1):107–24.
5. Falder S, Browne A, Edgar D, Staples E, Fong J, Rea S, et al. Core outcomes for adult burn survivors: a clinical overview. Burns. 2009;35(5):618–41.
6. Pereira C, Murphy K, Herndon D. Outcome measures in burn care: is mortality dead? Burns. 2004;30(8):761–71.
7. Herndon DN. Total burn care: chap. 6. 4th ed. Saunders; 2012.
8. Olufajo OA, Cooper Z, Yorkgitis BK, Najjar PA, Metcalfe D, Havens JM, et al. The truth about trauma readmissions. Am J Surg. 2016;211(4):649–55.
9. Centers for Medicare and Medicaid Services.Readmissions Reduction Program (HRRP). [Updated August 4, 2014]; Available on: https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Readmissions-Reduction-Program.html.
10. Pavoni V, Gianesello L, Paparella L, Buoninsegni LT, Barboni E. Outcome predictors and quality of life of severe burn patients admitted to intensive care unit. Scand J Trauma Resusc Emer Med. 2010;18(1):1.
11. Gilan Province. https://en.wikipedia.org/wiki/Gilan_Province (2016). Accessed 27 April 2010.
12. Sheppard N, Hemington-Gorse S, Shelley O, Philp B, Dziewulski P. Prognostic scoring systems in burns: a review. Burns. 2011;37(8):1288–95.
13. Mandell SP, Pham T, Klein MB. Repeat hospitalization and mortality in older adult burn patients. J Burn Care Res. 2013;34(1):e36–e41.
14. Holt PJE, Poloniecki JD, Hofman D, Hinchliffe RJ, Loftus IM, Thompson MM. Re-interventions, readmissions and discharge destination: modern metrics for the assessment of the quality of care. Eur J Vasc Endovasc Surg. 2010;39(1):49–54.
15. Finnerty CC, Jeschke MG, Branski LK, Barret JP, Dziewulski P, Herndon DN. Hypertrophic scarring: the greatest unmet challenge after burn injury. The Lancet. 2016;388(10052):1427–36.
16. Lundgren RS, Kramer CB, Rivara FP, Wang J, Heimbach DM, Gibran NS, et al. Influence of comorbidities and age on outcome following burn injury in older adults. J Burn Care Res. 2009;30(2):307.
17. Fawcett VJ, Flynn-O'Brien KT, Shorter Z, Davidson GH, Bulger E, Rivara FP, et al. Risk factors for unplanned readmissions in older adult trauma patients in Washington state: a competing risk analysis. J Am Coll Surg. 2015;220(3):330–8.
18. Knowlin L, Stanford L, Moore D, Cairns B, Charles A. The measured effect magnitude of co-morbidities on burn injury mortality. Burns. 2016;42(7):1433–8.
19. Logue E, Smucker W, Regan C. Admission data predict high hospital readmission risk. J Am Board Fam Med. 2016;29(1):50–9.
20. Thombs BD, Singh VA, Halonen J, Diallo A, Milner SM. The effects of preexisting medical comorbidities on mortality and length of hospital stay in acute burn injury: evidence from a national sample of 31,338 adult patients. Ann Surg. 2007;245(4):629–34.
21. Chiang RSBS., Borovikova AAMD., King KBS, Banyard DAM-DMBA, Lalezari SBS, Toranto JDMD., et al. Current concepts related to hypertrophic scarring in burn injuries. Wound Rep Regen. 2016;24(3):466–77.
22. Trace AP, Enos CW, Mantel A, Harvey VM. Keloids and hypertrophic scars: a spectrum of clinical challenges. Am J Clin Dermatol. 2016;17(3):201–23.
23. Smith DL, Cairns BA, Ramadan F, Dalston JS, Fakhry SM, Rutledge R, et al. Effect of inhalation injury, burn size, and age on mortality: a study of 1447 consecutive burn patients. J Trauma Acute Care Surg. 1994;37(4):655–9.