HISTORY OF MEDICINE AND ETHICS

# Equity in the allocation of hospital beds in Iran: a systematic review and meta-analysis

MOHAMMAD KESHVARI[1], MEHDI JAFARI[1], HAMID RAVAGHI[1]
[1] Department of Health Services Management, School of Health Management and Information Sciences, Iran University of Medical Sciences, Tehran, Iran

Keywords

Equity • Hospital beds • Systematic review • Iran

Summary

**Background.** *Equitable access to healthcare is a fundamental human right. As capital intensive infrastructures, hospitals consume 40-50% of health expenditure in low and middle-income countries. However, inequities in the allocation of hospital beds compromise efficiency, accessibility and outcomes. This study aimed to systematically review and meta-analyze the available evidence on the allocation of hospital beds in Iran and to quantify the inequality with established indices.*
**Methods.** *A systematic review has been done in accordance with the principles of PRISMA, and the search process was conducted in international (PubMed, Scopus, Web of Science, EMBASE, CINAHL, DOAJ, MEDLine) and Iranian (SID, BKNS, Magiran) databases, and studies published from 2000 to 2025 in English and Persian language. Eligible studies reported quantitative measures of the allocation of hospital beds using inequality indices. Study quality was evaluated by using the Joanna Briggs Institute checklist. Meta-analysis was conducted using random effects and quality effects models, with heterogeneity being tested by Cochran's Q, I2, and H2.*
**Results.** *Thirty studies were eligible for inclusion (16 English, 14 Persian). Eight studies contributed 18 effect sizes for meta-analysis. The pooled Gini coefficient was 0.24 (95% CI: 0.20-0.28), and this indicates relative equity across the country, though heterogeneity was very high (I2 = 96.3%). Quality-effects modelling produced a very similar, higher estimate 0.26 (95% CI: 0.21-0.30). At the provincial level, Gini values were found to be between 0.229 (South Khorasan) and > 0.50 (Sistan and Baluchestan, Bushehr), showing the existence of important regional differences. City level inequalities were greater where values of 0.46 and 0.68-0.70 were found in Tehran and Shiraz, respectively, compared to those in Shanghai and Shenyang.*
**Conclusion.** *While there is national equity in the allocation of hospital beds in Iran there are significant sub-national (provincial and urban) inequities. Addressing these requires equity-focused planning, monitoring and prioritization of disadvantaged regions.*

## Introduction

Providing access to health services has been recognized as a fundamental human right [1]. Hospitals as the vital columns of national health systems, are fundamental to the provision of care and to the provision of equitable access to health care services. However, the building and maintenance of hospital infrastructure, particularly bed capacity, is one of the most capital-intensive investments in health care [2]. Hospitals in most low and middle-income nations account for more than 35% of spending on health, underscoring the fact that they are a significant expenditure [3]. Conversely, inefficiencies in the use of resources is often accompanied by wastage estimated to be between 20 and 40 percent which erodes systems performance as well as long-term viability [4]. Due to high capital investments, the structure of hospitals involves region-specific, evidence-based planning to optimally utilize these resources to achieve maximum value for the resources invested [5].
The importance of equitable bed allocation at hospitals is best seen in instances such as the ongoing coronavirus (COVID-19) pandemic, where studies have shown a direct link between lower mortality rates and bed availability [6, 7]. Enhancement in the capacity of the hospital beds in any particular area automatically aids in the movement of specialized staff personnel in medicine, sophisticated medical equipment and other support facilities. Thus, it remains one of the most important parameters for measuring the allocation of fairness in healthcare services [8]. Hence, comparison of the hospital bed index in the regions through the size of their populations is important to establish regions with weak access to healthcare services and to undertake focused allocation of services to regions in want [9]. Nonetheless, no solitary ideal value remains acceptable for the hospital bed index per head of population as this indicator stretches over nations in light of public health culture, disease prevalence, as well as the health system's structure [10]. However, in a country with one health system, the hospital bed indicator can continue to be one of the most important indicators of balanced allocation of resources in regions. Thus, unequal allocation of hospital beds causes wastage of resources as well as migration of patients to cities with superior facilities, aggravating health system problems [11].
Various studies have been done on the allocation of

hospital beds among provinces or within cities of one province. However, these investigations have used diverse indices and methodological approaches, leading to heterogeneous results as regards equity in the allocation of hospital beds [12-14]. Such inconsistency poses problems in drawing a clear assessment in order to support an evidence-based decision making. Consequently, systematic monitoring of the allocation of health resources and the provision of correct evidence for policy makers are imperative [15]. There is a general consensus that implementation of evidence-based health policy-making is gaining momentum in a situation with limited resources like low and middle income countries since high quality and context specific evidence may be used to guide decision makers to tackle problems related to inequalities and resource allocation [16]. Due to the heterogeneity and methodological differences in current literature on hospital bed allocation, a meta-analysis will overcome inconsistencies and will be capable f giving strong evidence to make decisions [17]. The proposed study will address the knowledge gap by undertaking a systematic review and meta-analysis of the allocation of the bed in hospitals in Iran. This is aimed at evaluating equity in the access to hospital beds and giving concrete evidence to health policymaking.

## Methods

This systematic review was designed and conducted in 2025, and the results are reported following the "Preferred Reporting Items for Systematic Reviews and Meta-Analyses" (PRISMA) guidelines [18].

### Search Strategy

The searches were conducted in two international and Iranian databases, including articles published between January 1, 2000, to June 30, 2025. The international databases were Medline, Pubmed, Embase, Cinahl, Directory of open Access journals, Web of Science and Scopus and Iranian databases were SID, Barakat knowledge network system (BKNS), Magiran. Search terms used were: ('Distribution' OR 'Allocation' OR 'Rationing') AND ('Hospital facilities' OR 'Hospital beds' OR 'Hospital resources' OR 'Physical resources' OR 'Healthcare resource') AND 'Iran'. To ensure that no relevant articles were omitted, the resources located were critically reviewed, and studies that were deemed suitable for inclusion based on manual review of the title and abstract were added to the shortlist. The searches were performed independently by two authors, and if any difference occurred between the two, the third party was consulted as the arbitrator and any difference was resolved.

### Inclusion and Exclusion Criterion

Included studies were quantitative studies reporting the allocation of hospital beds at the national (inter-provincial), provincial (intra-provincial) or urban level with inequality measures (*e.g.,* Gini coefficient, Coefficient of Variation). We excluded studies that were qualitative in nature, letters to the editor, lacking hospital bed allocation data, as well as those analyses localized to special beds (due to limited comparability and heterogeneity in the allocation logic of beds).

### Assessing the Quality of Articles

Two researchers independently extracted the data and conducted the article quality assessments. In case of any disagreement during the data extraction or quality assessment process, a third researcher's opinion was sought to resolve the conflict and reach a consensus. The researchers were blinded to the authorship of the studies to prevent any potential bias in the evaluation process. Two researchers independently assessed the quality of the studies included in the final analysis The quality of the articles was assessed using the Joanna Briggs Institute (JBI) checklist for cross-sectional studies. This checklist consists of 8 criteria. Each article was scored based on these criteria and assigned one of the following values: conformity (Y), nonconformity (N), unclear (U), and items not applicable to the article (N/A). Studies were then categorized based on the percentage of conformity: studies with less than 50%, 50-70%, and greater than 70% conformity were categorized as low, medium, and high quality, respectively [19].

### Statistical Analysis

The search included international and Iranian databases, looking for articles published from January 1, 2000 to June 30, 2025. Studies in English and Persian were considered eligible for inclusion. Overall, eight studies met the criteria for the meta-analysis; however, because several studies reported the Gini coefficient at more than one time point, a total of 18 effect sizes were analysed. Each reported Gini coefficient for a distinct time point was treated as a separate effect size to preserve temporal information and document changes in inequality over time, while also reflecting study-specific heterogeneity across different periods. Given the anticipated high heterogeneity, we did not conduct subgroup analysis or meta-regression due to the insufficient number of studies available for meaningful exploration of the sources of heterogeneity. The latest version of the Cochrane Handbook suggests a minimum of 10 studies per examined covariate in metaregression [20]. To obtain these estimates, we used both a conventional random-effects model (inverse variance weighting) and a quality-effects model. The heterogeneity between studies was evaluated with Cochran's Q statistic, I2 index and H2 statistic. All analyses have been performed using Stata, version 18 (StataCorp, College Station, TX, USA).

## Results

### Study selection

The selection process is shown in Figure 1. In all, 136

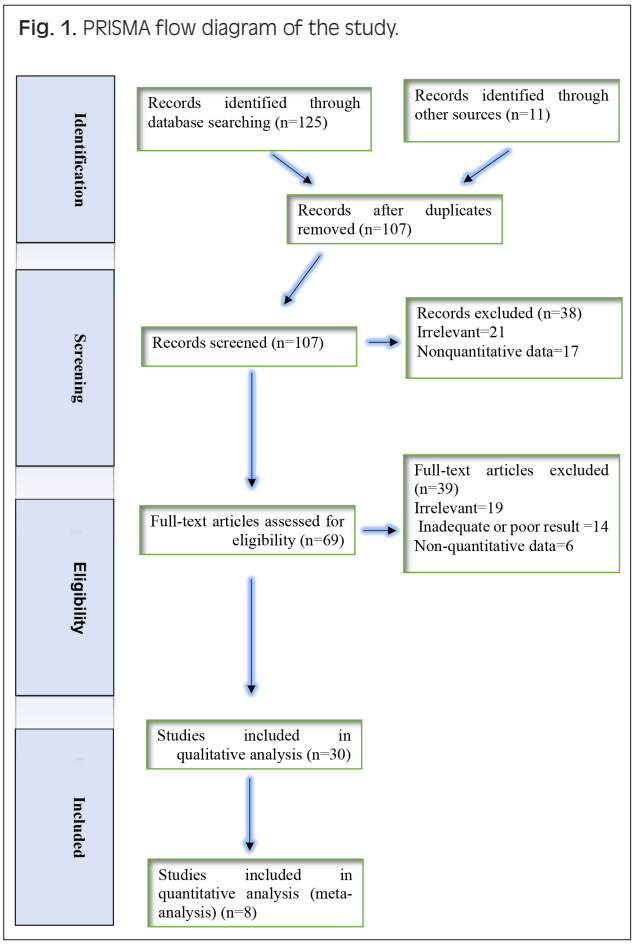



**Fig. 1.** PRISMA flow diagram of the study.

records were found (125 by searching the database and 11 by manual search). After eliminating 29 duplicates, there were 107 unique records to screen. Title and abstract evaluation resulted in 69 articles for full text review, out of which 30 articles met the inclusion criteria and were included in the qualitative synthesis (16 in English and 14 in Persian). Among these, 8 studies, specifically looking at national level of equity in the allocation of hospital beds, were included in the meta-analysis.

### Study characteristics

The included studies addressed the allocation of hospital beds at the level of different administrative levels: inter-provincial, 8 studies [14, 21-27]; intra-provincial, 18 studies [13, 28-44]; city-level, 3 studies [45-47] and within or across universities of medical sciences, 1 study [12]. Overall, most studies were on provincial-level allocation and comparatively fewer studies examined the allocation on national-level. This imbalance is likely the result of both the limited data available combined with the lack of comprehensive nationwide statistics.

### Quality assessment

The methodological quality of the included studies was appraised using the JBI checklist, which has been validated for appraisal of both quantitative and qualitative research in terms of design, methodology, sampling and validity of results [48]. Based on this assessment, 4 studies were determined to be high quality, 18 were medium quality and 8 were low quality. The low-quality studies were excluded from the quantitative synthesis.

### Measures of inequality

Among the 33 articles that were included in the final analysis, 32 used the Gini coefficient (or one of its variants) to assess hospital bed allocation. The Gini coefficient, which comes from the Lorenz curve, is generally accepted as the best measure of fairness in the allocation of resources [49]. The index ranges between 0 to 1, where 0 indicates absolute equality and 1 absolute inequality. Conventionally, values < 0.2 represent complete equality; 0.2-0.3, notable equality; 0.3-0.4, inequality; 0.4-0.6, substantial inequality; and > 0.6, absolute inequality" [50, 51]. In addition to the Gini coefficient, a few studies also reported other measures such as the Robin Hood, Gastwirth and Concentration indices. These complementary indicators were not widely applied but were included in Table I.

### Meta-analysis Interpretation

A total of 8 eligible studies were included in meta-analysis. Since most of these studies reported Gini coefficients for multiple time periods (*e.g.,* 2006, 2011, and 2016), each figure was treated as an effect size. Therefore, 18 effect sizes were included in a final analysis. Considering all the values reported made it possible to capture the temporal variation and study-specific heterogeneity, and thus allow a more complete and realistic evaluation of the allocation of hospital beds.

### Primary analysis (inverse-variance model).

Using the standard random effects model with inverse-variance weighting, a pooled Gini coefficient of 0.24 (95% CI: 0.20 to 0.28) was estimated (Fig. 2). This estimate implies a notable equity in the allocation of hospital beds across provinces. However, heterogeneity was very high (Cochran's Q = 619.54, df = 17, $p < 0.001$; I2 = 97.3%; H = 6.037). These values mean that virtually all of the observed variability is due to real differences between studies and not chance. Given this high degree of inconsistency, the use of a random-effects model was appropriate, as it accounts for the within- and between-study variance and provides a more realistic pooled estimate [52, 53].

### Complementary analysis (quality-effects model).

To further compensate for the methodological rigor, we also used a quality-effects model, as suggested by Doi and Thalib [54]. In this approach, study weights were adjusted based on quality scores based on the Joanna Briggs Institute (JBI) checklist, thus reducing the effect of statistically precise but methodologically weaker studies. The pooled Gini coefficient was 0.26 (95% CI: 0.21 to 0.30) (Fig. 3) under this model. Although broadly

**Tab. I.** Characteristics of the studies included in the final analysis.

| Row<br>Writer – Year – Language | Study Quality | Purpose of Study | Region/ Scope | Inequality Measure | Result |
|---|---|---|---|---|---|
| Jalilian<br>2025<br>English | Medium | To assess the correlation between the allocation of hospital beds and COVID-19 mortality in South Khorasan Province | South Khorasan | Gini Index | Gini = 0.229 → Equality (2022) |
| Rezaei<br>2024<br>English | High | Investigate trends in healthcare resource allocation inequality in Bushehr province | Bushehr | Gini, CI & RH Index(68, 69), | Gini = 0.47 (2012), 0.48 (2015), 0.49 (2019), 0.47 (2022) → Severe inequality |
| Behzadifar<br>2024<br>English | Medium | To examine the inequality in hospital bed allocation in Lorestan province | Lorestan | Gini Index | Gini = 0.27 (2023) → Equality |
| Mosadeghrad<br>2022<br>Persian | Low | To measure equity in the geographical allocation of hospital beds in Fars province | Fars | Gini Index | Gini = 0.30 (2016) → Inequality |
| Majiri<br>2022<br>Persian | Low | Evaluate inequality in the allocation of healthcare resources in Sistan and Baluchestan | Sistan & Baluchestan | Gini Index | Gini = 0.505 (2014), 0.262 (2015), 0.287 (2016), 0.287 (2017), 0.279 (2019), 0.345 (2022) → Inequality |
| Khammarniyeh<br>2021<br>English | Medium | To assess the equity in the allocation of health resources in Southeast Iran | Sistan & Baluchestan | Gini Index | Gini = 0.526 (2020) → Severe inequality |
| Mosadeghrad<br>2020<br>Persian | Low | To examine equity in the geographical allocation of hospital beds in Zanjan province | Zanjan | Gini Index | Gini = 0.26 (2016) → Equality |
| Mosadeghrad<br>2020<br>Persian | Low | To assess the geographic allocation of hospital beds in Khuzestan province | Khuzestan | Gini Index | Gini = 0.33 (2016) → Inequality |
| Mosadeghrad<br>2020<br>Persian | Low | To measure equity in the geographical allocation of hospital beds in Tehran province | Tehran | Gini Index | Gini = 0.299 (2016) → Equality |
| Daroudi<br>2019<br>Persian | Low | Assess equity in hospital bed allocation in Mazandaran | Mazandaran | Gini Index | Gini = 0.28 (2016) → Equality |
| Mosadeghrad<br>2020<br>Persian | Medium | To examine equity in the allocation of hospital beds across Iran | Iran | Gini Index | Gini = 0.107 (2016) → Complete equality |
| Mokhtaripayam et al.<br>2019<br>English | High | Investigate trends in the allocation of health sector resources in Iran | Iran | Gini Index | Gini = 0.107 (2006); 0.116 (2011); 0.147 (2016) → Equality weakened, but still relatively fair |
| Ebrahimzadeh<br>2019<br>English | Medium | To assess equity in the allocation of hospital beds in Gilan Province | Gilan | Gini Index | Gini = 0.23 (2016) → Equality |
| Chavehpour<br>2019<br>English | Medium | To investigate the socio-economic disparities in the allocation of hospital beds in 5 major cities of Iran | 5 Metropolitan Cities | Gini Index | Gini = 0.58 (Tehran), 0.53 (Mashhad), 0.56 (Isfahan), 0.59 (Shiraz), 0.54 (Tabriz) → (2016) Severe inequality |
| Haghdoost<br>2018<br>Persian | High | To evaluate the number and allocation of hospital beds in the country in 2015 and estimate the required hospital beds until 2025 | National (Univ.) | Coefficient of Variation | CV = 36% (2016) → High variability |
| Lotfi<br>2018<br>English | Medium | To evaluate the equality of health resources allocation (human resources, hospital beds, and medical centers) among the provinces of the country in 2014 | Iran | Gini Index & Robin Hood Index | Gini = 0.14 → Equality; RH = 6.7 → Inequality (2014) |
| Nouraei Motlagh<br>2018<br>Persian | Medium | To estimate the equality between physical and human resources in the health sector among the cities of Lorestan province from 2006 to 2014 | Lorestan | Gini Index | Gini = 0.49 (2006); 0.49 (2007); 0.49 (2008); 0.50 (2012); 0.51 (2013); 0.51 (2014) → Severe inequality |

▶

Tab. I. *(follows).*

| Row<br>Writer – Year – Language | Study Quality | Purpose of Study | Region/ Scope | Inequality Measure | Result |
|---|---|---|---|---|---|
| Feyzabadi<br>2018<br>Persian | Medium | To evaluate the inequality trend in the allocation of human force and healthcare facilities in Iran from 2006 to 2015 | Iran | Gini Index | Gini = 0.45 (2006); 0.30 (2011); 0.42 (2015) → Fluctuating, yet severe inequality |
| GolpariPour<br>2018<br>Persian | Low | Evaluate the inequality in the allocation of hospital resources in West Azerbaijan province before and after the Health System Reform Plan | W. Azerbaijan | Hall-Tiedman Index | Hall-Tiedman Index = 0.129 (2013); 0.153 (2016); Inequality worsened after Health Transformation Plan |
| Chavehpour<br>2017<br>English | Medium | To evaluate the spatial allocation of public and private hospitals in Tehran | Tehran | Gini Index | Gini (2011) Public Sector = 0.6 Private Sector= 0.8 → Absolute inequality |
| Hatam N<br>2016<br>English | Medium | To explore the allocation of hospital beds in Shiraz and surrounding regions | Shiraz | Gini Index | Gini = 0.68 (2014) → Absolute inequality |
| Rezaei<br>2016<br>English | Medium | To evaluate the allocation of physicians and hospital beds in Iran in 2001, 2006, and 2011 | Iran | Gini Index | Gini = 0.16 (2001); 0.15 (2006); 0.13 (2011) → Equality |
| Rezaei<br>2016<br>English | Medium | To evaluate the inequality of health resources allocation in Kermanshah province from 2005 to 2011 | Kermanshah | Gini Index | Gini = 0.47 (2005), 0.45 (2006), 0.45 (2007), 0.46 (2008), 0.46 (2009), 0.44 (2010), 0.40 (2011) → Severe inequality but improved over time |
| Ramandi<br>2016<br>English | High | To evaluate the allocation of physicians, staff, paramedics, and hospital beds | Iran | Gini Index | Gini = 0.52 (2006), 0.59 (2007), 0.59 (2008), 0.58 (2009), 0.57 (2010), 0.58 (2011), 0.58 (2012), 0.57 (2013) → Severe inequality with fluctuations |
| Masoudi Asl<br>2015<br>English | Medium | To evaluate the allocation of hospital beds across 22 regions of Tehran | Tehran | Gini Index | Gini = 0.46 (2010-2012) → Severe inequality |
| Sari<br>2015<br>English | Medium | To evaluate the inequality of physical and human resources in the health sector among the provinces of the country from 2001 to 2011 | Iran | Gini Index & Gastwirth Index(70) | Gini = 0.158 (2001), 0.13 (2011) → Improved<br>Gastwirth = 0.25 (2001), 0.20 (2011) → Improved |
| Rezaei<br>2015<br>English | Medium | To evaluate the access and need to hospital beds and physicians among the provinces of the country during 2001-2011 | Iran | Gini Index & Robin Hood Index | Gini = 0.16 (2001); 0.13 (2011) → Equality<br>Robin Hood = 7% (2001); 5% (2011) → Redistribution improved |
| Rezaei<br>2015<br>Persian | Medium | To evaluate the inequality trend in the allocation of resources in the health sector in the cities of Kurdistan province during 2006 – 2016 | Kurdistan | Gini Index | Gini = 0.34 (2006); 0.30 (2016) → Inequality improved |
| Mostafavi et al.<br>2013<br>Persian | Low | To assess the allocation of specialist physicians and hospital beds in West Azerbaijan Province | West Azerbaijan | Gini Index | Gini = 0.51 (2012) → Severe inequality |
| Zandian<br>2012<br>Persian | Medium | To measure inequality in the allocation of health resources in Ardabil Province | Ardabil | Gini Index | Gini = 0.60 (2001); 0.59 (2008) → Severe inequality |

References in parentheses indicate previous studies that also applied these indices and were used to guide interpretation (64, 65 & 66).

consistent with the inverse variance estimate, the wider confidence interval reflects sensitivity of results to quality and methodological diversity of studies.

## Summary of findings

Taken together the two approaches indicate a remarkable equity in the allocation of hospital beds across Iranian provinces. While the inverse variance model is a statistically more precise estimate, the quality effects model adds complementary information by highlighting the importance of methodology in determining results. Accordingly, the final interpretation is based largely

**Fig. 2.** Forest plots of the pooled Gini coefficients for hospital bed allocation across Iranian provinces. Inverse variance (Random-effects).

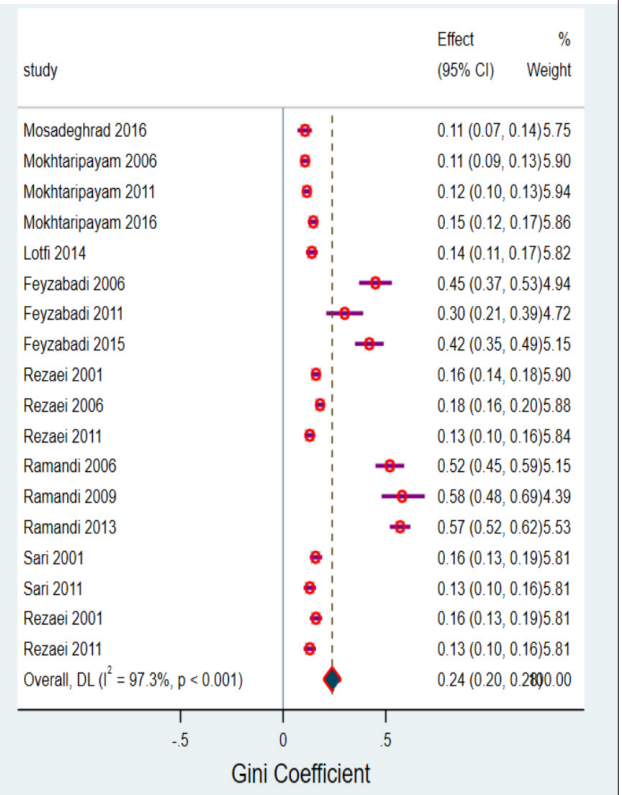
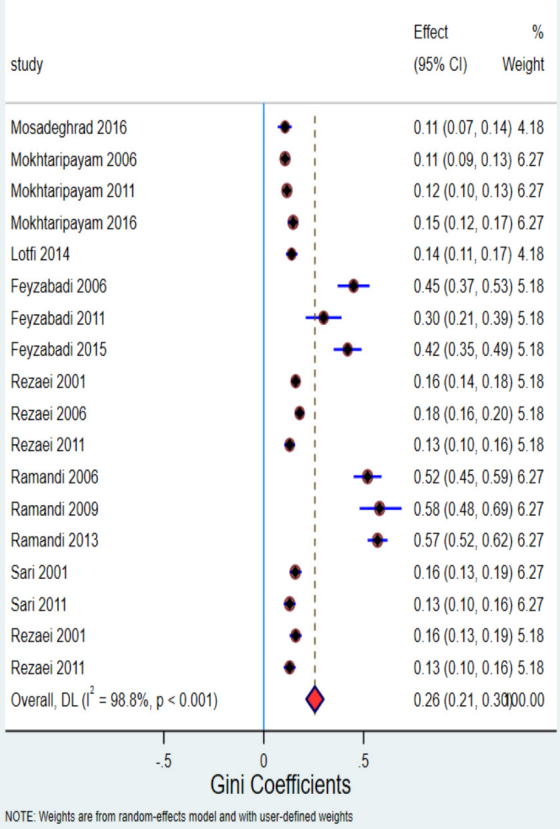



**Fig. 3.** Forest plots of the pooled Gini coefficients for hospital bed allocation across Iranian provinces. Quality-weighted (Random-effects).




(a) Random-effects model with inverse-variance weighting. The pooled estimate was 0.24 (95% CI: 0.20 to 28). (b) Random-effects model with quality-based weighting (red). The pooled estimate was 0.26 (95% CI: 0.21 to 0.30).Each horizontal line represents the 95% confidence interval (CI) for a reported effect size, labeled by the author and year of data collection. The diamond at the bottom of each panel indicates the pooled estimate with its CI. The wider CI in the quality-effects model reflects the reallocation of weights according to methodological rigor (JBI checklist) rather than statistical precision.

on the inverse variance random effects model with the quality-based model reported as a robustness check.

### Intra-provincial studies

Eighteen studies looked at equity of hospital bed allocation within provinces. Reported Gini coefficients were quite different, ranging from 0.229 for South Khorasan (2022) to 0.526 for Sistan and Baluchestan (2020). Most provinces, such as Tehran (0.299, 2016), Fars (0.300, 2016), Zanjan (0.260, 2016) and Gilan (0.230, 2019) reported significant equity allocations. However, severe inequality was identified in Sistan and Baluchestan where Gini coefficients were more than 0.50 in several years and in Bushehr (0.47, 2012-2022). Due to the high heterogeneity in scope, indicators and study design, these studies within provinces were not included in the meta-analysis. Nevertheless, they are important contextual evidence as they reveal that maldistribution of resources is not uniform between provinces and whereas some provinces have relatively equitable resource allocation, other provinces, especially disadvantaged areas such as Sistan and Baluchestan, Lorestan and Kurdistan, show persistently inequitable allocation.

### City-level studies

Three studies measured the allocation of hospital beds in large cities. Reported Gini coefficients varied from 0.46 in Tehran to 0.68-0.70 in Shiraz and another study in five metropolitan cities reported more than 0.55. These results suggest substantial to absolute inequality, and are consistent with a concentration of hospital resources in affluent urban districts.

## Discussion

### Importance of Equity in Resource Allocation

Population health improvement involves more than the absolute increase in resources for health; rather, it requires an equitable allocation of resources [55]. Even if hospital beds are increased, but the resources are not distributed evenly across populations, the improvement in population health is not guaranteed [28]. Evidence from developed as well as developing health systems indicates that maldistribution is linked with reduced accessibility

and efficiency of the delivery of services and increased health disparities, especially in disadvantaged areas [56]. Equity in allocation policies is therefore required to become a fundamental principle of health systems planning, and the benefits from augmented resources must be translated into measurable health outcomes for all population groups [57].

### National-Level Findings

At the national level, our meta-analysis of eight eligible studies resulted in a pooled Gini coefficient for hospitalization beds of 0.24 (95% CI: 0.20-0.28), which suggests a notable equity of hospital beds allocation between provinces. However, heterogeneity was extremely strong [I2 = 97.3%], indicating that there were large differences in scope, data quality and methodology. Studies also confirm that data collected from hospitals in Iran suffer from quality issues due to problems such as lack of coherence and integration in information systems and the absence of standardized indicators [58, 59]. To allow robustness, we also complemented the classical random-effects model with a quality-effects model [54]. Hence, by weighting studies according to methodological strength, the effect of weaker studies is minimized. The estimate obtained from the quality-effects model was slightly larger (0.26); however, the congruity between the two models demonstrates the consistency and robustness of the overall interpretation.

### International Comparison

Iran's pooled Gini coefficient (0.24) is roughly comparable to the Gini coefficient of South Korea, which had a Gini index for all hospital beds increased slightly from 0.269 in 2008 to 0.273 in 2012, which is a moderate level of inequality, despite the rapid expansion of their health systems [60]. However, the overall bed capacity is much different: in 2022, South Korea had about 12.8 beds per 1,000 people (56) compared to 1.65 in Iran in the same year [61], compared to 1.65 in Iran in the same year [62]. This difference highlights the fact that in situations of low total capacity, equity of access assumes greater importance: even small inequalities can have a powerful limiting effect [4], whereas in high capacity systems such as South Korea, the impact of imbalance is less severe.

By comparison, Iran's performance continues to exceed the unusually equitable level reported for China in 2014 (0.07), owing to far-reaching reforms and massive public investment since 2009 [63]. The same is true in other countries, including Saudi Arabia: the Saudi national Gini index in 2022 was 0.15, a fully equal national allocation by conventional standards [64].

### Intra-Provincial Disparities

Subnational analysis shows more dramatic differences. The Gini coefficients within the provinces varied from 0.229 (South Khorasan, 2022) to higher than 0.50 (Sistan and Baluchestan, 2020), and maldistribution remained an unwavering and recurrent pattern in Bushehr, while relatively uniform allocation was observed in Tehran, Fars, Zanjan, and Gilan. These disparities are located in structurally deprived areas like Sistan and Baluchestan, Lorestan and Kurdistan where geographic and socioeconomic barriers contribute to health inequities. A similar pattern was noted in Saudi Arabia where at the national level there was equity while at the regional level there were inequities between areas with high population density such as Makkah and Jeddah and those with low population density such as Al-Jouf and the Northern region [64].

### Intra-Urban Inequalities

The disparities are even further marked at the city level with Gini coefficients ranging from 0.46 in Tehran to 0.68-0.70 in Shiraz, and above 0.55 in a number of other metropolitan regions. These trends represent a clustering of hospital resources in high income neighborhoods and under-servicing of peripheral or disadvantaged communities. Comparable estimates for Shanghai (0.33-0.34) and Shenyang (0.52-0.68) indicate that differences between Iranian metropolitan areas are very high by global standards [65, 66].

### Policy Implications

The research suggests equity based allocation beyond the national level. Intra-provincial and intra-urban disparities clearly indicate the need to focus on poor provinces and deficient urban areas. In addition, the ability to incorporate systematic monitoring of equity into health planning could identify inequities early and inform corrective response.

Moreover, in the Iranian context where a significant share of outpatient specialty and sub-specialty services are provided by the private sector [67], the inequities in hospital bed allocation far transcend inpatient provision. Where there is not enough bed space, specialists have a smaller motivation to start private practices because there is not the infrastructure for admitting and managing patients. As a result, populations in these areas are left without access to hospital-based services as well as specialist out-patient care. This indicates that maldistribution of beds in hospitals can create a domino effect of inequity throughout the health system, at the same time undermining access to equitable basic and specialized services.

For future research, it is recommended to explore the underlying factors of hospital bed and health resource distribution and propose strategies to create an enabling environment for equitable distribution through appropriate policies.

## Conclusion

In conclusion, this study demonstrates that although, allocation of hospital beds at the national level is relatively even, there are considerable intra-provincial and intra-urban disparities in Iran. Ensuring equal access to hospital care among all population groups

requires equity-focused resource allocation and strategic monitoring of health system performance.

### Strengths and Limitations

This study is one of the first systematic reviews to systematically evaluate the allocation of hospital beds in Iran using national and subnational evidence. However, there are some limitations. First, there was considerable heterogeneity between studies (I2~96%) as a result of variability in data sources, definitions, and time periods. Specifically, some studies focused on active beds (beds currently in use and providing services to patients), while others examined static beds (beds that have been built and have operational permits). This difference in the definitions and types of beds contributed to further heterogeneity in the study results. Second, the majority of included studies were cross-sectional, which limited causal inferences. Third, because of the small number of studies included in the meta-analysis (eight studies, 18 effect sizes), a formal test of publication bias could not be performed. Lastly, studies with mixed methods were summarized narratively across provinces and cities because of heterogeneity of methods.

## Acknowledgements

This study is part of a Ph.D. thesis in Health Policy in Iran University of Medical Sciences (IUMS). The project is supported by (IUMS) by the grant number IUMS/SHMIS 1396.9321557001. The sponsor of the study has no role in the design of the study, data collection, analysis, interpretation, and the final report of it.

## Conflict of interest statement

The authors declare no conflict of interes.

## Authors' contributions

MK was responsible for the conceptualization and leadership of the study; MJ, HR contributed to the methodology, formal analysis, and supervision; all authors were involved in writing the original draft and reviewing and editing the manuscript.

### References

[1] Binagwaho A, Mathewos K. The Right to Health: Looking beyond Health Facilities. Health Hum Rights 2023;25:133-5.

[2] Kruk ME, Gage AD, Arsenault C, Jordan K, Leslie HH, Roder-DeWan S, Adeyi O, Barker P, Daelmans B, Doubova SV, English M, García-Elorrio E, Guanais F, Gureje O, Hirschhorn LR, Jiang L, Kelley E, Lemango ET, Liljestrand J, Malata A, Marchant T, Matsoso MP, Meara JG, Mohanan M, Ndiaye Y, Norheim OF, Reddy KS, Rowe AK, Salomon JA, Thapa G, Twum-Danso NAY, Pate M. High-quality health systems in the Sustainable Development Goals era: time for a revolution. Lancet Glob Health 2018;6:e1196-e252. https://doi.org/10.1016/S2214-109X(18)30386-3.

[3] Schneider MT, Chang AY, Chapin A, Chen CS, Crosby SW, Harle AC, Tsakalos G, Zlavog BS, Dieleman JL. Health expenditures by services and providers for 195 countries, 2000-2017. BMJ Glob Health 2021;6:e005799. https://doi.org/10.1136/bmjgh-2021-005799.

[4] World Health Organization. The world health report: Health systems financing – The path to universal coverage. Geneva: WHO; 2010 Available at: https://www.who.int/publications/i/item/9789241564021. Accessed on: 27/7/2025.

[5] McKee M, Healy J, editors. Hospitals in a changing Europe. Copenhagen: WHO Regional Office for Europe & European Observatory on Health Systems and Policies; 2002. Available at: https://eurohealthobservatory.who.int/docs/librariesprovider3/studies---external/hospitals-in-a-changing-europe.pdf. Accessed on: 27/7/2025.

[6] Zhou W, Wang A, Wang X, Cheke RA, Xiao Y, Tang S. Impact of Hospital Bed Shortages on the Containment of COVID-19 in Wuhan. Int J Environ Res Public Health 2020;17:8560. https://doi.org/10.3390/ijerph17228560.

[7] Pecoraro F, Luzi D, Clemente F. The efficiency in the ordinary hospital bed management: A comparative analysis in four European countries before the COVID-19 outbreak. PLoS One 2021;16:e0248867. https://doi.org/10.1371/journal.pone.0248867.

[8] Kovacevic P, Djajic V, Momcicevic D, Zlojutro B, Jandric M, Kovacevic T, Latinovic M, Seranic A, Bokonjic D, Skrbic R, Dragic S. Boosting ICU capacity during the COVID-19 pandemic in the western Balkan region, The Republic of Srpska experience. J Public Health Res 2023;12:22799036231151762. https://doi.org/10.1177/22799036231151762.

[9] Dong E, Xu J, Sun X, Xu T, Zhang L, Wang T. Differences in regional distribution and inequality in health-resource allocation on institutions, beds, and workforce: a longitudinal study in China. Archives of Public Health 2021;79:78. https://doi.org/10.1186/s13690-021-00597-1.

[10] Ravaghi H, Alidoost S, Mannion R, Bélorgeot VD. Models and methods for determining the optimal number of beds in hospitals and regions: a systematic scoping review. BMC Health Serv Res 2020;20:186. https://doi.org/10.1186/s12913-020-5023-z.

[11] Zhou M. The allocation and utilization efficiency of hospital beds in Sichuan Province, China. Medicine (Baltimore) 2024;103:e39329. https://doi.org/10.1097/MD.0000000000039329.

[12] Haghdoost AA, Hashemi H, Noori Hekmat S, Haji Aghajani M, Janbabaee G, Maher A, Javadi AM, Emadi S, Haghighi H, Rajabalipour MR, Dehnavieh R, Ferdosi M, RashidiNejad HR, Moeen Samadani F, Rahimisadegh R. The Geographical Distribution of Hospital Beds in Iran in 2016 and the Estimation of 2026. Iranian J Epidemiol 2018;13:1-13. Available at: http://irje.tums.ac.ir/article-1-5972-fa.html. Accessed on: 23/07/2025.

[13] Nouraei Motlagh S. Measuring Equity in the Distribution of Physical andHuman Resources in Health Sector among the Cities ofLorestan Province (2006-2014). J Health Adm 2017;20:92-104. Available at: http://jha.iums.ac.ir/article-1-4600-en.html. Accessed on: 23/07/2025.

[14] Lotfi F, Bayati M, Yusefi AR, Ghaderi S, Barati O. Inequality in Distribution of Health Care Resources in Iran: Human Resources, Health Centers and Hospital Beds. Shiraz E-Med J 2018;19:e63700. https://doi.org/10.5812/semj.63700.

[15] Kim JN, Oh IH. Optimizing hospital bed capacity and resource allocation using inflow and outflow indices for effective healthcare management. Inquiry 2024;61:469580241304244. https://doi.org/10.1177/00469580241304244.

[16] Nabyonga-Orem J, Mijumbi R. Evidence for informing health policy development in Low-income Countries (LICs): perspectives of policy actors in Uganda. Int J Health Policy Manag 2015;4:285-93. https://doi.org/10.15171/ijhpm.2015.52.

[17] Haidich AB. Meta-analysis in medical research. Hippokratia 2010;14:29-37.

[18] Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med 2009;6:e1000097. https://doi.org/10.1371/journal.pmed.1000097.

[19] Barker TH, Hasanoff S, Aromataris E, Stone JC, Leonardi-Bee J, Sears K, Klugar M, Tufanaru C, Moola S, Liu XL, Munn Z. The revised JBI critical appraisal tool for the assessment of risk of bias for analytical cross-sectional studies. JBI Evid Synth 2025;24:401-8. https://doi.org/10.11124/JBIES-24-00523.

[20] Geissbühler M, Hincapié CA, Aghlmandi S, Zwahlen M, Jüni P, da Costa BR. Most published meta-regression analyses based on aggregate data suffer from methodological pitfalls: a meta-epidemiological study. BMC Med Res Methodol 2021;21:123. https://doi.org/10.1186/s12874-021-01310-0.

[21] Mosadeghrad AM, Janbabaei G, Kalantari B, Dehnavi H, Darrudi A. Equity in distribution of hospital beds in Iran. SJKU 2020;24:12-36. Available at: http://sjku.muk.ac.ir/article-1-4674-fa.html. Accessed on: 23/07/202.

[22] Darzi Ramandi S, Niakan L, Aboutorabi M, Javad Javan Noghabi, Javan Noghabi J, Khammarnia M, Sadeghi A. Trend of Inequality in the Distribution of Health Care Resources in Iran. Galen Med J 2016;5:e618. https://doi.org/10.31661/gmj.v5i3.618.

[23] Yazdi Feyzabadi V, Mehrolhassani M, Khosravi S. Study of Geographical Inequality Trend in Distribution of Human Resources and Health Facilities in Health Sector of Iran in Past Decade. IJE 2018;13:27-36. Available at: Available at: http://irje.tums.ac.ir/article-1-5974-fa.html. Accessed on: 23/07/2025.

[24] Rezaei S, Bazyar M, Fallah R, Chavehpour Y, Homaie Rad E. Assessment of Need and Access to Physician and Hospital Beds: A Cross Sectional Province Based Study in Iran. Available at: https://brieflands.com/journals/semj/articles/20423. Accessed on: 23/07/2025.

[25] Akbari Sari A, Rezaei S, Homaie Rad E, Dehghanian N, Chavehpour Y. Regional Disparity in Physical Resources in the Health Sector in Iran: A Comparison of Two Time Periods. Iran J Public Health 2015;44:848-54. Available at: https://ijph.tums.ac.ir/index.php/ijph/article/view/3306. Accessed on: 23/07/2025.

[26] Rezaei S, Karami Matin B, Kazemi Karyani A, Pourreza A. Distribution of physicians and hospital beds based on Gini coefficient and Lorenz curve: A national survey.J Kermanshah Univ Med Sci 2016;20:e69750. https://doi.org/10.22110/jkums.v20i1.2186.

[27] Mokhtaripayam M, Bouzarjomehri H, Chivaee D, Shiva EH. Investigation of inequality trend in distribution of health sector resources in Iran during 2006, 2011 and 2016 timelines using Gini coefficient. EBHPME 2019;3:191-201. Available at: http://jebhpme.ssu.ac.ir/article-1-251-en.html. Accessed on: 23/07/2025.

[28] Jalilian H, Riahi SM, Heydari S, Taji M. Analysis of equity in the distribution of human resources and hospital beds and its association with the COVID-19 mortality rate: a case of Iran. BMC Health Serv Res 2025;25:110. https://doi.org/10.1186/s12913-025-12277-9.

[29] Rezaee M, Azmal M, Lotfi F, Omranikhoo H. Investigating the Inequality Trend in Health Resource Distribution in Iran: A Case Study in Bushehr Province.Shiraz E-Med J 2024;25:e141095. https://doi.org/10.5812/semj-141095.

[30] Behzadifar M, Shaygan F, Ebrahimi P, Shahabi S, Azari S, Teli BD, Martini M, Behzadifar M. Assessing equity in the distribution of hospital beds in Lorestan, western Iran: a regional analysis. J Prev Med Hyg 2024;65:E449-E455. https://doi.org/10.15167/2421-4248/jpmh2024.65.3.3356.

[31] Mosadeghrad AM, Dehnavi H, Darrudi A. Equity in distribution of hospital beds in Fars province. Hakim 2023;25:335345. Available at: http://hakim.tums.ac.ir/article-1-2207-en.html. Accessed on: 23/07/2025.

[32] Mojiri A, Ahmadi K. Inequality in the distribution of resources in health care system by using the Gini coefficient and Lorenz curve (A case study of Sistan and Baluchestan province over a five-year period). Payesh 2022;21:227-36. Available at: http://payeshjournal.ir/article-1-1874-fa.html. Accessed on:23/07/2025.

[33] Khammarnia M, Ghiasvand H, Javadi F, Adimi FS. Equity in the Distribution of Health Resources: A Case Study in Southeast Iran.Shiraz E-Med J 2021;22:e106392. https://doi.org/10.5812/semj.106392.

[34] Mosadeghrad A, Dehnavi H, Darrudi A. Equity in hospital beds distribution in Zanjan Province, Iran. Payesh (Health Monitor) Journal 2020;19:255-66. Available at: http://payeshjournal.ir/article-1-1369-en.html. Accessed on: 23/07/2025.

[35] Mosadeghrad A, Dehnavi H, Darrudi A. Equity in geographical distribution of hospital beds in Khuzestan Province. EBNE-SINA 2020;22:44-55.

[36] Mosadeghrad AM, Dehnavi H, Darrudi A. Equity in distribution of hospital beds in Tehran province. Payesh 2024;23:171-84. Available at: http://payeshjournal.ir/article-1-2220-en.html. Accessed on: 23/07/2025.

[37] Darrudi A, Mosadeghrad AM, Dehnavi H. Equity in distribution of hospital beds in Mazandaran Province. RSJ 2019;5:10. Available at: http://rsj.iums.ac.ir/article-1-194-en.html. Accessed on: 23/07/2025.

[38] Ebrahimzadeh J, Merati Z, Hedayati Zafarghandi M, Vasokolaei GR, Ezati Asar M, Sahranavard Veshareh Z, Sotodeh Manesh S. Assessing equity in the distribution of hospital beds: evidence from northern Iran. Proc Singap Healthc 2019;28:259-65. https://doi.org/10.1177/2010105819877894.

[39] Rezaei S, Karyani AK, Fallah R, Matin BK. Relative inequalities in geographic distribution of health care resources in Kermanshah province, Islamic Republic of Iran. East Mediterr Health J 2016;22:19-26.

[40] Asl IM, Abolhallaje M, Raadabadi M, Nazari H, Nazari A, Salimi M, Javani A. Distribution of hospital beds in Tehran Province based on Gini coefficient and Lorenz curve from 2010 to 2012. Electron Physician 2015;7:1653-7. https://doi.org/10.19082/1653.

[41] Rezaei S, Nouri B. Evaluation of inequalities in the distribution of health resources by Gini coefficient and Lorenz curve: a case study in Kurdistan province from 2006 to 2013. SJKU 2016;20:1-11. Available at: http://sjku.muk.ac.ir/article-1-2140-en.html. Accessed on: 23/07/2025.

[42] Mostafavi H, Aghlmand S, Zandiyan H, Alipoori Sakha M, Bayati M, Mostafavi S. Inequitable distribution of specialists and hospital beds in West Azerbaijan Province. Payavard 2015;9:55-66. Available at: http://payavard.tums.ac.ir/article-1-5664-en.html. Accessed on: 23/07/2025.

[43] Zandiyan H, Ghiasvand H, Nasimi Dosst R. Measuring inequality of distribution of health resources: a case study. Payesh 2012;11:799-805. Available at: http://payeshjournal.ir/article-1-398-en.html. Accessed on: 23/07/2025.

[44] Golparipour S, Nabilou B, Yusefzadeh H. Inequality assessment of hospital resources distribution in West Azarbaijan Province using economic indicators, before-after health system reform plan. Manage Strat Health Syst 2019;4:21-28. Available at: http://mshsj.ssu.ac.ir/article-1-221-en.html. Accessed on: 23/07/2025.

[45] Chavehpour Y, Rashidian A, Woldemichael A, Takian A. Inequality in geographical distribution of hospitals and hospital beds in densely populated metropolitan cities of Iran. BMC Health Serv Res 2019;19:614. https://doi.org/10.1186/s12913-019-4443-0.

[46] Chavehpour Y, Rashidian A, Raghfar H, Emamgholipour Sefiddashti S, Maroofi A. 'Seeking affluent neighbourhoods?' a time-trend analysis of geographical distribution of hospitals in the Megacity of Tehran. Health Policy Plan 2017;32:669-75. https://doi.org/10.1093/heapol/czw172.

[47] Hatam N, Zakeri M, Sadeghi A, Darzi Ramandi S, Hayati R, Siavashi E. Equity analysis of hospital beds distribution in Shiraz, Iran 2014. Med J Islam Repub Iran 2016;30:393.

[48] Zeng X, Zhang Y, Kwong JS, Zhang C, Li S, Sun F, Niu Y, Du L. The methodological quality assessment tools for preclinical and clinical studies, systematic review and meta-analysis, and clinical practice guideline: a systematic review. J Evid Based Med 2015;8:2-10. https://doi.org/10.1111/jebm.12141.

[49] Yu H, Yu S, He D, Lu Y. Equity analysis of Chinese physician allocation based on Gini coefficient and Theil index. BMC Health Serv Res 2021;21:455. https://doi.org/10.1186/s12913-021-06348-w.

[50] Eker OA, Imam A. Equity in the distribution of health resources and services in the West Bank, Palestine: a focus on hospitals and primary healthcare centers. Int J Equity Health 2025;24:106. doi.org/10.1186/s12939-025-02444-z.

[51] Nasiri A, Amerzadeh M, Yusefzadeh H, Moosavi S, Kalhor R. Inequality in the distribution of resources in the health sector before and after the Health Transformation Plan in Qazvin, Iran. J Health Popul Nutr 2024;43:4. https://doi.org/10.1186/s41043-023-00495-y.

[52] Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. BMJ 2003;327:557-60. https://doi.org/10.1136/bmj.327.7414.557.

[53] Higgins J TJ. Cochrane Handbook for Systematic Reviews of Interventions. Version 6.3 (updated February 2022) ed. London: Cochrane; 2022.

[54] Doi SA, Thalib L. A quality-effects model for meta-analysis. Epidemiology 2008;19:94-100. https://doi.org/10.1097/EDE.0b013e31815c24e7.

[55] Lewis CL, Yan A, Williams MY, Apen LV, Crawford CL, Morse L, Valdez AM, Alexander GR, Grant E, Valderama-Wallace C, Beatty D. Health equity: A concept analysis. Nurs Outlook. 2023;71:102032. https://doi.org/10.1016/j.outlook.2023.102032.

[56] Pan J, Deng Y, Yang Y, Zhang Y. Location-allocation modelling for rational health planning: Applying a two-step optimization approach to evaluate the spatial accessibility improvement of newly added tertiary hospitals in a metropolitan city of China. Soc Sci Med 2023;338:116296. https://doi.org/10.1016/j.socscimed.2023.116296.

[57] Bouckley T, Peiris D, Nambiar D, Mishra S, Sood T, Purwar P, Elshaug AG, Landon BE, Pearson SA, Huckel Schneider C, Schierhout G. Addressing health equity during design and implementation of health system reform initiatives: a scoping review and framework. Int J Equity Health 2025;24:68. https://doi.org/10.1186/s12939-025-02436-z.

[58] Keshvari M, Yusefi AR, Homauni A, Omidifar R, Nobakht S. Barriers for the Using of Information Systems in Hospitals: A Qualitative Study.Shiraz E-Med J 2018;19:e66180. https://doi.org/10.5812/semj.66180.

[59] Behzadifar M, Bakhtiari A, Shahabi S, Azari S, Aryankhesal A, Behzadifar M. Developing a national framework for health technology assessment in Iran: a mixed-methods Delphi consensus study. BMJ Open 2025;15:e100662. https://doi.org/10.1136/bmjopen-2025-100662.

[60] Oh Y. Optimal supply and the efficient use of hospital bed resources in Korea. Seoul: Korea Institute for Health and Social Affairs 2015. Report No: 93510.

[61] OECD. Health at a Glance 2023: OECD Indicators - Korea. Paris: OECD Publishing; 2023.

[62] Hemmati F, Jafari K, Mirmohammadkhani M. Iranian Healthcare System Response to Hospital and Intensive Care Bed Requirements During the COVID-19 Pandemic: A Cross-Sectional Study. Health Sci Rep 2025;8:e70639. https://doi.org/10.1002/hsr2.70639.

[63] Jin J, Wang J, Ma X, Wang Y, Li R. Equality of Medical Health Resource Allocation in China Based on the Gini Coefficient Method. Iran J Public Health 2015;44:445-57.

[64] Kattan W, Alshareef N. 2022 insights on hospital bed distribution in Saudi Arabia: evaluating needs to achieve global standards. BMC Health Serv Res 2024;24:911. https://doi.org/10.1186/s12913-024-11391-4.

[65] Dong E, Sun X, Xu T, Zhang S, Wang T, Zhang L, Gao W. Measuring the inequalities in healthcare resource in facility and workforce: A longitudinal study in China. Front Public Health 2023;11:1074417. https://doi.org/10.3389/fpubh.2023.1074417.

[66] Wang Y, Zhai D, Xie W, Huang S. Spatial optimization of hierarchical healthcare facilities driven by multi-source data: a case study of Shenyang, China. Front Public Health 2025;13:1640070. https://doi.org/10.3389/fpubh.2025.1640070.

[67] World Health Organization. Regional Office for the Eastern M. Understanding the private health sector: in the Islamic Republic of Iran. Cairo: World Health Organization. Regional Office for the Eastern Mediterranean; 2024.

[68] Suan NAM, Soelar SA, Rani RA, Anuar NA, Aziz KAA, Chan HK, Cheah WK, Sani SSM, Said RM, Hassan MRA. Exploring measurement tools to optimise hospital physician distribution. Med J Malaysia 2024;79:222-33.

[69] Farantos G, Pitis A, Diamantopoulou M, Tzavella F. Measuring Health Inequalities Using the Robin Hood Index: A Systematic Review with Meta-Analysis. Epidemiologia (Basel) 2025;6:35. https://doi.org/10.3390/epidemiologia6030035.

[70] Fleary SA, Joseph P, Zhang E, Freund K. Disparities in Adolescents' Obesogenic Behaviors, 2005-2017. Am J Health Behav 2021;45:677-94. https://doi.org/10.5993/AJHB.45.4.7

Received on October 30, 2025. Accepted on January 09, 2026.

**Correspondence:** Hamid Ravaghi, Department of Health Services Management, School of Health Management and Information Sciences, Iran University of Medical Sciences, Tehran, Iran.; World Health Organization Regional Office for the Eastern Mediterranean, Cairo, Egypt. E-mail: hamidra1966@gmail.com

**How to cite this article:** Keshvari M, Jafari M, Ravaghi H. Hospital beds in Iran: equitable access to healthcare. J Prev Med Hyg 2026;67:E00E00. https://doi.org/10.82082/2421-4248/jpmh2026.67.1.3785