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Original Article

Impact of the Iranian Health Sector Evolution Plan on Rehospitalization: An Analysis of 158000 Hospitalizations

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Abstract

Background: In May 2014, Iran launched the most far-reaching reform for the health sector, so-called Health Sector Evolution Plan (HSEP), since introduction of the primary health care network, with a systematic plan to bring about Universal Health Coverage. We aimed to analyze the time to first all-caused rehospitalization and all-caused 30-day readmission rate in the biggest referral hospital of Northwest of Iran before and after the reform.

Methods: We retrospectively analyzed discharge data for all hospitalization occurred in the six-year period of 2011-2017. The primary endpoints were readmission-free survival, and overall 30-day readmission rate. Using multivariate cox proportional hazards regression and logistic regression, we assessed between-period differences for readmission-free survival time and overall 30-day rehospitalization, respectively.

Results: Overall, 157969 admissions were included. After adjusting for available confounders including age; sex; ward of admission; length of stay; and admission in first/second half of year, the risk of being readmitted within 30 days after the reform was significantly higher (worse) compared to pre-reform hospitalization (odd ratio 1.22, $P<0.001$, 95% CI, 1.15-1.30). Adjusting for the same covariates, after-reform period also was slightly significantly associated with decreased (deteriorated) readmission-free time compared with pre-HSEP period (HR 1.06, $P=0.005$, 95% CI 1.01-1.11).

Conclusion: HSEP seems insufficient to improve neither readmission rate, nor readmission-free time. It is advisable some complementary strategies to be incorporated in the HSEP, such as continuity of care promotion, self-care enhancement, effective information flow, and post-discharge follow up programs.

Keywords: Readmission rate; Readmission-free time; Health transformation plan; Health care quality

Introduction

On Apr, 30th, 2014 the Iranian government embarked on the most far-reaching reform for the health sector since introduction of the primary health care network, with a systematic plan to bring about Universal Health Coverage. The plan, so-called Health Sector Evolution Plan (HSEP), was formulated by the Ministry of Health and Medical Education (MoHME). It included different interventions to expand population coverage of free basic health insurance in all uninsured Iranians; decline out-of-pocket costs of inpatient services at MoHME affiliated hospi-

tals (reduction of inpatient out of pocket payment to 6% and 3% for urban and rural/small town residents, respectively); provide substantial financial protection for patients with specific diseases such as hemophilia, thalassemia, cancer, and multiple sclerosis; improve quality of care and safety in the hospitals affiliated with MoHME (by increasing in specialist staffing level, bringing in the new policy of 24-h presence of specialists in all inpatient wards, improving quality of polyclinics' care and hoteling services); reduce cesarean section delivery rate; implement revised relative value units of clinical procedures, increase quality of primary health care (PHC) services; and cope with under-supply of medical doctors in deprived areas (1-5).

In addition to the fact that there was insufficient empirical research into the outcomes and effects of the reform, the current sparse research literature in this area to date has tended to focus on issues such as responsiveness (6), patients' satisfaction (7, 8), hospital efficiency (9, 10), nursing burnout (11), cesarean section rate (1), and out of pocket payments (4, 5) rather than performance and quality indicators. This is while, as mentioned above, quality improvement of hospital care is one of the key pillars of the HSEP.

Patient rehospitalization in a short time after discharging has reported as an indicator for measuring quality of care (12). In addition, rehospitalization is considered as a symptom of dysfunction in the continuity of care (13). A fifth of patients will be rehospitalized 30 days after discharge (14, 15) that presents tremendous burden on patients and payers (16).

Therefore, this study sought to evaluate the effect of this reform on all-caused readmission as an indicator of quality of care in hospitals (16-18). We aimed to compare survival of discharged patients from rehospitalization and also overall 30-day readmission rate before and after the initiation of Iranian HSEP reform in the biggest referral center in northwest of Iran. We hypothesize that after implementation of this multi-pillar reform, we could see improved readmission-related indicators.

Materials and Methods

Study setting

This study was conducted in the largest (800 beds) and best equipped tertiary-level multispecialist hospital in western north of Iran, affiliated with Tabriz University of Medicine Sciences, that serves roughly 4 million people of Eastern Azerbaijan and also neighbor provinces (Mostly Kurdistan, Western Azerbaijan, and Ardabil). This hospital has approximately 25000 annual inpatient admissions.

Data source

We obtained individual-based admissions and discharge data for all inpatient admissions from the discharge database of the hospital for a period of six years. This six-year period was from Mar, 2011 to Mar 2017, including a 38-month pre-reform period (Mar 21st, 2011, to Apr 21st, 2014) and a 34-month after-reform period (Apr 21st, 2014, to Mar 21st, 2017). The intervention of study (HSEP) implemented on 21st Apr 2014 in all the MoHME affiliated hospitals.

Patients' age, gender, ward of admission, and length of stay (LOS) were also provided by the above mentioned database. Permission to perform the study was granted by hospital authorities and TUOMS's Research Ethics Committee (IR.TBZMED.REC.1397.089).

Statistical Analysis

The primary outcomes were time to all-caused rehospitalization and 30-day rehospitalization (defined as any inpatient readmission to the hospital within 30 days of index hospitalization). Readmission was measured as occurring when a patient's unique insurance number reappeared in the dataset, as a second admission.

Between-period comparison was performed for readmission-free survival with Kaplan-Meier method. In this regard, hazard ratio was determined using a cox proportional hazards regression model that is commonly used for investigating the association between time to specific event and one or multiple variables (19). Assumptions

of proportional hazards were assessed by plotting log-log survival against (log) time and also with observed versus estimated survival curves (20). Concerning the available potential covariates to the survival time, we adjusted the model for gender (male defined as reference group), corresponding wards (internal and surgery wards as reference wards), categorized LOS (1-5 (reference), 6-10, 11-20, 21-40, 41-60, 61-100, >100 days), and age groups (1-9, 10-19, 20-29, 30-39, 40-49, 50-59 (reference group), ≥ 60 yr).

We also applied logistic regression, with the same adjustments as used in Cox, to analyze the difference in incidence of 30-day rehospitalization among those admitted in pre- and post-reform period.

"Time in days until rehospitalization" (i.e., survival time) was calculated as the interval (days) between the time of an index discharge and the admission date of the next hospitalization. Survival time was right censored (to Jun 1st, 2014 and Jun as implementation date of the reform for pre-reform admissions, and 1st, 2017 as the end of the study period for post-reform hospitalizations) for admissions that were not repeated until the end of the study.

In the survival analysis part of the study, we separated admissions occurred in each reform period (before- and after-reform) and calculated origin and second hospitalization, ignoring the admissions take placed in time out of the related period. This was necessary to avoid bias resulting from unequal time of risk exposure between this tow consecutive periods. We excluded readmissions that occurred for second or more times in each periods. We also excluded wards that established after the reform from the analysis.

Statistical analysis was carried out using StataMP (version 14; Stata Corporation, College Station, TX, USA). A *P* value of 0.05 or less was regarded as significant.

Results

During the six-year period of the study, a total of 176022 inpatient admissions were occurred in the hospital, from which 287 cases were excluded because of missing data. From the remaining 157,968 inpatient admissions, a number of 17,767 records were excluded because they were 2nd (or more) readmission. From this number of admissions, we excluded those occurred in wards hematopoietic stem cell transplantation, general internal, and general surgery given that they were established after the reform. Overall, 157,266 admissions were included in our analysis.

Of this 157,266 inpatients admissions, 74137 (47/14%) were recorded in the pre-reform period. The mean age for patient admitted in the pre-reform period was 52.43 yr (SD= 21.2), and 49.23 years (SD=20.9) for those admitted after the reform. Admissions were from twenty-five wards. Fig. 1 displays the distribution of included admission in terms of corresponding wards.

Readmission-free time

The length of observation period was similar for both before- and after-reform period (mean time-at risk of 537.8 days for pre-reform period and 469.6 days for post-reform period).

The unadjusted median survival time for pre-reform admissions was 523 days compared with 456 days for post-reform period. Survival was 86.77% for the before-reform period versus 87.06% for the after-reform period.

Kaplan Meier estimator was used to compare survival trends between the periods. Fig. 2 depicts the Kaplan Meier Curves for each period. As it is obvious from the figure, the curves for each periods are similar, indicating that there are not any major change resulted in the reform on the readmission-free time survival. Compared with the pre-reform period, the risk of rehospitalization was significantly higher in after-reform period (hazard ratio 1.065 (1.02-1.11) *P*=0.005). In other words, patients that hospitalized after the reform were 1.06 times more likely to be re-admitted than those in post-reform period.

Predictors of readmission-free time

In this section of the study, we were to explain the effects of other covariates on readmission-free time of the included hospitalizations. HRs and 95% confidence intervals for each of the co-

variates that included in the model are shown in Table 1. In terms of age-group covariate, age category of 41-50 yr old were at highest risk of readmission (HR 1.34, CI 1.1-1.4). According to covariate "ward of admission", the highest risk of readmission is for oncology 2 (HR 3, CI 2.73-3.3) and oncology 1 (HR 2.95, CI 2.67-3.25) wards, respectively. The lowest ward-related risk of readmission is for general ICU (HR 0.23, CI 0.07-0.71).

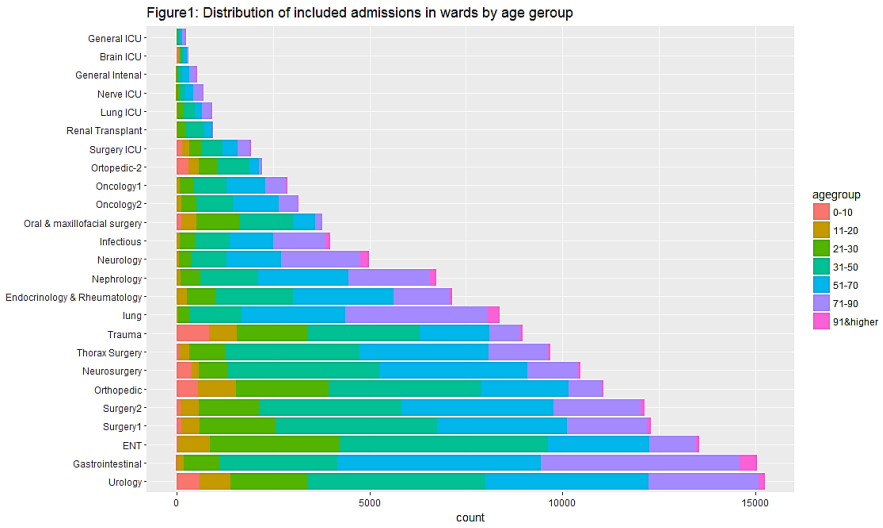

Fig. 1: Distribution of included admissions in hospital wards by age groups

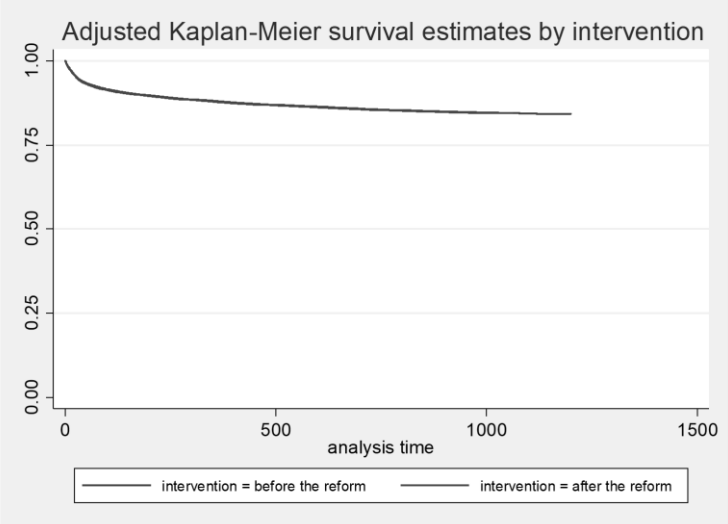

Fig. 2: Adjusted Kaplan-Meier survival estimates by intervention

In related to length of stay, hospitalizations that lasted for 41-60 days are the most vulnerable group to early readmission (HR 1.74, CI 1.44-2.1). In addition, compared with male patients, readmission-free time survival had a relatively good prognosis in female patients (HR 0.93, CI 0.89-0.96). Finally, hospitalization in the second half of year (cold half of Persian year) was associated with lower risk of readmission (HR 0.93, CI 0.89-0.96).

Table 1: Cox Hazard Model

Intervention	*Hazard Ratio*	*Standard Error*	*P>z*	*[95% Confidence interval]*	
After Reform	1.065086	0.023748	0.005	1.019542	1.112664
Age-group (reference group= 1-9 yr)					
10-19 yr	1.061712	0.0775083	0.41	0.9201661	1.225031
20-29 yr	1.082595	0.0703867	0.22	0.9530672	1.229725
30-39 yr	1.095646	0.0702583	0.15	0.9662441	1.242377
40-49 yr	1.217075	0.078266	0.002	1.07295	1.38056
50-59 yr	1.34285	0.0859944	< 0.001	1.184453	1.52243
60 yr and older	1.244961	0.0783462	< 0.001	1.100498	1.408388
Clinical ward of admission (reference group = surgery & internal ward)					
ENT	0.5552424	0.029303	< 0.001	0.50068	0.615751
Thorax Surgery	1.04257	0.048565	0.3	0.9516	1.142235
Urology	1.3418	0.050649	< 0.001	1.246113	1.444834
Neurosurgery	0.582458	0.032137	< 0.001	0.522758	0.648976
Orthopedic	0.753252	0.043182	< 0.001	0.673199	0.842824
Trauma	0.6150698	0.034978	< 0.001	0.550197	0.687592
Gastrointestinal	1.088714	0.043915	0.03	1.005956	1.17828
Infectious Diseases	0.7061113	0.051704	< 0.001	0.61171	0.815081
Oncology-1	2.952608	0.148552	< 0.001	2.675346	3.258604
Oncology-2	3.006169	0.143202	< 0.001	2.738202	3.30036
Lung	0.888686	0.044617	0.01	0.805403	0.980582
Oral & maxillofacial surgery	0.7164453	0.056303	< 0.001	0.614173	0.835748
Nephrology	1.809589	0.07824	< 0.001	1.662559	1.969622
Endocrinology & Rheumatology	1.06876	0.052452	0.1	0.970745	1.17667
Renal Transplant	1.817905	0.178357	< 0.001	1.499888	2.20335
Neurology	0.4926609	0.038599	< 0.001	0.42253	0.574432
Surgery ICU	0.9613166	0.081466	0.64	0.814202	1.135013
General ICU	0.2301972	0.133088	0.01	0.074127	0.714861
Brain ICU	0.4635817	0.120508	0.003	0.27852	0.771607
Lung ICU	0.4721481	0.091816	< 0.001	0.322515	0.691204
Nerve ICU	0.3444459	0.077678	< 0.001	0.221393	0.535894
Ortopedic-2	0.5257775	0.063048	< 0.001	0.415654	0.665078

30-day readmission rate

Before the initiation of the reform, 4028 (5.74%) of the 70109 admissions repeated within 30 days. This amount was 4680 (5.9%) from 78449 hospitalizations for after-reform period. Fig. 1 provides descriptive non-adjusted changes in 30-day readmission rate between pre- and post-reform period in terms of related inpatient ward. As it is obvious, from the 25 included wards, 17 wards experienced unfavorable change and only eight wards experienced favorable change (Fig. 3).

After correcting for possible effect of other variables, the same as included in the cox model, admissions that occurred in after-reform period had 22% greater odds of 30-day readmission (odd ratio 1.22, CI 1.15-130) relative to hospitalization took place before the initiation of the reform.

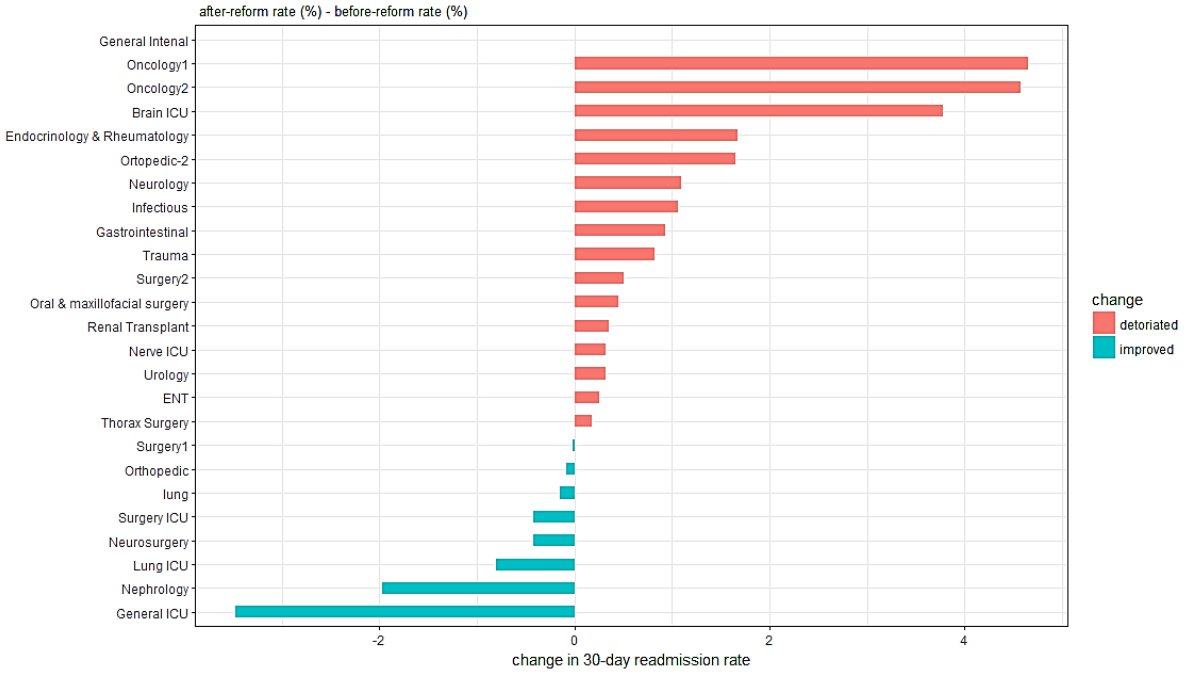

Fig. 3: Unadjusted difference between 30-day readmission rate by hospital wards

Discussion

We compared before/after-HSEP hospitalizations with respect to both 30-day readmission rate and time (days) to rehospitalization in a large tertiary-level hospital within six years. Surprisingly, we found that following the implementation of the HSEP, a small but significant negative difference was made in both rehospitalization-free days (decreased) and 30-day readmission rate (increased), compared with pre-reform period.

Our reason for linking HSEP effect on hospital readmission was based on the assumption that 24-h presence of physicians in inpatient wards, as part of the reform, would improve quality of hospital care and therefore reduce (increase) readmission rate (readmission-free time). We also assumed that, according to a study (21), extending insurance coverage would result improved access to outpatient care through opening an opportunity to provision of outpatient follow-up care would result in the same effect.

Regarding our second assumption, in a study under same assumption about the Massachusetts reform, expanding health insurance coverage in the reform failed to improve readmission rate (22). Results of an earlier study also showed that Massachusetts insurance expanding reform was not associated with improvement in accessing personal physician visits (23).

One of the potential explanation for the observed slight adverse effect of the reform on readmission is that gaining health insurance (for previously uninsured population) and increased reimburse rate, that substantially reduced financial barrier of receiving hospital care, may allow people to seek inpatient follow-up care after hospital discharge. Another potential reason for this negative effect is that, because of the fact that hospital physicians are paid for each individual services provided (fee for services mechanism), the rise in medical tariff following the reform may provide an incentive for them to hospitalise patients unnecessarily that can result in rehospitalization. Furthermore, it is well-documented that "social instability" as a multi-dimensional intersectional factor, which reflects insufficient social support; poor education; economic instability and patients' unsafe environment, is a strong risk factor for readmission (24, 25).

However, in this study, there was an important statistical point that should be considered in interpreting the results. When interpreting the results of relatively large sample data analysis, the focus should be on magnitude of effect size rather than *P* vale which it may be the product of large sample size (26). This is known as "magnitude or large sample size fallacy" in statistics literature (27, 28).

Our study may have important implications for future research in the field of HSEP. First, the results strengthen the need to investigate the potential unwanted effects of the reform implication in hospital care. Second, future works also should address the question that if the health insurance expansion affected the outpatient primary or specialist follow-up care.

Strengths

To our knowledge, this study is the first to assess the effect of Iranian HSEP reform on survival time of each discharge (regarding to readmission) with comprehensive longitudinal data analysis using real large sample utilization data (versus self-reported) .

Limitations

We investigated the effect of this national reform on selected outcomes in only one hospital. Therefore, although the study benefited from significant power due to a large sample size and relatively long-term follow-up, but the generalizability of the results to other hospitals may be hindered. Although this study controlled for gender, age, admission ward and LOS, we were unable to control covariates such as illness severity and comorbidities, which were not available in hospital electronic system. For the same reason, we also could not control for specific diagnoses. Another important limitation of the study is that we have not access to databases of other hospitals to ascertain potential readmissions occurred outside of the study hospital, and as Davies and his colleagues concluded (29), caution should be used when interpreting the results.

Conclusion

In the biggest referral hospital of western north of Iran, there was not any improvement made in the readmission-free survival time and 30-day readmission rate, but rather a slight deterioration. This study strengthen the idea that to improve rehospitalization-related indicators, decision makers needs to implement systematic and focused strategies. Health sector policy makers and authorities in Iran should include sustainable and purposeful changes to improve quality of care and related measures. We encourage decision makers in MOHME to identify and eradicate barriers hindering the successful implementation of the HSEP. In addition, several fundamental prerequisites that were neglected in HSEP should be considered through complementary steps such as: continuity of care programs, effective information flow in various levels of health care, developing universal protocols and guidelines, post-discharge follow up strategies, promotion of primary health care, integrated and coordinated stewardship in all parts of the health system, and promotion of self-care behavior in patients. We furthermore advocate the use of modern methods to monitor and enhance planning in the inpatient settings. In this vein, we encourage healthcare management researchers to investigate the effects of the HSEP on other quality related measures in inpatient settings and address potential issues in this regard.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that there is no conflict of interest.

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