Effects of Executing Health Sector Evolution Plan on Emergency Department Performance Indices: A 5-Year Survey

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Abstract

Objectives: Continuous evaluation, supervision and improvement of the performance of emergency departments (EDs) are done using 5 emergency performance indices (EPI), which are significantly affected by various factors including inward and outward flow of patients, number of ED personnel being in proportion to the number of patients, rapid decision making, the rate of overcrowding in the ED and so on. Since health sector evolution plan (HSEP) can affect the performance of the ED by changing the mentioned factors, we decided to compare these indices in a 5-year period before and after the execution of this program.

Materials and Methods: In this cross-sectional study, all performance indices of ED were calculated and analyzed using parametric and non-parametric tests from one year before to four years after the execution of HSEP. Data were analyzed using SPSS statistical software version 21.0 and all tests were considered significant at 0.05.

Results: By continuous execution of HSEP, the total number of ED visits increased in levels 2 and 5 and decreased in level 4. The percentages of patients discharged within 6 hours and discharge against medical advice improved. Mean triage time in all levels, the percentage of patients leaving the ED within 12 hours, unsuccessful cardiopulmonary resuscitation, mean time interval between triage and the first visit in triage levels 3 and 4, and mean time interval between presentation and execution of orders by the nurse in all levels increased.

Conclusions: Execution of HSEP can affect performance indices of ED.

Keywords: Health Care Reform, Health Sector Evolution Plan, Emergency Performance Indices, Health Policy, Iran.

Introduction

By admitting about 30 million patients each year, hospital emergency is one of the most crowded departments of the healthcare system and is one of the gateways that faces most of the people presenting at odd times of the day. Since for most patients, the initial healthcare is equal to the first and the main contact level in the healthcare system, hospitals are of special importance in management programs and development of healthcare and financial policies. Therefore, organizing emergency departments (EDs) is one of the main priorities of the Ministry of Health and its performance has significant direct and indirect effects on the performance of hospitals and the healthcare system (1-6).

The EPI is a tool designed and approved by Ministry of Health and Medical Education (MoHME) for continuous evaluation, supervision and improvement of the performance of ED (Table 1). These indices significantly affect the performance of all hospital units and patients satisfaction, and are affected by different factors including

the inward and outward flow of patients, the number of personnel working in ED in proportion to the number of patients, rapid decision making, ED overcrowding and so on (4,5,7,8).

The healthcare system reforms are possible via changes in control levers including financial, funding and payment policies, the establishment of flexible rules and regulations and changing behaviors. All levers should be changed in line with each other for optimum performance (9,10). One of the policies of the Iranian healthcare system for improving the quality of care is HSEP, which has been executed since May 2014 with 3 following approaches: 1) financial protection of the population, 2) providing justice in availability of healthcare services, and 3) improving the quality of services by concentrating on 7 general service packages including reducing pocket payments fees of patients hospitalized in governmental hospitals, promotion of natural deliveries, hoteling improvement in governmental hospitals, supporting strategies for persuading prolonged stay of physicians in deprived areas,

Table 1. National Emergency Performing Indices (EPI)

Index	Data Necessary of Calculation	The Method Used for Calculation
The percentages of patients were disposed during 6-hour	The number of patients were disposed in 6 hours; the total number of patients hospitalized temporarily; the time of admission into the emergency ward; the time of disposition	The ratio of patients hospitalized temporarily in the emergency ward, whose cases were disposed in 6 hours to the total number of patients hospitalized temporarily in the emergency ward
The percentage of patients leaving the ED in a 12-hour	The number of patients hospitalized temporarily in the emergency ward; the times of admission into and discharge from the emergency ward	The ratio of patients hospitalized temporarily in the emergency ward, whose cases were disposed in 12 hours from the admission and discharged to the total number of patients hospitalized temporarily in the emergency ward
Unsuccessful CPRs[2]	The total number of CPRs; the number unsuccessful CPRs	The ratio of the number of unsuccessful CPRs to the total number of CPRs at a time interval; successful CPR was defined as cases in which the patient had spontaneous circulation and did not need CPR again for at least 20 minutes
Discharge against medical advice	The number of patients hospitalized temporarily; the number of patients discharge against medical advice	The ratio of patients discharge against medical advice despite the advice of the emergency physician to the total number of patients hospitalized temporarily in the emergency ward
Mean time of triage	Duration of triage; triage level; the total number of the patients in the same triage level	The ratio of the total duration of patient triage to the total number of patients in the same triage level

Abbreviation: ED, Emergency department; CPR, cardiopulmonary resuscitation.

presence of specialists residing in governmental hospitals, improving the quality of visiting services in governmental hospitals and financial support of patients with hard to cure diseases with the aim of using resources in a way other than cash (11).

The studies performed by the healthcare research center in 2015 revealed 70% satisfaction with the execution of the mentioned plan among patients and healthcare personnel. In addition, the studies on the process of providing services, performance and qualitative indices, patient satisfaction, increased stay of physicians and so on in the first year of executing the plan reveal desirable results in line with the executive policies of the plan (2,8,9,11-13). However, limitations such as scarcity of permanent financial resources, lack of timely payback by insurance companies, increase in the number of patients presenting to EDs and governmental hospitals, the number of beds and staff not being in proportion to the increased number of patients can result in poor outcomes in the long run. A few studies have comparatively studied the effect of executing HSEP on the performance of hospitals and EDs. Considering the national priority of HSEP and its effect on ED performance indices, and the necessity to plan and improve the mentioned indices by considering the general national policies and on a case to case basis in each hospital and district to improve the quality of services given, the present study was designed and performed in one of the largest specialized teaching hospitals with 564 approved beds and 453 occupied beds in Tehran, Iran with the aim of comparing performance indices of ED from one year before to 4 years after the execution of HSEP.

Materials and Methods

In this cross sectional-study, by using daily and monthly statistics recording forms in patients' files and ED and data recorded from the profiles registered in the electronic hospital information system (HIS), all performance indices of ED were calculated based on the Iranian national EPI (Table 1) during a five-year period from March 2013 to March 2018. Since the time of execution of HSEP was May 2014, the time span of a year before and after execution of the plan was also analyzed on this basis and the month of May was not counted in the time span of the initiation of the plan.

Data Collection

The total number of ED visits including outpatients, hospitalized patients and critical care patients during one month registered daily in either special forms or HIS system was extracted. Additionally, this number was calculated and divided based on patients with a hospitalization profile (code 700) and patients who were visited as outpatients by the physician (code 735 and triage levels 4 and 5). Regarding the mean triage time in level 1, where the patient is immediately moved to the cardiopulmonary resuscitation (CPR) room, the times were recorded as less than 1 second until 2014 and based on the agreement by the MoHME, the timing changed to at least1 minute after the execution of the plan. Regarding the mean triage time in levels 2 and 3, this time was calculated as the first visit of the physician by ED secretary subtracted from the initial triage time. In levels 4 and 5, triage time has been calculated via random evaluation of patients in 2-hour periods by manual recording of the difference between triage time by the nurse and time of entering the physician's room.

The number of patients who left the ED during 24 hours, had failed CPRs and left ED against medical advice was also recorded during each shift by the secretary and nurse.

All necessary data presented in Table 1 had been collected using patients' files and registered data in HIS

at the end of each 24-hour shift by the department of medical records staff. Then the data were rechecked by the ED manager and after the final approval, were entered into the database designed for the study to calculate Emergency Department Performing Indexes (EDPI) at the end of each month. For evaluating the effects of HSEP, the data were divided into 2 periods of one year before and four years after the execution of the plan.

Since the same team had the responsibility of extracting and recording the mentioned statistics, personal error in registering is minimized in this study.

Statistical Analysis

We analyzed the data by SPSS statistical software version 21.0. To describe data, descriptive statistics of mean and standard deviation, frequency and percentage were used. We used both parametric (chi-square and ANOVA) and nonparametric (Kruskal-Wallis and Wilcoxon) tests for analyzing data and the level of significance was considered to be 0.05.

Results

The total number of ED visits, visits based on triage level, mean duration of hospital stay, patients' satisfaction, mean time interval between triage and the first visit and therapeutic measure as well as EPIs of Imam Hossein hospital are summarized in Tables 2 and 3.

There was a significant increase in the total number of ED visits especially in levels 2 and 5. There was also a significant decrease in the number of patients in level 4. However, the number of patients presenting via emergency medical service (EMS), mean duration of hospital stay and satisfaction percentage had not changed significantly (Table 2).

The mean time interval between triage and the first visit had significantly increased in levels 1, 3 and 4, while it decreased in levels 2 and 5 by 2016 and then increased. In addition, there is a significant increase in mean time interval between triage and first nursery care in all levels, but in 2016 and 2017, these measures have decreased a little in levels 4 and 5 (Table 2).

The percentages of the patients who were discharged during 6 hours increased significantly ($P = 0.00$). However, the percentage of temporarily hospitalized patients leaving ED in less than 12 hours and the percentage of failed CPRs has increased significantly (Table 3).

The percentage of patient leaving ED against medical advice has significantly decreased until 2016, however in 2017, this percentage has grown significantly ($P = 0.00$).

Despite a slight decrease in the first year of executing the plan in levels 2, 4 and 5, mean triage time has also significantly increased in all levels (Table 3).

Discussion

After the execution of HSPE, the total number of ED visits increased in all levels of ESI triage except for level 4. Additionally, the indices of the percentages of patients discharged within 6 hours, and leaving against medical

Table 2. Total Number of Visitors, Visitors by ESI Level, Mean Time of Stay, Satisfaction and Mean Time Between Arrival and First Visit and Treatment in Each ESI Level and Year

Variable	2013	2014	2015	2016	2017	P Value
Total number of visitors	88911.00	105000.00	120731.00	140271.00	15918.00	0.00
Total number of visitors by EMS	15772.00	15328.00	15856.00	15267.00	13739.00	0.11
Total number of visitors based o ESI triage level						
Level 1	350.00	374.00	376.00	348.00	326.00	0.59
Level 2	809.00	1002.00	1500.00	2130.00	2001.00	0.00
Level 3	37555.00	38101.00	36833.00	38731.00	41874.00	0.33
Level 4	8382.00	4822.00	2566.00	1511.00	5713.00	0.00
Level 5	42738.00	60701.00	76923.00	160119.00	118178.00	0.02
Satisfaction (%)	81.58±4.01	80.08±3.39	81.98±3.26	82.5±3.2	82±3.54	0.51
Mean of stay (days)	3.89±0.39	3.68±0.36	3.94±0.23	3.98±0.37	3.97±0.28	0.17
Mean of time between arrival and first visit based on ESI triage level (min)						
Level 1	0.68±0.5	0.84±0.02	1.03±0.14	1.04±0.14	1±0.00	0.00
Level 2	2.63±0.15	2.6±0.17	3.53±1.84	7.95±1.84	10.59±4.23	0.01
Level 3	4.61±0.11	4.71±0.13	7.15±0.02	14.29±2.25	16.8±1.86	0.00
Level 4	5.89±0.42	5.65±0.3	9.4±5.04	26.56±6.25	22.14±5.99	0.00
Level 5	27.15±0.39	23.09±0.84	23.1±0.8	20.29±5.71	30.83±3.97	0.00
Mean time between arrival and first order execution by nurse based on ESI triage level (min)						
Level 1	0.75±0.09	0.9±0.02	1.07±0.29	1.08±0.28	1.04±0.14	0.00
Level 2	2.61±0.14	2.65±0.14	3.7±2.03	7.23±2.56	7.01±3.49	0.00
Level 3	4.71±0.18	5.04±0.23	13.56±20.16	14.52±6.13	13.3±6.04	0.02
Level 4	6.3±0.31	5.91±0.33	9.33±5.49	21.2±11.21	19.4±4.44	0.00
Level 5	-	-	-	-	-	-

Table 3. Emergency Department Performing Indices

Variable	2013	2014	2015	2016	2017	P Value
The percentages of patients were disposed during 6-hour	71.54±6.9	83.92±1.17	84.45±0.69	86.15±1.23	87.93±0.96	0.00
The percentage of patients leaving the ED in a 12-hour	90.14±2.5	88.27±6.46	80.31±8.31	72.39±2.21	76.98±3.99	0.00
Unsuccessful CPRs	61.77±4.84	71.2±5.59	74.61±2.87	75.2±5.08	75.81±1.74	0.00
Discharge against medical advice	11.21±1.9	7.02±0.92	6.4±1.03	4.57±0.66	11.34±1.74	0.00
Mean time of triage based on ESI triage level						
Level 1	0.7±0.13	0.84±0.03	0.95±0.14	1.04±0.00	1±0.15	0.00
Level 2	2.74±0.36	2.6±0.17	3.53±1.57	7.5±1.84	6.73±2.61	0.00
Level 3	4.65±0.18	4.71±0.13	7.15±3.02	14.29±2.25	16.85±0.18	0.00
Level 4	5.87±0.79	5.65±0.8	9.4±5.71	27.4±3.97	28.9±5.65	0.00
Level 5	5.87±0.42	5.65±0.3	9.4±5.04	27.4±4.89	23.93±6.82	0.00

Abbreviation: ED, Emergency department; CPR, cardiopulmonary resuscitation.

advice have improved, while the percentage of patients leaving the ED in less than 12 hours, failed CPR and mean triage time of all levels have increased. The mean time interval between triage and the first visit has significantly increased in levels 1, 3 and 4 but decreased in levels 2 and 5 until 2016, and then increased. In addition, a significant increase was seen in the mean time interval between triage and the first nursing care in all levels; yet, in 2016 to 2018, there is a drop in levels 4 and 5. In the following paragraphs, we will discuss the factors and interventions affected EPI in Imam Hossein hospital after HSEP and review similar studies.

By executing HSPE and considering the significant difference between service quality and treatment tariffs of the governmental and private segments, as well as having full-time specialists and increasing the quality of specialized services, the number of visits to governmental hospitals and medical centers, especially to ED increased. Furthermore, by the end of work hours of clinics, most outpatients would visit ED for treatment which results in ED overcrowding and the increase in ED visits.

The factors that can affect the improvement of percentages of patients disposed within 6 hours in Imam Hossein hospital are as follows: 1- changes in the case mix of patients admitted to ED, 2- increase in the number of ED admission from clinics for educational purposes and rapid transportation of these patients to the wards, as well as staff education about importance of these indices and assigning regulatory rules, doubling the number of emergency medicine specialists in each shift and their direct supervision on the number of visits by other services and decision-making over a 6-hour period. However, despite the improvement of this index, the percentage of patients leaving ED in 12 hours has decreased significantly which is best explained by the increase in the number of elective hospitalizations in other departments and scarcity of empty beds in wards and ICU and accumulation of patients in ED. Despite the significant increase in this index, mean time of stay in ED has not significantly changed, which can be explained by the increase in the

number of patients in levels 4 and 5.

The increase in the number of failed CPR attempts can also be due to the increase in the number of ICU patients in ED and a rise in the number of old critically ill and end-stage hospitalized patients.

The number of patients in first ESI level increased until 2015 and then dropped, which was not statistically significant, there was also a constant increase in mean triage time, mean time interval between triage and the first visit and mean time interval between the first orders and the execution of the order by the nurse. During the first year of executing the plan, the main cause of this increase was the change in recording the time from a fraction of second to one minute. However, these results can be explained by the constant presence of critically ill and ICU patients in CPR and also transferring level 2 and 3 critically ill patients to CPR for visit and initial stabilizing.

In the third level of ESI triage, in spite of a non-statistically significant increase in the number of visitors, a similar trend is seen which is due to the prolongation of triage time, mean visit time and order performance times, ED overcrowding and long waiting lines and inappropriate proportion of beds and human resources to patients for the initial examination and performing the orders. The same trend was observed in the second level.

In level 4, despite a significant decrease in the total number of patients, other indices have increased significantly, which can be due to elongation of the waiting lines for opening a profile and the diagnostic and therapeutic outpatient services.

In level 5, despite the increase in the number of patients presenting and elongation of triage time, the mean time interval between triage and the first visit has decreased because of the increase in the number of resident physicians in the outpatient department.

The results obtained from the present study were mostly in line with other national and worldwide studies

Mohammadi et al in 2016 have evaluated EDPI in hospitals of Kermanshah, Iran, a year before and after the execution of HSEP, failed CPR, mean triage time of level

4, patients discharged within 6 hours and patients leaving the ED in 12 hours had significantly decreased after the execution of the evolution plan (13).

Jafari Sirizi et al have also evaluated EPI after the constant presence of specialist physicians in governmental hospitals of West Azarbaijan province. In this study, constant presence of specialist physicians had resulted in relative improvement of performance indices such as duration of decision making for emergency patients in triage level 1 and the percentage of patients discharged within 6 hours. In addition, the constant presence of emergency medicine specialist, management strategies in ED, triage of patients, number of consultations, preparing the required equipment and hoteling, continuous education and motivation of personnel and presence of appropriate diagnostic equipment are factors that lead to overall improvement in the performance of ED of the hospital (7).

Hashemi et al in 2013 studied the effects of the presence of an emergency medicine specialist on the performance indices of Shohadaye Tajrish hospital, Tehran, Iran. They conclude that the presence of emergency medicine physicians had led to the improvement in triage time and patients leaving ED in 12 hours (8).

Hosseini et al evaluated the timing of providing service to the patients in the ED of Shohadaye Haftome Tir hHospital, Tehran, Iran. Based on the findings of their study, which was performed on more than 629 patients, the mean time interval between triage and physician's visit, physician's visit to decision making, and triage to decision making was 22, 210 and 243 minutes respectively, which was significantly correlated with the number of surgery and neurosurgery visits, requested imaging, and laboratory tests (14).

In the study conducted by Emamgholipour et al, the execution of health sector evolution plan (HSEP) did not have a significant effect on the percentage of patients leaving ED within 12 hours and percentage of being discharged from ED against medical advice. However, it had a significant effect on the percentage of patients discharged within 6 hours and the mean time to receive the results of emergency tests. They concluded that execution of HSEP had led to improvement in the status of the percentage of patients disposed within 6 hours and an increase in the mean time to receive emergency test results. In addition, although there was a significant increase in the trend of successful CPRs, the quality of service had decreased (9).

Yusefzadeh et al evaluated the effect of HSEP on the performance of teaching and non-teaching hospitals. In their cross-sectional study, in most hospitals, the mean percentage of bed occupation and bed turnover had increased and the duration of hospitalization had decreased especially in regional hospitals. They concluded that HSEP has led to an increase in hospitalization and improvement of performance (15).

In the study by Moradi et al mean time of bed occupation and bed turnover of hospital had increased and although more than 50% of the hospitals had not reached their maximum level of bed occupation, a significant decrease manifested in the efficiency rate of health care. They suggest a short-term prevention of physical expansion of the hospital and increase the number of hospital beds (12).

Hashemi et al evaluated the satisfaction of patients hospitalized in ED over a 6-month period before and after the execution of HSEP. The satisfaction with patient education before discharge, status of hospitalization rooms, sanitation of restrooms, timely visit of the physicians, spending time for performing an accurate physical examination, patient's financial affairs deals and rate of consideration for religious and ethical principles had decreased significantly within 6 months after the plan (16).

Asadi et al assessed the reasons for leaving against medical advice in 2012 in Poursina hospital, Rasht, Iran. Based on their study, 95.19% of the reasons for leaving against medical advice were related to the patients' willingness (referring to a private hospital, etc) especially in evening and night shifts and among surgery and neurosurgery patients, 3.3% were related to staff performance and 1.51% were due to inappropriate hoteling. However, 90.6% of the patients were admitted to the hospital within 2 weeks after leaving (17).

In the study by Mahmoodian et al in 2012-2013, waiting time of 900 patients was evaluated after using ESI triage system. Mean waiting time from triage to first physician visit was 5-14 minutes, 84 minutes for the physician's order and 85 minutes for executing the physician's order. About 75%, 84.6% and 95.6% of patients were visited during the intended time in triage levels 1, 2 and 3, respectively (18).

In conclusion, despite the significant increase in the number and flow of ED patients after execution of HSEP, performance indices of the ED in Imam Hussein Hospital have been maintained at the desirable level or improved in cases that management interventions were possible. Otherwise, without considering appropriate financial support, management and supportive interventions, it can have inappropriate effects on the healthcare system.

Limitations of This Study

- Incomplete recording of the patients' profiles and not registering the times and percentages accurately, which might lead to errors in recording the indices.
- No studies or automatically recording case mix of patients, which can play an effective role in performance indices, analyses and management decisions
- Not having access to national statistics of evaluation and monitoring of HSEP and limitations in the publication of the statistics.
- The absence of studies and accurate statistics regarding the costs and financial levers and cost-

effectiveness of the changes
- The mentioned indices may not be in accordance with national standards and the desired achievements of HSEP.

Recommendations and Suggestions
- Prospective comparison of executing the plan.
- Designing multicenter studies regarding the efficiency of ED performance indices in true assessment of ED performance
- Designing case mix registration system

Conflict of Interests
The authors have no conflict of interest in this study.

Ethical Issues
This study is approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences with reference number IR.SBMU.RAM.REC.1395.156 .

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