

Effects of the Health Transformation Plan on caesarean section rate in the Islamic Republic of Iran: an interrupted time series

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Abstract

Background: In recent decades, the rate of caesarian section (C-section) has increased in the Islamic Republic of Iran. A reform in the Iranian health system – the Health Transformation Plan (HTP) – was launched in 2014 in which one of the objectives of HTP is decreasing the rate of C-section.

Aims: This study aimed to assess the effects of the Health Transformation Plan (HTP) on the C-section rate in the Islamic Republic of Iran.

Methods: This study was an interrupted time series analysis that used segmented regression analysis to assess the immediate and long-term effects of the HTP on C-section rate in two groups of hospitals affiliated and not affiliated to the Ministry of Health and Medical Education (MoHME) in Kurdistan province. Study samples were selected using the data on monthly C-section rate collected over a period of four years.

Results: We observed significant decreases in C-section rate immediately after the HTP in both groups of hospitals by 0.0629 and 0.0013, respectively ($P < 0.05$). In the long run, we observed no significant decrease in the regression slope of C-section rate in both groups.

Conclusions: The implementation of HTP decreased the C-section rate. However, the reduction does not meet expectations.

Keywords: Health system reform, caesarean section, financial incentive, Iran

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Introduction

In recent years, the Islamic Republic of Iran, like many countries of the world, has observed an increase in the rate of caesarian section (C-section) (1–3). Between 2000 and 2013 the C-section rate increased from 35% to 56.1% (1,4,5), while the acceptable rate of C-section recommended by the World Health Organization (WHO) is between 10% and 15% (4,6). The rapid increase in the rate of C-section can be attributed to both clinical and non-clinical factors. Among the non-clinical factors that can affect a physician's decision for C-section are training and fear of malpractice claims (6–9), as well as opportunity for higher income (10). On the other hand, the mother's level of education, ethnicity, income, and insurance status are also contributing factors (11,12).

The growing number of unnecessary C-sections can result in many problems; for example, it not only increases healthcare costs but also augments the risk of mortality and morbidity in mothers and neonates, which in turn affects public health (13). In recent years, in order to reduce the rate of C-sections in the Islamic Republic of Iran, the Ministry of Health and Medical Education (MoHME) has suggested a number of reforms. For instance, it is recommended to change the educational curriculum

of midwives and the content of obstetric residency programmes as well as revise their postgraduate training courses. It is also suggested to develop guidelines for outpatient and inpatient obstetrical emergencies and even make changes to medical legislation. However, the C-section rate has still not declined (5).

Previous studies have shown that cost variation is another factor that affects the decision regarding the mode of delivery. As C-section is financially more rewarding and requires less time per birth than a vaginal delivery, physicians are motivated to over-utilize C-section (14–17). Thus, changes in the reimbursement system with respect to the cost of delivery may change the decision of physicians and mothers regarding the mode of delivery. In recent years in the Islamic Republic of Iran, the mean cost of C-section delivery has been almost twice as much as that of vaginal delivery. According to health experts, it is one of the reasons that motivates obstetricians and gynaecologists to perform C-section without any indication (18).

An overview of the Iranian healthcare system

In the Islamic Republic of Iran, public, private, quasi-public and charity sectors provide healthcare services. Primary healthcare services are provided by the government

through an extensive healthcare network and are offered free of charge. Over 93% of second and third level healthcare services are provided by clinics, centres and hospitals affiliated to MoHME, with other centres affiliated to the Social Security Organization (SSO) and the private sector. Centres affiliated to MoHME and SSO, respectively, are classified as public sector and quasi-public sector. SSO not only provides health services, but is also one of the largest insurance agencies in the country. Social security insurance holders who attended the centres affiliated to SSO receive the majority of services free of charge, but other insurance holders have to pay a portion of the costs (19,20).

The Islamic Republic of Iran has three main insurance organizations including the Iranian Health Insurance Organization (IHIO), SSO, and Armed Forces Insurance Organization (AFIO). IHIO and SSO have multiple insurance schemes, which cover both compulsory and optional insurances, while the AFIO schemes are compulsory. The universities of medical sciences in every province are responsible for monitoring all healthcare centres (public or not) in the province; in addition, the hospitals affiliated to MoHME in each province are under the direct supervision of the university (19). In the Islamic Republic of Iran, about 95% of deliveries occur in hospitals (20), with 557 hospitals affiliated to MoHME, 337 hospitals to the private sector, and 70 hospitals to SSO (19).

Iranian Health Transformation Plan

In the Islamic Republic of Iran a series of health reforms (under the title of Health Transformation Plan) were implemented over three phases that started in 2014. The first phase consisted of eight packages and came into force 5 May 2014 in all hospitals affiliated to MoHME (university hospitals) (21). The Natural Delivery Promotion Package encourages mothers to have a vaginal birth and natural childbirth in hospitals affiliated to MoHME is free of charge. In addition, during this phase to motivate obstetricians, gynaecologists and midwives to encourage vaginal delivery, the promotional tariff of 30K (K is the fee of a surgical operation which in 2013 was set at 88000 Rials for the public sector and social security (quasi-public) and 380000 Rials for the private sector) for natural childbirth (added to the tariff of natural delivery), was considered for all deliveries performed in hospitals affiliated to MoHME within a time interval from 5 May 2014 to 23 September 2014. In case of vaginal delivery under the supervision of a full-time gynaecologist and obstetrician, the incentive was shared as follows: 70% for

physicians, 10% for midwives 10% for staff, and 10% for the delivery unit.

However, during this period the C-section tariff did not change in hospitals and remained at 17K. In addition, with the implementation of the Natural Delivery Promotion Package in hospitals affiliated to MoHME, the private sector hospitals and social security hospitals were also required to reduce their C-section rate; accordingly, the reduction in the rate of C-section was considered as an important factor in their annual accreditation.

The second phase of the HTP was focused on screening chronic diseases and promoting health indicators in rural and marginalized areas and in the suburbs of large cities, and started in June 2014. The second phase is not related to the current study.

In the third phase of HTP, the new book of health services' valuation was issued and implemented in the health system from October 2014 to set tariffs for medical services and promote equality in various medical specialties. To implement the third phase, there was an increase in medical services tariffs in all sectors (public, private, and quasi-public). During this phase, the relative tariffs for vaginal delivery service and C-section service, respectively, were set at 50K and 40K (18,21).

Given the elimination of costs for natural childbirth in hospitals affiliated to MoHME, requiring hospitals to reduce the number of C-sections, and increasing the tariffs for normal delivery, it is expected to observe changes in the behaviour of mothers and health service providers in choosing natural delivery. In the current study, the immediate and long-term effects of HTP are investigated on the rate of C-section in hospitals affiliated to MoHME (university hospitals) and those not affiliated to MoHME (Social Security and private sector hospitals) in Kurdistan province. The results of this study can provide feedback to healthcare policy-makers to assess the success of HTP and revise health reforms in order to enhance them.

Methods

The HTP (intervention) was implemented in May 2014. We conducted an interrupted time series (ITS) study and analysed monthly C-section rate to assess immediate and long-term effects of HTP on C-section rate in all hospitals affiliated to MoHME and hospitals not affiliated to MoHME in Kurdistan province (Table 1). The study was approved by the Ethics Committee of Tehran University of Medical Sciences.

We detected abrupt drops or increases in the C-section rate and investigated gradual changes in trends during the interruption time. An interrupted time series study

Table 1 Characteristics of Kurdistan province, 2014 (30)

Variable	Number
Population	1524000 (approximately 2% of Iranian population)
Number of cities	10
Number of hospitals affiliated to MoHME	12
Number of hospitals not affiliated to MoHME	3 (2 hospitals affiliated to SSO and one to private sector)

does not require a concurrent “control group” to establish a causal link between an intervention and an outcome (22,23). ITS analysis is perhaps the strongest quasi-experimental research design and is particularly useful when a randomized trial is not feasible or unethical (23,24). Using hospitals’ health information systems we obtained the data on deliveries. We modeled data using segmented regressions to assess causal links between the intervention were and the outcome of interest. Our sample included 50 observations (i.e., one per month) starting 25 months before (March 2012 to April 2014) and 24 months after the HTP (June 2014 to May 2016).

Several diagnostic tests were conducted. The results of Dickey–Fuller test suggested the presence of stationary residuals. We estimated the Jarque–Berastatistic to check the normality of the residuals. The results suggested a normal residual distribution. We performed ITS analysis using Newey OLS regression-based approaches available in the official Stata package. The Newey estimates the coefficients by OLS regression, but in addition to possible heteroskedasticity, it presents Newey–West standard errors to handle autocorrelation (25). First, the model was estimated using Newey with lag (0). To ensure the estimation of a model that accounts for the correct autocorrelation structure, we used Actest, lag (6) to investigate autocorrelation. Based on the output table, there was an autocorrelation of error terms at lag 4 ($P = 0.039$) and lag 1 ($P = 0.016$) in C-section rate data in hospitals affiliated to MoHME and hospitals not affiliated to MoHME, respectively.

Thus, our initial model was adjusted with lag (4) and lag (1) to account for this autocorrelation. The standard ITSA regression model was formed as follows:

$$Y_t = \beta_0 + \beta_1 \text{time}_t + \beta_2 \text{intervention}_t + \beta_3 \text{time after intervention}_t \quad (1)$$

In equation 1, Y_t is C-section rate per month; time is a continuous variable indicating time in months at time t from the start of the observation period; intervention is an indicator for time t occurring before (intervention = 0) or after (intervention = 1) the HTP, which was implemented at the 26th month in the series, and time after intervention is counting the number of months after the HTP at time t ; β_0 represents the intercept, or starting level of the outcome variable; β_1 is the slope, or trajectory of the outcome variable until the introduction of the intervention. β_2 represents the change in the level of the outcome that occurs in the period immediately following the introduction of the intervention (compared to the counterfactual); β_3 represents the difference between pre- and post-intervention slopes of the outcome. The sum of β_1 and β_3 is the post-intervention slope. Thus, we look for significant P -values in β_2 to indicate an immediate treatment effect, or in β_3 to indicate a treatment effect over time (24,25). Analyses were conducted using STATA statistical software version 13.

Results

Table 2 reports the total number of deliveries and C-section rate in all hospitals from March 2012 to May 2016.

As shown in the regression table (Table 3), the starting level of C-section rate in the hospitals affiliated to MoHME was estimated to be 0.3716, and C-section rate appeared to significantly increase by 0.001 every month prior to May 2014 ($P < 0.05$). Right after the intervention (HTP) C-section rate (level) significantly decreased by 0.0629 ($P < 0.05$). However, we did not observe any significant decrease in the regression slope (Trend) ($P > 0.05$). In addition, after the introduction of HTP, post-trend of C-section rate decreased monthly, but the decrease was not significant ($P > 0.05$) (Table 3). The regression model for C-section rate in the hospitals affiliated to MoHME is shown in equation 2:

$$Y_t = 0.37159 + 0.00104 \text{time}_t - 0.06288 \text{intervention}_t - 0.00118 \text{time after intervention}_t \quad (2)$$

Figure 1 presents the visual display of these results.

As shown in the regression table, the starting level of C-section rate in the hospitals not affiliated to MoHME was 0.3783; the C-section rate significantly increased by 0.0013 before the intervention ($P < 0.05$). Moreover, we observed a significant decrease by 0.0311 in the intercept right after the initiation of the intervention ($P < 0.05$). However, we did not observe any significant change in the regression slope after the intervention ($P > 0.05$). The post-intervention slope of the C-section rate increased monthly, but this increase was not significant ($P > 0.05$). The regression model for C-section rate in the hospitals not affiliated to MoHME is shown in equation 3:

$$Y_t = 0.37831 + 0.0013 \text{time}_t - 0.0314 \text{intervention}_t - 0.0011 \text{time after intervention}_t \quad (3)$$

Figure 2 provides a visual display of these results.

Discussion

When a patient is receiving healthcare services delivered by healthcare providers, one of the important issues that cannot be neglected is the cost of the services. Altering the costs of different services and changing the reimbursement system can have an impact on healthcare providers’ policies and decision, and consequently the C-section rate may change in turn (16,17). Therefore, it is necessary to assess the reimbursement system and other factors that can alter the rate of caesarean delivery. In the current study, we evaluated the effects of the HTP on C-section rate in the Islamic Republic of Iran.

The implementation of HTP significantly decreased the level (immediate effect) of C-section rate in the hospitals affiliated to MoHME. The reduction observed in the hospitals affiliated to MoHME may be due to the elimination of costs of natural delivery (to encourage pregnant women to choose natural delivery), utilizing promotional tariffs for physicians to perform vaginal delivery (after the implementation of the first phase, a promotional tariff of 30K was added to the natural delivery tariff in hospitals affiliated to MoHME), and increasing the tariff of natural delivery within the new book of tariffs published in the third phase (the tariff of natural delivery was increased to 50K) (18). Despite the two years since the beginning of the HTP, the elimination

Table 2 Data for analysis of the impact of Health Transformation Plan on C-section rate in hospitals in Kurdistan province, March 2012–May 2016

Observation	Total number of deliveries in hospitals affiliated to MoHME	C-section rate in hospitals affiliated to MoHME	Total number of deliveries in hospitals not affiliated to MoHME	C-section rate in hospitals not affiliated to MoHME	Time (Month)	Intervention	Time after intervention
1	1947	0.370827	400	0.3875	1	0	0
2	1890	0.37037	401	0.40399	2	0	0
3	1962	0.365953	426	0.401408	3	0	0
4	2031	0.360414	378	0.383598	4	0	0
5	1994	0.361083	377	0.366048	5	0	0
6	2009	0.383275	395	0.36962	6	0	0
7	1769	0.384398	436	0.401376	7	0	0
8	1781	0.400898	396	0.40404	8	0	0
9	1694	0.401417	407	0.361179	9	0	0
10	1846	0.385699	417	0.364508	10	0	0
11	1889	0.390683	452	0.393805	11	0	0
12	1843	0.398264	390	0.364103	12	0	0
13	1979	0.376453	441	0.390023	13	0	0
14	1834	0.377317	469	0.415778	14	0	0
15	1956	0.380368	503	0.379722	15	0	0
16	1990	0.38794	519	0.400771	16	0	0
17	2013	0.398907	482	0.400415	17	0	0
18	1968	0.412602	505	0.415842	18	0	0
19	1711	0.374635	453	0.415011	19	0	0
20	1806	0.379845	485	0.416495	20	0	0
21	1909	0.387114	417	0.407674	21	0	0
22	2056	0.375486	441	0.414966	22	0	0
23	2017	0.392662	500	0.416	23	0	0
24	2061	0.402717	295	0.40339	24	0	0
25	2048	0.408691	336	0.401786	25	0	0
26	2070	0.384541	363	0.396694	26	1	1
27	2049	0.367496	458	0.40393	27	1	2
28	2155	0.342459	475	0.383158	28	1	3
29	2088	0.314176	474	0.405063	29	1	4
30	2126	0.326435	502	0.386454	30	1	5
31	1961	0.319225	384	0.372396	31	1	6
32	1941	0.308089	433	0.385681	32	1	7
33	1979	0.331481	385	0.366234	33	1	8
34	2044	0.327299	455	0.397802	34	1	9
35	2153	0.337204	479	0.363257	35	1	10
36	2044	0.34002	334	0.362275	36	1	11
37	2210	0.333937	341	0.360704	37	1	12
38	2399	0.300959	382	0.363874	38	1	13
39	2326	0.322872	452	0.360619	39	1	14
40	2336	0.318493	424	0.360849	40	1	15
41	2402	0.336803	413	0.377724	41	1	16
42	2282	0.339176	469	0.394456	42	1	17
43	2008	0.318227	426	0.396714	43	1	18
44	1916	0.336117	322	0.378882	44	1	19
45	1917	0.3229	383	0.391645	45	1	20
46	2094	0.346227	419	0.396181	46	1	21
47	2040	0.347059	435	0.393103	47	1	22
48	2072	0.343147	336	0.39881	48	1	23
49	2211	0.341927	358	0.396648	49	1	24
50	2069	0.343644	333	0.393393	50	1	25

Table 3 Estimated coefficients of segmented regression model for C-section rate in the hospitals affiliated to MoHME in Kurdistan province, March 2012–May 2016

Regression with Newey-West standard errors						
Maximum lag: 4	Number of observations =50		F (3,46) =45.29		Prob> F =0.0000	
Parameter	Coefficients	Newey-West Std. Err.	t	P-value	95% CI	
Intercept	0.37159	0.0066	56.44	0.000	0.3583	0.3849
Pre-intervention slope	0.00104	0.0004	2.67	0.010	0.0003	0.0018
Change in intercept	-0.06288	0.0126	-4.98	0.000	-0.0883	-0.0375
Change in slope	-0.00118	0.0010	-1.22	0.230	-0.0031	0.0008
Post-intervention Linear Trend	-0.00010	0.0008	-0.17	0.860	-0.0018	0.0011

of costs of natural childbirth for mothers, and increasing the tariffs of natural delivery for medical personnel, the rate of C-section in hospitals affiliated to MoHME in Kurdistan province still varies considerably with the standard rate recommended by WHO. There is no significant reduction in the slope of C-section in this group of hospitals.

The implementation of HTP significantly decreased the level (immediate effect) of C-section rate in non-university hospitals. The decrease in C-section observed in hospitals not affiliated to MoHME may be attributed to the fact that the hospitals were obliged (by Kurdistan University of Medical Sciences) to reduce their rates of C-section during the implementation of the HTP. As ordered by MoHME, non-university hospitals must decrease their rate of C-section by 10% annually, as compared with the baseline; the reduction will be considered as a factor in their annual accreditation (18).

The results of a study by Kim et al. in the Republic

of Korea suggested that the type of the reimbursement system was associated with higher probability of C-section. To reduce the rate of caesarean delivery in the Republic of Korea, the payment method for caesarean delivery changed from Fee-For-Services (FFS) to Diagnostic Related Groups (DRG) and the tariff of natural delivery was increased by 50%. After taking these measures, the rate of C-section was significantly reduced (17). In line with the results of previous studies, the results of the current study indicated that women's decision to undergo C-section is affected by the related costs (10,26,27). However, some studies found no relationship between the costs of the procedure and women's decision to undergo C-section (28,29). For example, the results of a study by Lo in Taiwan (29) showed that the policy of fee equalization for vaginal and caesarean deliveries had no influence. Accordingly, as decided by the National Health Insurance (NHI) in Taiwan, the costs of vaginal birth and C-section were equalized. In an insurance

Figure 1 Segmented regression model showing C-section rate in the hospitals affiliated to MoHME in Kurdistan province, March 2012 to May 2016

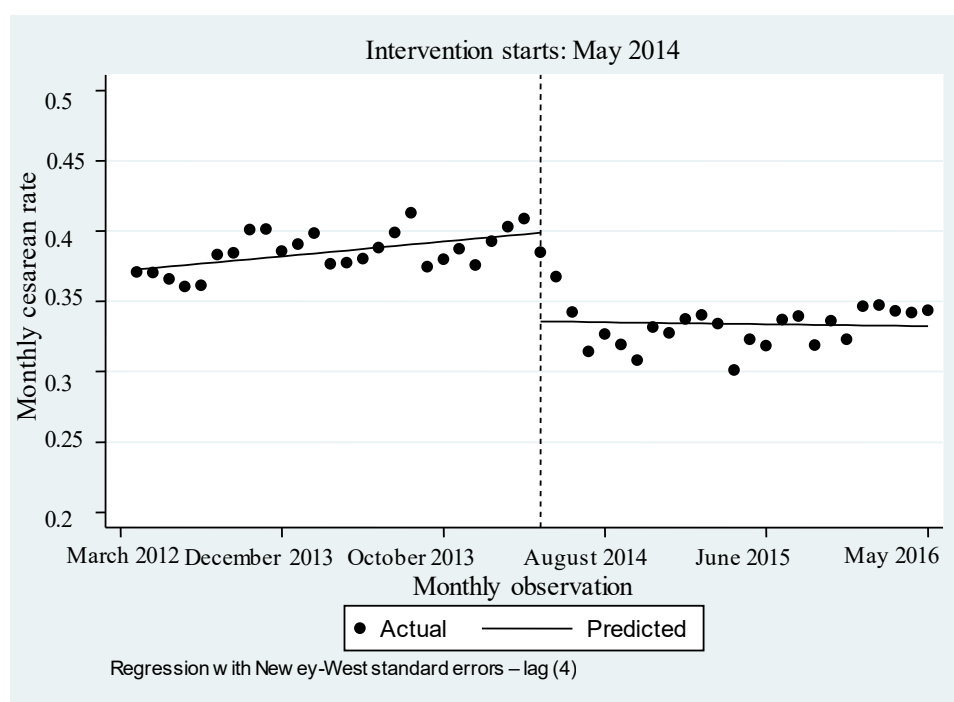
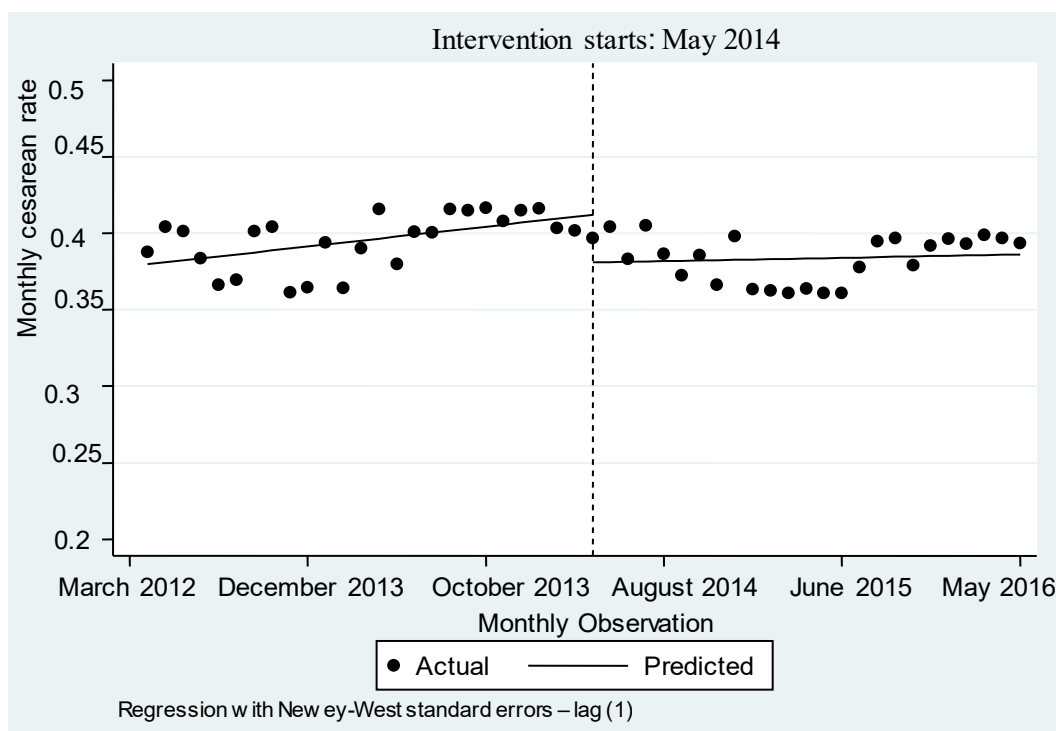


Figure 2 Segmented regression model showing C-section rate in the hospitals not affiliated to MOHME, in Kurdistan province, March 2012 to May 2016



reform in California, United States, the costs of vaginal and caesarean deliveries had been equalized, as studied by Keeler and Fok (28). Based on the results of their study, after adjusting for case-mix, there was an insignificant reduction (0.7%) in C-section rate after the reform (28).

The current study aimed to assess the impact of HTP on the rate of C-section; however, it did not consider the effects of birth order and previous caesarean, and these two factors might have an impact on interventions utilized in HTP and on the rate of C-section. Studies have shown that most mothers who already had had a caesarean delivery are forced to undergo a caesarean again in subsequent pregnancies (29). According to the results of a study in Taiwan (29), the rate of C-section increased with the birth order, rising from 29% in the first birth to 37.4% in the second birth and 39.3% in the third birth. This observation was mainly attributed to the previous history of C-section, where the primary rates were 29%, 11.8%, and 12.1%, respectively. In that study the increasing fee for vaginal deliveries did not influence the C-section rate (29). However, based on our findings, cost has an impact on the choice made by physicians and patients for a specific medical procedure.

Limitations

This study was carried out in Kurdistan province in the west of the Islamic Republic of Iran; hence, the results may not represent a full picture of the impact of HTP on C-section rate across the whole country. Moreover, in this study we assessed the effects of HTP on C-section without taking into account the previous C-section and medical risk factors. Given the high rate of C-section in

the years before the implementation of HTP in the Islamic Republic of Iran and Kurdistan, it might have reduced (distorted) the real effect of the HTP on the rate of C-section. Thus, further studies are needed to more accurately study this issue at an individual level.

Conclusion

In general, based on the results of this study, after the implementation of HTP the rate of C-section was significantly reduced in Kurdistan province; however, the reduction observed was less than the expected level. The rate of C-section in Kurdistan province is still significantly higher than the standard rate recommended by WHO. Apparently, in order to further reduce the rate of C-section it is necessary not only to promote financial incentives for mothers and health service providers, but also focus on policies to change mothers' choice behaviours through awareness-raising programmes on natural childbirth and the negative consequences of C-section. However, our study has provided some evidences for policy-makers and suggests that health providers are under the influence of the existing reimbursement system. Accordingly, healthcare providers' decisions on the mode of delivery might be largely influenced by economic factors and advantages. As a result, it is necessary to design and adopt proper strategies for reimbursement in order to decrease the rate of superfluous procedures.

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Competing interests: None declared.

Effets du plan national de transformation du secteur de la santé sur le taux de césarienne en République islamique d'Iran : série chronologique interrompue

Résumé

Contexte : Au cours des dernières décennies, on a observé une augmentation du taux de césarienne en République islamique d'Iran. Une réforme du système de santé iranien – le plan national de transformation du secteur de la santé – a été lancée en 2014. L'un des objectifs de ce plan vise à réduire le taux de césarienne.

Objectifs : La présente étude vise à évaluer les effets du plan national de transformation du secteur de la santé sur le taux de césarienne en République islamique d'Iran.

Méthodes : La présente étude constitue une analyse d'une série chronologique interrompue basée sur une analyse de régression segmentée afin d'évaluer les effets immédiats et à long terme du plan de transformation du secteur de la santé sur le taux de césarienne dans deux groupes d'hôpitaux affiliés et non affiliés au ministère de la Santé et de l'Éducation médicale dans la province du Kurdistan. Les échantillons de l'étude ont été choisis en utilisant les données relatives au taux mensuel de césariennes, collectées sur une période de quatre ans.

Résultats : Nous avons observé une diminution sensible du taux de césarienne immédiatement après la mise en place du plan de transformation du secteur de la santé dans les deux groupes d'hôpitaux, s'élevant respectivement à 0,0629 et 0,0013, ($p < 0,05$). À long terme, nous n'avons observé aucune diminution importante de la pente de régression du taux de césarienne dans les deux groupes.

Conclusions : La mise en œuvre de ce plan de transformation du secteur de la santé a permis de diminuer le taux de césarienne. Cependant, cette réduction est en deçà des attentes.

آثار خطة التحوُّل الصحي على معدل الجراحات القيصرية في جمهورية إيران الإسلامية: سلسلة زمنية متقطعة

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الخلاصة

الخلفية: في العقود الأخيرة، ارتفع معدل الجراحات القيصرية في جمهورية إيران الإسلامية. وبدأ إصلاح نظام الصحة الإيراني - خطة التحوُّل الصحي - في عام ٢٠١٤، وكانت أحد أهداف الخطة تخفيض معدل الجراحات القيصرية.

الأهداف: هدفت هذه الدراسة إلى تقييم آثار خطة التحوُّل الصحي على معدل الجراحات القيصرية في جمهورية إيران الإسلامية.

طرق البحث: استخدمت هذه الدراسة طريقة "تحليل سلسلة زمنية متقطعة"، حيث استُخدم التحليل الانحداري الجزئي في تقييم الآثار الفورية وعلى المدى الطويل لخطة التحوُّل الصحي على معدل الجراحات القيصرية في مجموعتين من المستشفيات التابعة لوزارة الصحة والتعليم الصحي في محافظة كردستان، ومستشفيات أخرى غير تابعة لها. وتم اختيار عينات الدراسة باستخدام البيانات المُجمَّعة عن المعدل الشهري للجراحات القيصرية على مدار أربع سنوات.

النتائج: لاحظنا انخفاضات جوهرية فورية في معدل الجراحات القيصرية بعد تنفيذ خطة التحوُّل الصحي في مجموعتي المستشفيات بمقدار ٠,٠٦٢٩ و ٠,٠٠١٣ على التوالي ($P > ٠,٠٥$). وعلى المدى البعيد، لاحظنا عدم وجود أي انخفاض جوهرية في ميل خط الانحدار لمعدل الجراحات القيصرية في كلا المجموعتين.

الاستنتاجات: أدى تنفيذ خطة التحوُّل الصحي إلى تخفيض معدل الجراحات القيصرية. ومع ذلك، لم يَحَقِّق الانخفاض التوقعات المأمولة.

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