The impact of rural health system reform on hospitalization rates in the Islamic Republic of Iran: an interrupted time series

Arash Rashidian, Hossein Joudaki, Elham Khodayari-Moez, Habib Omranikhoo, Bijan Geralli & Mohamad Arab

Introduction

According to the World Health Organization (WHO), the purpose behind universal health coverage (UHC) is to ensure for all people, whether rich or poor, access to effective health services that meet most of their needs without being exposed to the risk of financial hardship. In most low- and middle-income countries, these conditions are not met and the effective health services that are available are not accessible to the entire population.1,2

An important prerequisite for UHC is the adequate provision of health services, which depends on factors such as the availability of physicians and hospital beds to meet demand. By adequate service provision we mean the existence of a sufficient number of services of acceptable quality distributed in a manner that allows the population’s health-care needs to be fulfilled. People who lack services of acceptable quality distributed in a manner that allows service provision we mean the existence of a sufficient number of health services, which depends on factors such as the availability of physicians and hospital beds to meet demand. Although there was no significant increase or decline in hospitalization rates in the intervention or comparison group before the intervention, after the intervention a significant increase in the hospitalization rate – of 4.6 hospitalizations per 100 000 insured persons per month on average – was noted in the intervention group (P < 0.001). The monthly increase in the hospitalization rate continued for over a year and stabilized thereafter. No increase in the hospitalization rate was observed in the comparison group.

Conclusion

The primary health-care programme instituted as part of the health system reform process has increased access to hospital care in a population that formerly underutilized hospital services. It has not reduced hospitalizations or hospitalization-related expenditure.
Secondary care services for the Islamic Republic of Iran’s rural population have been less easily accessible. Unlike PHC, which is almost entirely financed by the central government, outpatient care is not free and is delivered mostly by private sector professionals in urban areas. Such care includes, for example, visits to non-PHC physicians, specialist visits, laboratory and radiology services and medicines dispensed at private pharmacies. Access to hospital care for rural residents has been hindered by financial and organizational factors and by the lack of a fully implemented referral system. Uninsured rural households used a “rural insurance card” that covered 90% of hospital costs, but only upon referral by a PHC service. The card, which was issued free of charge by the Medical Services Insurance Organization (MSIO), did not cover any outpatient care, apart from the PHC services which were covered by the government funding.

In recent years, concerns have arisen about the PHC’s ability to respond to the needs of the population in light of changing epidemiologic trends, such as the increase in chronic diseases. To respond to these changes, in 2005 the Islamic Republic of Iran’s parliament approved a reform that substantially increased the national budget for rural health care. The reform covered all villages and towns with populations of up to 20,000 and had two main elements: a family physician programme and a social protection scheme for rural inhabitants (known as “rural insurance”). About 6000 physicians and 400 midwives were added to the PHC network in a span of three years as part of the reform.

Since the health system reform process was intended to improve access to more comprehensive preventive and outpatient care, policy-makers expected it to result in a decrease in hospitalizations. Our objective was to assess the immediate and long-term effect of the reform (henceforth referred to as “the intervention”) on hospitalization rates among rural residents, which were the target population.

### Methods

#### Study design

The intervention was implemented in June 2005. We conducted an interrupted time series study and analysed: (i) monthly hospitalization rates starting two years before the intervention (2003–2007) to assess its immediate effects; and (ii) monthly hospitalization rates up to September 2012 to assess its long-term effects. An interrupted time series study does not require a concurrent “control group” to establish a causal link between an intervention and an outcome. However, the use of a comparison group can result in a better understanding of the effects of the intervention on the intervention group. For this reason, we used a concurrent series of monthly hospitalization rates for a non-equivalent “comparison group” consisting of primarily urban civil servants and their dependants, who were the target population of another insurance fund also managed by the MSIO.

#### Setting

We hypothesized that the intervention would affect hospitalization rates more strongly in areas where households were poor and hence more likely to benefit from the intervention than affluent households. We also needed to select a province that was not a patient referral hub for other provinces. Lorestan, a province in the western part of the Islamic Republic of Iran, met these criteria (Table 1).

#### The intervention

The purpose of the intervention was to improve rural households’ access to outpatient and hospital care. All households in villages and small towns were eligible to join the social protection scheme by paying a nominal fee – approximately 0.25 United States dollars – that covered the printing costs of the “insurance booklet”. There was no additional cost for remaining in the scheme. Since most rural household members were employed in the informal sector, the majority of rural households joined the scheme. According to data for the province, 92% coverage had been attained within two years.

The intervention improved access to health care at two levels. First, better pay drew more family physicians and midwives to PHC centres. Between 2004 and 2005 the number of PHC physicians in the province increased from 124 to 191. Of the new physicians, many came from the private sector, which they were required to leave to work as a PHC family physician. Others were new graduates or physicians who had previously held managerial posts in the PHC system. Second, households were given access to outpatient services – visits to specialists, radiology services, laboratory and pharmacy services – and to hospital care (located primarily in cities) at a reduced cost. This was facilitated by possession of the “insurance booklet”, signed by the referring family physician. Patients referred by a family physician were expected to pay 10% of inpatient costs and 30% of outpatient costs out of pocket; self-referred patients had no financial coverage.

#### Data sources

We obtained population data from the Statistics Centre of the Islamic Republic of Iran and social protection coverage and monthly hospitalization data from MSIO records.

The inpatient services provided by the Imam Khomeini Relief Foundation for poor rural households, which existed before the intervention, could have exerted a confounding effect on our results. However, the Relief Fund had ceased to function within two years of the intervention. We obtained from the Relief Fund its monthly hospitalization claims for rural households for the study period – there were none from 2008 onwards – and included them when calculating the number of hospitalizations. We asked experienced officers to check the data for accuracy. We engaged three physicians and PHC managers in the province to verify the accuracy of all dates and activities.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Province</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>1750,000</td>
<td>74,631,000</td>
</tr>
<tr>
<td>Urban population, %</td>
<td>62</td>
<td>72</td>
</tr>
<tr>
<td>Hospital beds per 10,000</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Population insured under new social protection scheme, no. and (%)</td>
<td>765,000 (44)</td>
<td>23,056,000 (31)</td>
</tr>
</tbody>
</table>

Sample size and data analysis

We modelled data using segmented regressions to assess causal links between the intervention and the outcome of interest.20,21 It takes at least 48 observations in a segmented regression analysis to be able to assess seasonality in the data.21,25 Our sample included 60 observations (i.e. one per month) – 27 before and 33 after the intervention – to assess the intervention’s immediate effects, and a longer time series – 114 observations – to assess its long-term effects.

To eliminate the effects of population growth, we defined each observation as the number of hospitalizations per month divided by the population under coverage during the year (i.e. the hospitalization rates) (Table 2). We looked for abrupt drops or increases in the hospitalization rate and for gradual changes in trends at the interruption times.

We analysed data for the comparison group for the entire study period except for about two years after 2008. This is because during the latter period the MSIO’s civil servant fund transferred the care of the elderly population to another insurer and this altered the demographic profile of the population under its coverage.

We conducted several diagnostic assessments. The Durbin-Watson test suggested the existence of autocorrelations, which we corrected using the Cochrane-Orcutt method.26 We estimated the Kolmogorov-Smirnov statistic to check the normality of the residuals and saw that a power transformation correction was required for the analysis of long-term effects. We estimated the Dicky-Fuller statistic to determine if the series was stationary and the Breusch-Pagan statistic to check for heteroscedasticity in the residuals. The results suggested a normal residual distribution and a lack of seasonality and heteroscedasticity.26

The first “interruption” time was set at June 2005, when the intervention was first implemented. To identify the next interruption point, we used segmented regressions with multiple time periods for each point and monitored the time series to find the first point showing a significant change in the trend (Appendix A, available at: https://docs.google.com/file/d/0B32jQZp_KmJzefHfMrUhwRUt5ySgs/edit?usp=sharing). All analyses were conducted using R statistical software version 2.12.1 (The R Foundation for Statistical Computing, Vienna, Austria).
Results

Over 700,000 inhabitants of rural areas, including small towns, were covered by the intervention, and about 150,000 urban inhabitants were covered by the MSIO fund for civil servants (Table 2). From 2003 to 2007, the annual hospitalization rate in the population covered by the intervention increased from 44.3 to 65.6 per 1000 inhabitants. The corresponding rates in the population covered by the MSIO’s fund for civil servants were 92.7 in 2003 and 95.7 in 2007. In 2011, the annual hospitalization rate for the intervention group and the comparison group was 62.5 and 78.8 per 1000 inhabitants, respectively.

Immediate effect on hospitalization rate

No significant increase or decline in the hospitalization rate was noted in either the intervention or the comparison group before the intervention. The pre-intervention rates remained stable in both groups (Table 3) even though the baseline monthly hospitalization rate per 1000 inhabitants was markedly lower in the intervention group than in the comparison group.

We looked for changes in slope and intercept in the comparison group to check for confounding factors unrelated to the intervention — e.g., disease epidemics, data recording policies at the MSIO — that might have occurred at the same time as the intervention and biased the findings. We observed no significant changes in slope or intercept in the hospitalization rate of the comparison group after the intervention (P > 0.4). However, we did note a significant change in the regression slope (P < 0.001) in the intervention group right after the intervention started (Table 3). This finding suggests that the intervention resulted in a greater likelihood that people would use hospital services (Fig. 1). To develop the model for the hospitalization rate in the intervention group, we transformed the model back to its original coefficients (after correcting for autocorrelation; Y = aY_0). Hence, for Model 1:

\[ Y = 0.00423 + (6.709 \times 10^{-6}T) + (4.603 \times 10^{-5}P) + (2.024 \times 10^{-4}D) \]

where Y is the hospitalization rate, ρ is the autocorrelation parameter and equals 0.125516; T is pre-intervention slope; P is the change in slope and D is the change in intercept.

According to Model 1, the hospitalization rate in the intervention group increased, on average, by about 4.6 hospitalizations per 100,000 insured people per month. Fig. 1 shows that before the intervention the slope was close to zero but showed a much steeper forward incline after the intervention. Segmented regression analysis conducted in both groups revealed that the post-intervention slopes in the intervention

### Table 3. Estimated coefficients of segmented regression model for hospitalization rates in the intervention group and the non-equivalent comparison group before and after the intervention, Islamic Republic of Iran, April 2003 to March 2008

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value (SE)</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intervention group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>0.0037 (0.0002)</td>
<td>21.39</td>
<td>0.0000</td>
</tr>
<tr>
<td>Pre-intervention slopea</td>
<td>0.67E-05 (1.05E-05)</td>
<td>0.64</td>
<td>0.53</td>
</tr>
<tr>
<td>Change in slopeb</td>
<td>4.60E-05 (1.29E-05)</td>
<td>3.58</td>
<td>0.0007</td>
</tr>
<tr>
<td>Change in intercept</td>
<td>0.0002 (0.0002)</td>
<td>0.99</td>
<td>0.33</td>
</tr>
<tr>
<td><strong>Comparison group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>0.0082 (0.0006)</td>
<td>14.38</td>
<td>0.0000</td>
</tr>
<tr>
<td>Pre-intervention slopea</td>
<td>–1.33e-05 (3.36e-05)</td>
<td>–0.40</td>
<td>0.69</td>
</tr>
<tr>
<td>Change in slopeb</td>
<td>–0.37e-05 (4.17e-05)</td>
<td>–0.09</td>
<td>0.93</td>
</tr>
<tr>
<td>Change in intercept</td>
<td>0.0004 (0.0006)</td>
<td>0.74</td>
<td>0.47</td>
</tr>
</tbody>
</table>

SE, standard error.

a Indicates a non-significant rise in the hospitalization rate from month to month before the intervention.

b A significant change in the regression slope — indicating a significant increase in the hospitalization rate — was noted in the intervention group right after the intervention.

c No significant change in the regression slope — indicating no significant increase in the hospitalization rate — was noted in the comparison group right after the intervention.

Fig. 1. Segmented regression model showing hospitalization rates over the short-term in the intervention group, April 2003 to March 2008

Note: The intervention was implemented in June 2005.
group and the comparison group differed statistically ($P = 0.004$). After the intervention, the intervention group had about 7 monthly hospitalizations more per 100,000 insured people than the comparison group (Appendix B, available at: https://docs.google.com/file/d/0B32jQZp_KmJzN3YtWWp1cXRLbWC/edit?usp=sharing). As a result, the intervention increased the utilization of hospital beds in a population that had historically underutilized hospital services. This suggests that the “access effect” of the intervention outweighed its potential “efficiency effect”. It appears, therefore, that while family physicians provided rural inhabitants with a “point of referral” to specialists, the social protection scheme increased their actual use of specialists, and, ultimately, of hospital services.

Our results differ from those of previous studies that claim that expanding primary care services – or access to such services – would result in a decrease in the hospitalization rate by reducing primary-care-sensitive hospitalizations. All such studies but one were conducted in high-income countries with high baseline access to inpatient hospital services and have one major limitation: they focused exclusively on primary-care-sensitive avoidable hospitalizations. Only Friedman & Basu (2001) measured total hospitalizations and observed a reduction in all hospitalizations among children in the state of New York, United States of America.

Other studies have led to conclusions similar to those derived from ours. In a study in Canada, improving access to primary care resulted in a reduction in primary-care-sensitive hospitalizations among the elderly but did not change total hospitalization rates. In Ireland, Nolan et al. (2011) observed no changes in avoidable hospitalizations as a result of improved access to primary care.

A study conducted in the United States revealed that reductions in the hospitalization rate were not linked to the use of primary care services.

Saha et al. (2007) had hypothesized, like we did, that improving access to primary care – by expanding the Medicaid programme in the state of Oregon in the United States to cover an additional 100,000 low-income families – would result in fewer hospitalizations. Instead, they observed an increase in the hospitalization rate.

In their study, the baseline hospitalization rate in the intervention group was lower than in the rest of the population. In ours, the hospitalization rate at baseline was also substantially lower in the rural than in the urban population. These findings suggest that the increase in the hospitalization rate that we observed in the rural population reflects a pre-existing unmet need for hospitalizations. We would expect the increase to have occurred in referral-sensitive hospitalizations, although this should be the focus of future studies.

Fig. 2. Segmented regression model showing hospitalization rates over the long term in the intervention group, April 2003 to September 2012

Note: The intervention was implemented in June 2005.
Our study has important methodological strengths. We took advantage of the opportunity to perform a natural experiment and used robust research methods.\textsuperscript{19,21} We made certain that all statistical assumptions were met. We also looked for potential confounding influences during the intervention period that might have biased the results and found none. The study involved a relatively large number of observations (months) that resulted in enough power to test the hypothesis and obtain significant results at the desired confidence level.

The study also has important limitations. It was conducted in only one province, whereas ideally it should have been conducted in a nationally representative sample. On the other hand, by focusing on a single province we were able to better monitor data quality and contextual factors that could have influenced hospitalizations in the intervention group. We lacked data on hospitalization length and causes of admission. Future studies should explore whether hospitalization patterns changed after the rural health system reform.

Our study has important policy implications. If the hospitalization rate in the intervention group had continued to increase for over one year after the intervention as a response to unmet needs, it should have continued to rise until the unmet need was satisfied - i.e. until it had reached a level similar to that in the comparison group. However, the hospitalization rate in the intervention group did not reach the level observed in the comparison group. This is difficult to explain because the two groups were not comparable in terms of demographic or access characteristics. The comparison group was predominantly composed of more affluent urban residents with better geographical access to specialist and hospital care than the intervention group.

To conclude, programmes that focus on improving access to primary care do not necessarily lead to reduced hospitalization rates and hence to lower hospitalization-related expenditures. Improved accessibility offsets potential efficiency gains from the intervention, especially in societies with an unmet need for hospitalization.

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Competing interests: None declared.

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ملخص
أثر إصلاح النظام الصحي الريفي على معدلات الإدخال إلى المستشفيات في جمهورية إيران الإسلامية: سلسلة زمنية منطقية

وعلى الرغم من عدم وجود زيادة أو انخفاض كبير في معدلات الإدخال إلى المستشفيات في مجموعة التدخل، إلا أنه لوحظ بعد التدخل وجود ازدياد كبير في معدلات الإدخال إلى المستشفيات - 4.6 إدخال لكل 100000 شخص مؤمن عليه في شهر - في مجموعة التدخل (الإحالة > 0.001). واستمر الأزياد اليومي في معدل الإدخال إلى المستشفيات لأكثر من سنة واستمربعدها. ولم يتم ملاحظة أي ازدياد في معدل الإدخال إلى المستشفيات في مجموعة المقارنة.

الاستنتاج: ينتج عن زيادة إصلاح النظام الصحي الريفي ("التدخل")، وتتم إجراء تحليل سلسلة زمنية منطقية، ومن ثم استخدام تحليل ارتداد المضمن لتحديد الأثر الفوري والآدي للتدخل على معدلات الإدخال إلى المستشفيات في مجموعة مكونة من سكان المناطق الريفية ومجموعة مقارنة. وذلك كان معدل الإدخال إلى المستشفيات بين سكان المناطق الريفية، قبل التدخل، أقل حسب كنأ عدد في مجموعة المقارنة.

توصيات
1. إصلاح النظام الصحي الريفي.
2. تحليل البيانات في مستشفيات.
3. استمرار تحسين الوضع الصحي.
4. البحث في أسباب الازدياد.

يراجع

Research
Rural health reform and hospitalizations in the Islamic Republic of Iran

Arash Rashidian et al.

El impacto de la reforma del sistema sanitario rural en las tasas de hospitalización en la República Islámica del Irán: una serie cronológica interrumpida

Objetivo Evaluar los efectos de una reforma importante del sistema de salud sobre las tasas de utilización de los hospitales – un programa introduciendo un médico de familia y un régimen de protección social – vinculado en las áreas rurales de la República Islámica del Irán en 2005.

Métodos Se seleccionó una provincia «indicadora», que no era un centro de relevo de pacientes, para recabar los datos mensuales de hospitalización durante un período de 10 años aproximadamente, el cual comenzó dos años antes de que comenzara la reforma del sistema de salud rural (la «intervención»). Se llevó a cabo el análisis de una serie cronológica interrumpida y se empleó un análisis de regresión segmentada para evaluar los efectos inmediatos y graduales de la intervención en las tasas de hospitalización en un grupo de intervención compuesto por residentes rurales y un grupo de comparación formado principalmente por residentes urbanos.

Resultados Antes de la intervención, la tasa de hospitalización de la población rural era significativamente inferior a la del grupo de comparación. Sin embargo, después de la intervención, hubo un aumento significativo en las tasas de hospitalización en el grupo de intervención, y no hubo un aumento equivalente en el grupo de comparación. El incremento mensual en las tasas de hospitalización continuó durante más de un año y posteriormente se estabilizó. Respecto al grupo
de comparación, no se observó aumento alguno en la tasa de hospitalización.

**Conclusión** El programa de salud de atención primaria instituido como parte del proceso de reforma del sistema sanitario ha aumentado el acceso a la atención hospitalaria en una población que anteriormente no utilizaba los servicios hospitalarios de forma suficiente. Por otro lado, no ha reducido las hospitalizaciones ni los gastos relacionados con las mismas.

**References**


