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Does increasing the number of beds or health workers contribute to the rational use of scarce public health resources?

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Abstract: Turkey makes substantial investments to increase the number of qualified beds in hospitals, the shortage in health professionals remains one of the main obstacles of the health system in the country. To address this research gap, the study aims to formulate a rational solution for the dilemma on whether to invest in beds or health professionals contribute to the rational use of scarce public health resources. Data for testing the model were derived from the Turkish Statistical Institute across 81 provinces in Turkey. The path analytic approach was used to determine the associations among hospital size, utilization/facility, health workforce, and indicators of health outcomes. The results point to a strong link between quantity of qualified beds, utilization of health services, and facility indicators, and health workforce. Rational use of scarce resources, optimal capacity planning, and increased quantity of health professionals will be beneficial for the sustainability of health care services.

***Keywords*:** hospital size, utilization, facility, health workforce, health outcomes, Turkey

Introduction

Resource planning for nonprofit health care organizations is critical (*1*) for better management of limited public health resources. Enhanced coordination among departments is key to each stage of planning, response, and recovery of health care services (*2*) as the global public health crisis continues to be a threat to health and economy (*3*). Moreover, pressures from cost containment and the Covid-19 pandemic force health care institutions to re-examine decisions regarding human resource management and facilities and their utilization (*4*). Previous studies argued that effective coordination among health care services is critical during health crises (*3*). Specifically, research on facility management decisions in health care indicate that decisions on facility acquisition and utilization may influence the management of workforce and equipment and the performance of hospitals in terms of cost and quality (*5,6*). Large-scale hospital construction and operation in countries with mixed economies feature public–private partnerships (*7*). The previous literature mentions that decisions regarding facility management are long term. Thus, measuring their impact on health care operations in the short run is impossible (*8*).

In Turkey, the Ministry of Health (MoH) made substantial investments in city hospitals under the Health Transformation Program (*9*). The reason behind these capacity enhancement decisions is to respond to increase in demand for health services and to improve the quality of such services (*10*). The distinguishing feature of city hospitals was that they are physically large and built within large complexes since 2017. To this day, many of these hospitals remain under construction. Moreover, investment in 10 city hospitals enabled the establishment of health services in campuses across cities as of 2020 (*9*). However, the Covid-19 pandemic increased the need for the better planning of health services and critical care to respond to the need for rapid, innovative, and cost-effective response to unforeseen health crises (*11*). The presence of gaps in critical care capacity and scarcity of health professionals became obvious in the majority of countries worldwide after the outbreak of the Covid-19 pandemic (*12,13*). Indeed, a common lore of capacity management stated that strategies for capacity improvement should be pursued based on the various sizes and locations of facilities. Moreover, as their size increases, hospitals should place increased emphasis on decisions regarding facility management (*8,14*). In this regard, effective capacity planning can significantly enhance the capability and effectiveness of treatment for critical care patients due to a tremendous health crisis (*15*).

Demographics and the variety of services of hospitals are frequently used to categorize hospitals and are used as a criterion for comparing decisions on capacity management (*16*). A common factor for determining hospital size is the number of beds, wherein large-scale hospitals tend to contain more capacity for idle facilities than small-scale hospitals. This scenario is a result of the

nationwide decrease in hospital occupancy ratios (*8*). In this regard, if large-scale hospitals fail to appropriately manage facility utilization, then they may jeopardize cost and quality performance relative to competitors (*17*). In other words, facility management is considered the front end in a hospital resource planning system, which describes the capacity resource required to perform the various activities according to priority (*5*). Facility management decisions typically examine issues related to hospital inpatient admission and average length of stay. In addition, bed occupancy rate provides an overview of the level of utilization of beds in the hospital (*18*). The higher the bed occupancy rate, the lower the capacity to admit new patients (*19*).

Conversely, the literature suggests a causal inter-relationship between facility, utilization, and workforce management of health services (*20*). Growth in the number of individuals living with chronic conditions is a major driver of health care costs, whereas the utilization of primary care provider, nurse, and physician services is associated with less use of acute care services and less total costs (*21*). Facility management throughout outpatient capacity expansion and demand management are helpful measures for meeting time-varying demands and for improving utilization (*8*). Health professionals are pressured to deliver effective, efficient services by considering the skill mix of the workforce, particularly the staffing of new services (*22*). Health care organizations are established in response to demand (*23*). Thus, considering the appropriate number of health professionals is useful for guiding service planning and delivery, where the supply of health professionals exerts a powerful force in changing the health care system (*23,24*). However, the Covid-19 pandemic has led to drastic changes in bed capacity and physician and nursing workforce requirements (*25*), such that the availability of number of beds, critical care capacity, and health workforce supply during health crises have become current topics of interest to researchers on health care capacity planning (*26*). In-depth understanding of hospital capacity, workforce, and outcome inter-relationships have strongly advocated for the preparedness of health systems in terms of effective management of crisis situations (*27*). As such, better management of health care capacity and preparedness for times of crisis is critical for developing countries (*28*). In Turkey, investments in city hospitals include a large quantity of qualified beds to provide relief to health policy makers during the pandemic with regard to providing better responses to the sudden increase in demand for health services (*29*). Moreover, despite the fact that Turkey lags behind developing countries in terms of number of physicians and nurses (*30*), the sacrifice and outstanding performance of Turkish physicians and nurses proved essential to the country's fight against the pandemic (*31*). Existing knowledge emphasizes that increase in hospital size and human resources have a direct impact on health services utilization such as average length of stay and bed occupancy rate (*32*) and this will lead to an increase in number of health professionals. Because limited numbers of physicians and nurses, in addition to high bed occupancy rate may be significant drivers of mortality (*33*). Increase in health services utilization and health workforce results in an increase in health outcomes such as death rates (*34*). However, high burden of health services utilization and increase in health facilities is interrelated with amount of human health resources. High number of health professionals is necessary to answer an increase in health services utilization and facilities. Negative causal transmission between health services utilization and facility indicators and health workforce can be a result under the mediating effect of an increase in burden of health services. In this vein, a lack of a number of health professionals are not responding to that increase. This necessitates a better understanding and better planning of health services performance indicators in developing countries. Thus, the rationalization of decisions regarding new health care facility investment and rational capacity planning is critical for enhancing the management of scarce health resources and improving health outcomes in Turkey. Bearing this in mind, the purpose of this experiment sought to understand the nexus between hospital size, health services utilization and facility management, health workforce and health outcomes. The following sections present the conceptual study model and hypotheses, the study results, and a discussion of the key study findings.

Methods

Conceptual model and hypothesis

Figure 1 presents the conceptual model of the relationship between hospital size, utilization and facility of health services, health workforce and health outcomes. The theoretical basis of this model is based on interrelationships between intermediate operations decisions and health outcomes (*35*). The study model and conceptual framework of this study inspired from the literature (*36*) has been built by the author and the hypotheses developed based on comprehensive literature review by focusing on these factors relationship. The following part of the study reviews literature and develops hypotheses that link selected variables, which include the number of hospitals and qualified beds, utilization and facility indicators of health services, number of health workforce and health outcomes.

Hospital size

The hospital size factor is assessed by the number of beds. Generally, large hospitals tend to have more idle capacity than smaller hospitals and increase in number of

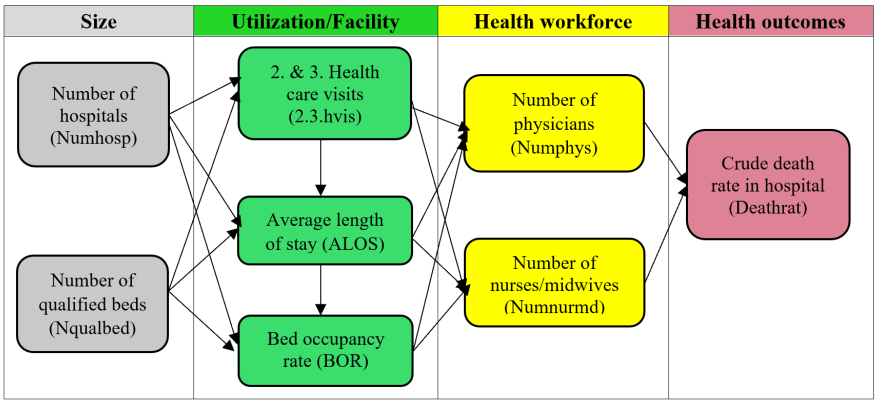


Figure 1. Conceptual model. *Adapted from reference (*36*).

hospitals and beds will lead to an increase in utilization and facility indicators of health services (*8,14,37*).

The related hypotheses are as follows:

H1a: The increase in number of hospitals will lead to an increase in secondary and tertiary health care visits.

H1b: The increase in number of hospitals will lead to an increase in average length of stay.

H1c: The increase in number of hospitals will lead to an increase in bed occupancy rate.

H1d: The increase in number of qualified beds will lead to an increase in secondary and tertiary health care visits.

H1e: The increase in number of qualified beds will lead to an increase in average length of stay.

H1f: The increase in number of qualified beds will lead to an increase in bed occupancy rate.

Utilization and facility indicators of health services

Improving the administrative planning of utilization and facility of health services is critical for the management of scarce health resources. The literature stated that an increase in health care visits is strongly associated with average length of stay because it indicates increased bed occupancy rate (*38,39*).

The related hypotheses are as follows:

H2a: The increase in secondary and tertiary health care visits will lead to an increase in average length of stay.

H2b: The increase in average length of stay will lead to an increase in bed occupancy rate.

Health workforce

The literature has long discussed the inter-relationships between the increase in hospital utilization and supply of health professionals (*40,41*). Many studies have stated that developing countries should improve data on their workforce and changing population needs. Moreover, they should integrate new professional roles into their workforce planning models to better respond to health needs during crises (*42*).

H3a: The increase in secondary and tertiary health care visits will lead to an increase in number of physicians.

H3b: The increase in secondary and tertiary health care services will lead to an increase in number of nurses and midwives.

H3c: The increase in average length of stay will lead to an increase in number of physicians.

H3d: The increase in average length of stay will lead to an increase in number of nurses and midwives.

H3e: The increase in bed occupancy rate will lead to an increase in number of physicians.

H3f: The increase in bed occupancy rate will lead to an increase in number of nurses and midwives.

Health outcomes

Standardized mortality rates, infant mortality, life expectancy and potential lost years of life have traditionally been used as health outcome indicators (*43*). The number of physicians (supply) is associated with population mortality (*44,45*). Moreover, not only physician but also nurse staffing characteristics can lead to the formulation of strategies that aim to reduce mortality and prevent unnecessary deaths (*46*). Increasing health care service utilization and improving health care facilities necessitates an increase in the number of health professionals, such as physicians and nurses/midwives. Indicators of health care utilization and facility and workforce availability are closely related to health outcomes, such as number of deaths.

The related hypotheses are as follows:

H4a: The increase in number of physicians will lead to an increase in crude death rate in hospital.

H4b: The increase in number of nurses and midwives will lead to an increase in crude death rate in hospital.

Data

In this study, data gathered from official Turkish

Ministry of Health-Health Statistics Yearbook-2018 legal online records (*https://dosyasb.saglik.gov.tr/Eklenti/36164,siy2018en2pdf.pdf?0*). Study variables presents data for 81 provinces of Turkey for the year 2020 (*30*). There is no need for ethical approval for this study. Detailed explanations about study variable descriptions, labels, years and data sources are represented in Table 1.

Results

Descriptive statistics

Table 2 presents descriptive statistics of study variables. Median, minimum, maximum, and standard deviation values are represented. Because of non normal distribution of study variables, median values are also presented. The mean value of number of hospitals in 81 provinces is 18.94 (± 27.82), number of qualified beds is 1,721.02 (± 2,740.27), number of secondary and tertiary health care visits is 6,382,950 (± 11,589,451.42), bed occupancy rate is 65.92 (± 7.62), average length of stay is 4.05 (± 0.69), number of physicians is 1,883 (± 4,202), number of nurses and midwives is 3,051 (± 5,079), crude death rate in hospital is 16.16 (± 5.79).

Path analytic models

Before constructing the path analytic models, Spearman rank correlations between study variables indicated that there is no fear for multicollinearity in this study. First path analytic model results performed on the variance-covariance matrix is presented in Figure 2. The whole model is significant ($p < 0.001$); however certain path links of the model include insignificant "t" values (Figure 2). The "t" values, presented in "red" color for the number of hospitals [Numhosp] and average length of stay [ALOS]; average length of stay [ALOS] and bed occupancy rate [BOR]; bed occupancy rate [BOR] and number of nurses/midwives [Numnurmd]; number of physicians [Numphys] and crude death rate in hospital [Deathrat], are insignificant ($p > 0.05$). Due to non meaningful "t" values in the first path model, the path links from Numhosp to ALOS, ALOS to BOR; BOR to

Table 1. Variable descriptions and labels

Variable group	Variables	Explanations	Year	Labels
Size	Number of hospitals	Total number of MoH, university, private and other hospitals.	2018	Numhosp
	Number of qualified beds	Qualified bed is a bed with a bathroom, a toilet, and a maximum of 2 patient beds, television, telephone, refrigerator, dining table, shelf and a folding companion seat. These figures are included in the total number of beds.	2018	Nqualbed
Utilization	Secondary and tertiary health care visits	Total number of secondary and tertiary health care visits by province.	2018	2.3.hvis
Utilization	Bed occupancy rate	This indicates the rate of bed usage by the patient within one year. It is calculated as follows: (Number of Days Stayed × 100) / (Number of Beds × 365).	2018	BOR
Facility	Average length of stay	The average number of days a patient stays in a hospital. It is calculated as follows: (Number of Days Stayed) / (Discharged + Deceased).	2018	ALOS
Health workforce	Number of physicians	Total number of specialist physicians, general practitioners and medical residents.	2018	Numphys
	Number of nurses/midwives	Total number of nurses and midwives.	2018	Numnurmd
Health outcomes	Crude death rate in hospitals (‰)	It indicates the proportion of patients who died in a hospital within a year to those who died and discharged from the hospital in the same period. (Deceased × 1.000) / (Discharged + Deceased)	2018	Deathrat

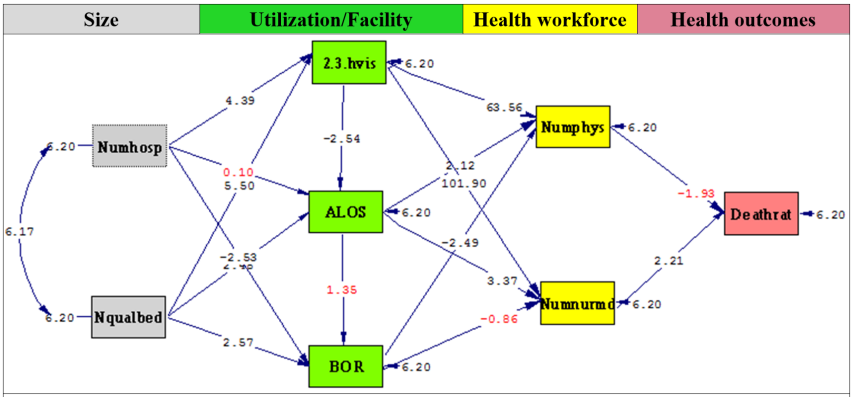
Table 2. Descriptive statistics

Variable group	Variables	N	Min	Max	Median	Mean	SD
Size	Number of hospitals	81	1	236	12	18.94	27.82
	Number of qualified beds	81	108	22278	999	1721.02	2740.27
Utilization	Secondary and tertiary health care visits	81	409,722	94,393,122	3,247,625	6,382,950	11,589,451.42
Utilization	Bed occupancy rate	81	46.9	84.7	66.30	65.92	7.62
Facility	Average length of stay		2.6	6.1	4	4.05	0.69
Health workforce	Number of physicians	81	112	33052	740	1883	4202
	Number of nurses/midwives	81	281	40618	1763	3051	5079
Health outcomes	Crude death rate in hospitals	81	2.8	29.3	16.60	16.16	5.79

Numnurmd, Numphys to Deathrat were excluded from the first path analytic model. Therefore, H1b, H2b, H3f and H4a were rejected. After the exclusion of the non meaningful path links of the prior model, a redefined second path analytic model was constructed and presented in Figure 3.

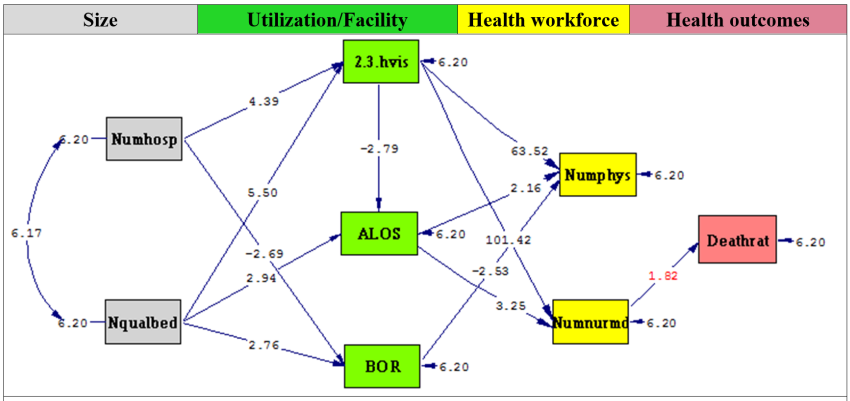
Second path analytic model results performed on the variance-covariance matrix is presented in Figure 3. The whole model is significant ($p < 0.001$); however, one of the path links of the model include insignificant "t" values (Figure 3). The "t" value, presented in "red" color for the number of nurses/midwives [Numnurmd] and crude death rate in hospital [Deathrat] is insignificant ($p > 0.05$). Because of non meaningful "t" value of the second path model, the path link from [Numnurmd] to [Deathrat] was excluded from the model and H4b was rejected. After the exclusion of the insignificant path link from the model, "t" values and standard path coefficients obtained from a redefined final path model was constructed and presented in Figure 4 and Figure 5, respectively.

Figure 4 represents final path analytic model. This model presents a causal interrelationship between hospital size, utilization and facility of health care services and health workforce indicators. We hypothesized that the increase in number of hospitals will lead to an increase in secondary and tertiary health care visits. As expected, the increase in number of hospitals led to an increase in secondary and tertiary health care visits (PC = 0.44; t = 4.39; $p < 0.01$). Therefore, H1a was accepted. Additionally, we hypothesized that the increase in number of hospitals will lead to an increase in bed occupancy rate. Interestingly, study findings show that the increase in number of hospital has a strong negative effect on an increase in bed occupancy rate (PC = -2.04; t = -2.69; $p < 0.01$). Therefore, H1c was rejected. Moreover, we hypothesized that an increase in number of qualified beds will lead to an increase in secondary and tertiary health care visits. As expected, the increase in number of qualified beds will lead to an increase in secondary and tertiary health care visits (PC = 0.55; t = 5.50; $p < 0.01$). Thus, H1d was accepted. Furthermore,



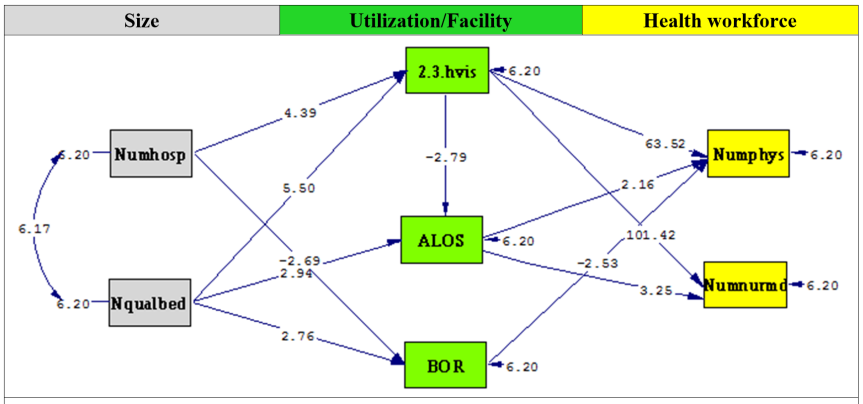
Path analytic model (t values). See Table 1 for description of variables. See Table 3 for global fit indices obtained from first model. Numbers associated with single headed arrows are t-values. t-values which are greater than 1.96 and 2.56 are meaningful at 0.05 and 0.01 levels, respectively.

Figure 2. First path analytic model (t values).



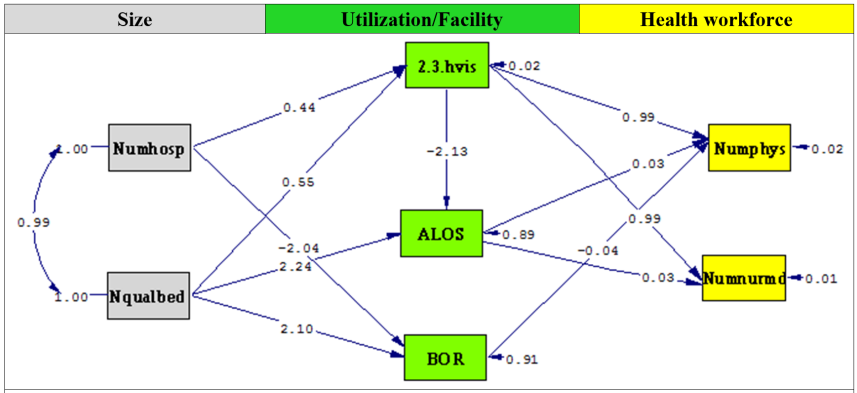
Path analytic model (t values). See Table 1 for description of variables. See Table 3 for global fit indices obtained from second model. Numbers associated with single headed arrows are t-values. t-values which are greater than 1.96 and 2.56 are meaningful at 0.05 and 0.01 levels, respectively.

Figure 3. Second path analytic model (t values).



Path analytic model (t values). See Table 1 for description of variables. See Table 3 for global fit indices obtained from second model. Numbers associated with single headed arrows are t-values. t-values which are greater than 1.96 and 2.56 are meaningful at 0.05 and 0.01 levels, respectively.

Figure 4. Final path analytic model (t values).



Numbers associated with single headed arrows are standardized path coefficients. Standart path coefficients indicate significant relations of final model. The coefficients with absolute values less than 0.01 may indicate "small" effect, values around 0.30 "medium" effect, values greater than 0.50, a "large" effect.

Figure 5. Final path analytic model (standard path coefficients).

we hypothesized that the increase in number of qualified beds will lead to an increase in average length of stay. As expected, the increase in number of qualified beds will lead to a strong increase in average length of stay (PC = 2.24; t = 2.94; $p < 0.01$). Therefore, H1e was accepted. Additionally, we hypothesized that an increase in number of qualified beds will lead to an increase in bed occupancy rate. As expected, the increase in number of qualified beds led to an increase in bed occupancy rate (PC = 2.10; t = 2.76; $p < 0.01$). Thus, H1f was accepted. Moreover, we hypothesized that, an increase in secondary and tertiary health care visits will lead to an increase in average length of stay. However, it is seen that an increase in secondary and tertiary health care visits have a negative effect on an increase in average length of stay (PC = -2.13; t = -2.79; $p < 0.01$). Therefore, H2a was rejected. On the other hand, a causal relationship between health care utilization and facility indicators and health workforce was characterized by the relation between secondary and tertiary health care visits and number of physicians. We hypothesized that the increase in secondary and tertiary health care visits will lead to an increase in number of physicians. As expected, the increase in number of secondary and tertiary health care visits has a very strong effect on an increase in number of physicians (PC = 0.99; t = 63.52; $p < 0.01$). Thus, H3a was accepted. Moreover, we hypothesized that the increase in secondary and tertiary health care visits will lead to an increase in number of nurses/midwives. As expected, the increase in number of secondary and tertiary visits has a very strong effect on an increase in number of nurses/midwives (PC = 0.99; t = 101.42; $p < 0.01$). Therefore, H3b was accepted. Furthermore, we hypothesized that, an increase in average length of stay will lead to an increase in number of physicians. It is seen that, the increase in average length of stay will lead to a small increase in number of physicians (PC = 0.03; t = 2.16; $p < 0.05$). Thus, H3c was accepted. Moreover, we hypothesized that, the increase in average length of stay will lead to an increase in number of nurses and midwives. As expected, the increase in average length of stay has a small positive effect on an increase in number

Table 3. Global fit indices obtained from first, second and final path models

Index	First model	Second model	Final model
Chi-square (X^2)	72.03	77.98	53.60
Df	11	15	9
p	< 0.001	< 0.001	< 0.001
NFI	0.87	0.86	0.89
CFI	0.87	0.87	0.90
GFI	0.81	0.80	0.84
RMSEA	0.268	0.234	0.254

Abbreviations: Df: Degrees of freedom; NFI: Normed fit index; CFI: Comparative fit index; GFI: Goodness of fit index; RMSEA: Root mean square error of approximation.

of nurses and midwives (PC = 0.03; t = 3.25; $p < 0.01$). Therefore, H3d was accepted. Finally, we hypothesized that an increase in bed occupancy rate will lead to an increase in number of physicians. Interestingly, study findings emphasize that, an increase in bed occupancy rate has a small negative effect on an increase in number of physicians (PC = -0.04; t = -2.53; $p < 0.05$). Therefore, H3e was rejected.

Table 3 represents global fit indices the ratios derived by dividing Chi-square (X^2) by degree of freedom (Df) (X^2/Df) were also examined. Note that, X^2/Df ratio less than 2 was considered a "perfect" model fit, whereas one that is less than 3 was considered as a "medium" model fit, and one less than 5 was considered as a "small" indicator of model fit (*47*). According to the X^2/Df (53.60/9=5.9) value obtained from the final model, it is clear to say that final path model indicates an acceptable model fit. Moreover, we used multiple criteria of model fit indices besides X^2 statistics, because X^2 statistics are influenced by sample size and number of variables in the dataset (*48*). Other fit indices obtained from the final path model include the normed fit index (NFI), comparative fit index (CFI) and goodness of fit index (GFI). The NFI is 0.89, CFI is 0.90 and GFI is 0.84, indicating acceptable model fit (*43,44*) between final model and the dataset, as seen in Table 3.

Discussion

Key findings

The study aimed to answer the research question: "*Is investment in the number of beds or health professionals a priority for the rational use of scarce health resources in Turkey?*" The key findings indicate that, an increase in the number of qualified beds exerted a strong positive effect on the increase in facilities and indicators of the utilization of health services. However, an increase in average length of stay indicates an extremely small positive effect on increases in the number of physicians and nurses/midwives. Moreover, an increase in bed occupancy rate led a decrease in the number of physicians moderated by the direct positive effect of the increase in the number of qualified beds. The findings highlight that an increase in the number of qualified beds exerts a direct and strong positive effect on the increase in utilization and health services facility indicators. However, an increase in average length of stay and bed occupancy rate did not exhibit a strong positive effect on the increase in the number of physicians and nurses/midwives. Moreover, the increase in the number of hospitals displays a medium positive effect on the increase in secondary and tertiary health care visits, which leads to a strong positive effect on the increases in the number of physicians and of nurses/midwives.

A surprising finding of this research, which is related to the research question, is that an increase in the number of hospital beds exerts a strong negative effect on the increase in bed occupancy rate. In relation to this finding, the increase in bed occupancy rate displays a slight mediating negative effect on the increase in the number of physicians. In other words, an increase in the number of qualified beds clearly displays a strong positive effect on the increase in utilization and facility indicators of health care services. However, the increase in utilization and facility indicators of health services exhibits a negative and a slight positive effect on increases in the number of physicians and nurses/midwives. The findings suggest that public health policy makers should prioritize the number of health professionals to maximize the scarce health resources in Turkey. By focusing on the inter-relationships between the size of health services, utilization, facility and health workforce indicators, the broad scope of the study will appeal to all scholars interested in the field of health care capacity and health workforce indicators.

Moreover, the findings elucidate the strong negative inter-relationships between the utilization of health services and indicators of the health workforce. A clear concept identified is that a positive relationship between an increase in the utilization of health services on the increase in the indicators of the health workforce is desirable. However, the findings are unique and emphasize that an increase in bed occupancy rate leads to a decrease in the number of physicians. The results of this study are in line with current health statistics of Turkey. The scarcity of number of health workforce such as physicians is noticeable in Turkey. In terms of total number of physicians per 100,000 population, Turkey lags behind all developed Organization for Economic Co-operation and Development (OECD) countries with 205 doctors in 2019, compared to 356 in the OECD average. The acute bed occupancy rate in Turkey was 65.3% in 2009 and 65.5% in 2019, while the OECD average was 76% for 2019 (*49*). The results of this study shows that the increase in bed occupancy results in a decrease in number of physicians. This result highlights that, human resources are failing to respond the growing needs of health facilities such as increase in the number of beds. This finding critically emphasizes the necessity

of reinforcing the number of health professionals to enable better responses to global health challenges. In other words, the rational use of scarce resources and better planning of health human resources are urgent to better cater to the need for high-capacity health care services apart from building new hospitals and expanding the current capacity of such services as the primary motivations of the Health Transformation Program in Turkey. However, the lack of health professionals in Turkey is notable compared with that of developed countries (*49*). Additionally, the Covid-19 pandemic increased the urgency for the development of the health workforce (*35*). Thus, increasing the number of health professionals is key to future sustainability and better preparedness during health crises (*12*). The findings pose several important implications for future studies by emphasizing the strong inter-relationships between health care capacity, utilization, and indicators of facility and health workforce. Notably, the findings do not support the inter-relationships between size, utilization/facility, health workforce indicators, and health outcomes. In light of these study findings, future researchers will benefit from further investigation for a better understanding of the inter-relationships between health care capacity, health workforce, and health outcome. The findings bolster the claim that an increase in investment for qualified beds increases the utilization of health services and facility indicators. However, increases in average length of stay and bed occupancy rate did not exhibit a strong positive effect on the increase in the number of physicians, nurses, and midwives. A common view in public health care capacity planning suggests that the degree of increase in the utilization of health services leads to an increase in the number of health professionals (*42*). The current results differ from this view and demonstrates that an increase in bed occupancy rate exerts a negative effect on the number of physicians. At the heart of this finding lies the objective to highlight the need for improvement in health human resource planning in Turkey.

The key findings reveal that increasing the number of hospitals and qualified beds can lead to an increase in the utilization and facility indicators of public health care services. However, an increase in utilization and facility indicators of health care services does not lead to an increase in the number of the health workforce, such as physicians, nurses, and midwives. Moreover, the increase in health workforce does not exert a strong positive effect on health outcome even with the mediating effect of the increase in utilization and facility indicators of health services. In summary, the findings highlight the positive inter-relationship between hospital size/utilization of health services and facility indicators but not between utilization and facility indicators of health services with health workforce with the indirect effect of the increase in hospital size. The results can help broaden the vision of public health policy makers in their decisions regarding capacity enhancement, public resource management and recommend a balanced capacity management approach that aims not only to invest for the improvement of hospital size but also for the increase in the number of health professionals.

Strengths of this study

The study makes several contributions that can enhance the understanding of the inter-relationship between hospital size, utilization and facility indicators of health services, and number of health professionals. This empirical study allows us to examine a novel way the interrelationship between public health facilities and health human resources. Study findings bring many lights for rational distribution and better management of public health resources. In Turkey, substantial investments in city hospitals is common, which leads to high capacities for qualified beds (*10*). However, operational planning of health services is crucial and should thus be improved for the rational management of scarce health resources. To the best of our knowledge, a paucity in the research on the adequacy of health professionals in Turkish health care continues. Thus, the results of the present study aims to fill this research gap by emphasizing the strong associations between hospital size, utilization, and facility indicators of health services, and workforce indicators. The findings can serve as reference for certain general decisions for the support of health care professionals operating in a fast-moving health care environment. An added strength of this study lies in its emphasis of enhancing the understanding on the negative effect of increased bed occupancy rate on increased number of physicians. This finding strongly emphasizes the need for better health human resource management and increased number of health professionals in Turkey. As such, the current deficit in the number of health professionals that persists in developed countries is critical to the response to international health crises (*3*). Health policy makers and planners can use the findings to increase awareness of the need to reinforce the current workforce and to consider equity during the geographic distribution of the health workforce.

Limitations and recommendations for future studies and public health policy makers

The study has limitations that are worth noting. First, the findings are based on a secondary dataset derived from the Turkish Ministry of Health Statistical Yearbook for 2018 (*30*). In this regard, the researchers acknowledge the limited control over the type of data available. Thus, the study strongly suggests that future studies should include primary datasets in the analysis based on the operational efficiency and performance indicators of public city hospitals. In addition, the findings emphasize the strong negative effect of increased bed occupancy

rate on increased number of physicians. In Turkey, health policy makers should initially mainly focus on the development of health workforce supply. In light of these results, future studies are required to provide in-depth understanding of the adequacy and responsiveness of health human resources in terms of efforts to improve health care capacity. Furthermore, health policy makers in Turkey should prioritize issues related to capacity filling and effective planning of health human resources. Ensuring more involvement from key stakeholders of the health system in the facility and utilization decisions of the health system is crucial. In addition, the voices of the public and health professionals should be heard during the formulation of capacity enhancement decisions. Health planners should ensure more transparency during the bid–offer process for public–private partnerships during the hospital-building stages. Health planners and policy makers should provide a rational basis for the question "Can one-size hospitals respond to the need of the Turkish population after considering accessibility to health services and rural–urban discrepancies?"

Conclusions

The results demonstrate strong inter-relationships between hospital size, utilization of health services and facility indicators of the health workforce. The findings should be considered during the operational planning of health services and integrated into health human resource planning and development. Additionally, the results are expected to appeal to many public health policy makers who are interested in effective health workforce planning. Additional research and better planning of the number of health human resources are required for the strategic development of health care operations and services. In summary, the results elucidate that increased bed occupancy rate exerts a negative effect on increased number of physicians in Turkey despite the fact that one of the motivations for building new hospitals is to improve bed capacity. In other words, capacity filling problems exist in the health system in Turkey. Thus, effective health human resource planning and rational demand forecasting should be essential components of public health policy making to better respond to the increasing demand for and utilization of health services.

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