ACHSM Asia-Pacific Journal of Health Management

RESEARCH ARTICLE

NETWORK ANALYSIS OF PHYSICIAN MOBILITY IN ISTANBUL'S PRIVATE HOSPITALS, TÜRKIYE

Hüseyin Tolga Çağatay[*1], *Yahya Kemal Ulusoy*[2], *Hulusi Cenk Sözen*[3]

1. Vocational School of Health Services, Başkent University, Ankara, Türkiye
2. Independent researcher, Ankara, Türkiye
3. Faculty of Economics and Administrative Sciences, Başkent University, Ankara, Türkiye

*Correspondence: tcagatay@baskent.edu.tr

ABSTRACT

OBJECTIVE:

To examine whether physician workplace transitions among private hospitals in Istanbul display a systematic network structure and whether this structure varies by district-level socioeconomic development.

DESIGN:

Cross-sectional social network analysis of documented inter-hospital physician transitions using a directed, weighted network framework.

SETTING:

Private hospitals in Istanbul, Türkiye.

MAIN OUTCOME MEASURES:

Hospital-level physician mobility patterns were assessed using a three-layer framework comprising role typology based on inflow structure, flow-based community structure derived from inter-hospital transitions, and district-level socioeconomic development profiles. Network role concentration, inter-community mobility, and socioeconomic differentiation across communities were evaluated.

RESULTS:

The mobility network included 169 private hospitals and 3,834 documented inter-hospital transitions. Physician mobility was not randomly distributed but clustered around identifiable attraction centers and modular communities. Inter-community transitions accounted for 44% of total transition weight, indicating a segmented yet permeable mobility structure. Hospitals classified as centers of attraction were overrepresented in the core mobility community. Community structure also varied significantly by district socioeconomic development, with the core community concentrated in relatively more developed districts. District-level aggregation further suggested that a substantial share of transitions converged on these more advantaged locations.

CONCLUSIONS:

Physician mobility in Istanbul's private hospital sector appears to follow a structured inter-organizational pattern associated with both network position and urban socioeconomic context. These findings suggest that physician mobility can be interpreted not only as individual career movement but also as a measurable workforce governance signal.

Network-based monitoring of documented mobility flows may help managers and policymakers identify attraction pressures, retention asymmetries, and potential service continuity risks across metropolitan private hospital markets.

KEYWORDS

physician mobility; health workforce; social network analysis; directed weighted networks; network role typology; community detection; socioeconomic stratification

INTRODUCTION

Healthcare systems require not only sufficient numbers of health workers but also an adequate distribution of personnel across locations and providers. Recent global assessments indicate that workforce shortages and maldistribution remain major challenges, particularly in settings where private provision is expanding and workforce monitoring is incomplete [1,2]. In metropolitan health systems, these challenges can be intensified by job to job mobility across competing providers, especially where routine data do not consistently capture movements between employers.

In Türkiye, reforms introduced since the early 2000's have increased the scale and visibility of the private hospital sector and broadened physicians' employment options across providers [3,4]. Over time, this expansion may have strengthened competitive recruitment dynamics within the private hospital market. Yet evidence remains limited on how physicians are distributed and how they move between private hospitals within large urban settings.

This question is particularly relevant in Istanbul, Türkiye's largest and most complex healthcare market. The city hosts a dense provider landscape that includes numerous private hospitals and hospital groups operating across districts with marked socioeconomic differences. In such a setting, physician movement between private hospitals may carry managerial relevance for workforce stability, service continuity, and talent competition. However, routine data sources do not always capture these transitions in a way that supports inter-organizational analysis.

Social network analysis offers a useful framework for examining structured patterns of connection in healthcare systems. Although prior studies have often focused on patient-sharing, collaboration, and intra-organizational relationships, this perspective can also be extended to workforce mobility between hospitals [5–7]. Treating hospitals as nodes and physician workplace transitions as ties makes it possible to identify institutions that appear to attract inflows, those that function mainly as sources of outflows, and those occupying more peripheral positions within the mobility structure.

Against this background, the present study examines physician workplace transitions among private hospitals in Istanbul as an inter-hospital mobility network. It aims to describe the structure of documented intra-city physician mobility and to assess whether hospitals' network positions vary in relation to district-level socioeconomic context. The study contributes by integrating three complementary perspectives within a whole-network framework: hospital-level attraction roles, flow-based mobility communities, and district-level socioeconomic context. The study addresses the following research question: *do physician transitions among Istanbul's private hospitals display a systematic network structure, and does this structure vary across districts with different socioeconomic profiles?*

METHODS

STUDY DESIGN, SETTING, AND DATA COLLECTION

We conducted a quantitative, whole-network social network analysis (SNA) to examine inter-organizational physician mobility among private hospitals in Istanbul, Türkiye. The hospital node set represents the full population of active private hospitals operating in Istanbul during the study period (n = 169), preserving institutional-level network completeness.

Between January and May 2024, we systematically reviewed publicly available physician curricula vitae (CVs) on hospital corporate websites and extracted sequential career histories. Consecutive workplace changes were coded as directed transitions. This yielded 3,838 recorded transition entries, of which 3,834 off-diagonal inter-hospital transitions were used in the substantive analyses. To prevent duplicates, physicians were uniquely identified using name, specialty, and profile URL, and identical career sequences appearing across hospital pages were consolidated. Missingness was recorded for key fields, including district, current hospital, and prior hospital.

Because physician rosters and CV-style career histories are institution-maintained and publicly reported, coverage and timeliness likely vary across hospitals and individuals. Accordingly, the observed transitions represent publicly documented career moves rather than a complete census of all physician mobility in the underlying labor market. The analyses therefore model documented mobility flows.

ETHICS STATEMENT

This study is exempt from ethics committee approval under local regulations because it uses exclusively publicly available professional data obtained from institutional websites and involves no direct interaction with human subjects. Data were collected only from publicly accessible institutional pages without circumventing access controls or restricted areas, and were analyzed at aggregate level to minimize re-identification risk. Individual level data were de-identified at source and analyzed only in aggregate. Institutional identities were coded (hospital names are not reported), and district-level visualizations are presented to further reduce re-identification risk.

NETWORK CONSTRUCTION AND MEASURES

Physician mobility was modelled as a directed, weighted network $G = (V, E)$, where nodes **(V)** represent private hospitals and directed edges ($i \rightarrow j$) represent physician transitions between hospitals. Edge weights **(X_{ij})** denote the frequency of transitions.

Analyses were performed using UCINET and Python (NetworkX). We computed standard network connectivity measures, including in-degree (D_i^{in}) and out-degree (D_i^{out}), defined as the number of distinct origin and destination hospitals and interpreted as partner diversity, and in-strength (S_i^{in}) and out-strength (S_i^{out}), defined as the weighted volume of incoming and outgoing physician transitions. We also calculated total activity indicators, including total volume $\left(V_i = S_i^{in} + S_i^{out}\right)$ and total partner diversity ($C_i = D_i^{in} + D_i^{out}$).

To operationalize mobility, we developed an integrated framework [8–10]:

Role typology (T_i):
Hospitals were classified using explicit thresholds for inflow volume (S_in), inflow diversity (D_in), total transition volume (V_i), and total partner diversity (C_i):
T_0 (No Attraction): S_in = 0 and D_in = 0.
T_4 (Low Attraction): 1 ≤ S_in ≤ 8 and 1 ≤ D_in ≤ 8.
T_3 (Attraction Center): S_in ≥ 35 and D_in ≥ 20, with core activity defined as V_i ≥ 57 and C_i ≥ 35.
T_5 (Intermediate): all remaining hospitals.

Flow Communities (C_i):
To identify subgroups with dense internal transitions, that is, "who moves with whom," we applied the Louvain community detection algorithm to the symmetrized weighted matrix ($W_{ij} = X_{ij} + X_{ji}$) [11]. Modularity (Q) was used as the optimization criterion to select the final partition [12], and the procedure was implemented in Python (NetworkX). Symmetrization was used to detect cohesive mobility blocs driven by mutual exchange, while directionality was preserved in role typology and directional flow analyses. Robustness was assessed by repeating the Louvain solution across alternative random seeds and resolution settings and by testing an alternative symmetrization; stability was judged by consistency of C3 membership and persistence of the attraction core.

Contextual layer (SEDI)

The socioeconomic context of mobility was assessed using the Socio-Economic Development Index (SEDI) of the districts in which hospitals are located [13]. We used the Kruskal-Wallis test to compare SEDI profiles across mobility communities and chi-square analysis to test the association between role typology (T_i) and community membership (C_i).

RESULTS

OVERALL NETWORK STRUCTURE

The inter-hospital physician career-transition network for Istanbul's private sector comprised 169 nodes (private hospitals) and 2,660 unique directed edges. Network density was 0.0937, indicating that approximately one in ten possible ordered hospital pairs exhibited at least one observed transition.

Total transition volume (sum of weights) was 3834 when excluding diagonal elements ($i = j$) and 3838 when including them. Because the substantive focus is inter-organizational mobility, results are reported based on the off-diagonal transition structure; inclusion of the diagonal affects totals minimally and does not alter any structural conclusions.

Despite the presence of modular structure (communities), 44.44% of total transition volume occurred between communities (i.e., across community boundaries), indicating that inter-community mobility remains substantial even when within-community clustering is evident.

MODULAR FLOW COMMUNITIES (C_i) AND SEDI PROFILES

Community detection based on the symmetrized weighted matrix yielded four mobility communities (C1 to C4), capturing bidirectional connectivity while ignoring directionality. Across the robustness checks described above, C3 membership remained highly consistent and the C3 attraction core was stable. Table 1 summarizes community-level SEDI rank distributions (rank 1 = most developed). C3 had the most developed profile, whereas C1 and C4 were shifted toward higher ranks consistent with less developed SEDI bands.

TABLE 1. DISTRICT SOCIOECONOMIC PROFILE OF MOBILITY COMMUNITIES BASED ON SEDI RANK

Community (C)	N	Mean SEDI rank	Median [IQR]	SEDI Interpretation
C3	32	6.312	4.0 [2.0, 10.0]	More developed
C2	54	12.148	12.0 [6.75, 15.0]	Middle level
C4	16	16.250	17.0 [4.75, 23.0]	Less developed
C1	67	18.701	21.0 [11.0, 26.0]	Less developed

Note.1 SEDI ranks were computed at the district-level. Lower rank indicate higher socioeconomic development.

Note.2 SEDI differences between Communities:

Kruskal–Wallis: H(3)=33.88, p<0.001

Impact: ε^2=0.195, indicating a moderate magnitude of between-community differences.

Dunn post-hoc: C1–C3 (adj p<0.001); C1–C2 (adj p=0.001); C2–C3 (adj p=0.006); C3–C4 (adj p=0.006)

ASSOCIATION BETWEEN ATTRACTION-ROLE TYPOLOGY (T_i) AND COMMUNITY MEMBERSHIP (C_i)

Table 2 reports the association between attraction-role typology and community membership. Attraction centers (T3), defined by high inflow volume and inflow source diversity, were over-represented in the core community (C3) relative to independence expectations (O=12, E=6.06, O/E≈1.98; standardized residual=2.41). This pattern indicates that hospitals acting as major attractors of physicians tend to cluster within the core mobility community.

TABLE 2. ASSOCIATION BETWEEN ROLE TYPOLOGY AND COMMUNITY MEMBERSHIP

Panel A. *Cross tabulation (n)*					
Community (C)	**T0**	**T3**	**T4**	**T5**	**Row total**
C1	1	8	15	43	67
C2	0	7	14	33	54

C3	0	12	4	16	32
C4	0	5	7	4	16
Column total	1	32	40	96	169

Panel B. *Cells with notable deviation from independence*

Community (C)	Typology	Observed (O)	Expected (E)	O/E	Std. residual
C3	T3	12	6,06	1,98	2,41

Note. Chi Square-$\chi^2(9)=25.06$, p=0.003; Cramer's V: 0.222

INTEGRATED COMMUNITY–SEDI–TYPOLOGY PROFILE

Table 3 integrates community level socioeconomic context with role typology composition. C3 shows the most developed SEDI profile and contains the highest proportion of attraction centers, while also including a large share of intermediate hospitals, indicating that the core community combines attraction with substantial throughflow.

In contrast, C1 and C2 are dominated by intermediate hospitals and align with less developed and mid-level SEDI profiles, consistent with corridor-like segments in the mobility network. C4 aligns with a less developed SEDI profile but still contains a non-trivial share of attraction centers, suggesting heterogeneity; SEDI aligns with community structure overall, but notable exceptions remain.

Table 4 complements this view by showing how each typology distributes across communities. T3 is most concentrated in C3, whereas T4 and T5 are concentrated in C1 and C2, consistent with a core community dominated by attraction centers and corridor communities dominated by intermediate and low-attraction roles.

TABLE 3. INTEGRATED COMMUNITY SEDI AND ROLE TYPOLOGY PROFILE

Community (C)	N	SEDI median (Q25, Q75)	SEDI interpretation	Dominant typology n (%)	Secondary typology n (%)	Remaining typologies n (%)	T3 n (%)
C3	32	4,0 (2,0-10,0)	More developed	T5 16 (50.0)	T3 12 (37.5)	4 (12.5)	12 (37.5)
C2	54	12,0 (6,75-15,0)	Middle level	T5 33 (61.1)	T4 14 (25.9)	7 (13.0)	7 (13.0)
C4	16	17,0 (4,75-23,0)	Less developed	T4 7 (43.8)	T3 5 (31.3)	4 (25.0)	5 (31.3)
C1	67	21,0 (11,0-26,0)	Less developed	T5 43 (64.2)	T4 15 (22.4)	9 (13.4)	8 (11.9)

Note. SEDI ranks are at district level, rank 1 indicates the most developed. Percentages are within community, denominator equals community n. Dominant and secondary typologies are the two most frequent types within each community, remaining aggregates all other types.

TABLE 4. DISTRIBUTION OF TYPOLOGIES ACROSS COMMUNITIES, N (% WITHIN TYPOLOGY)

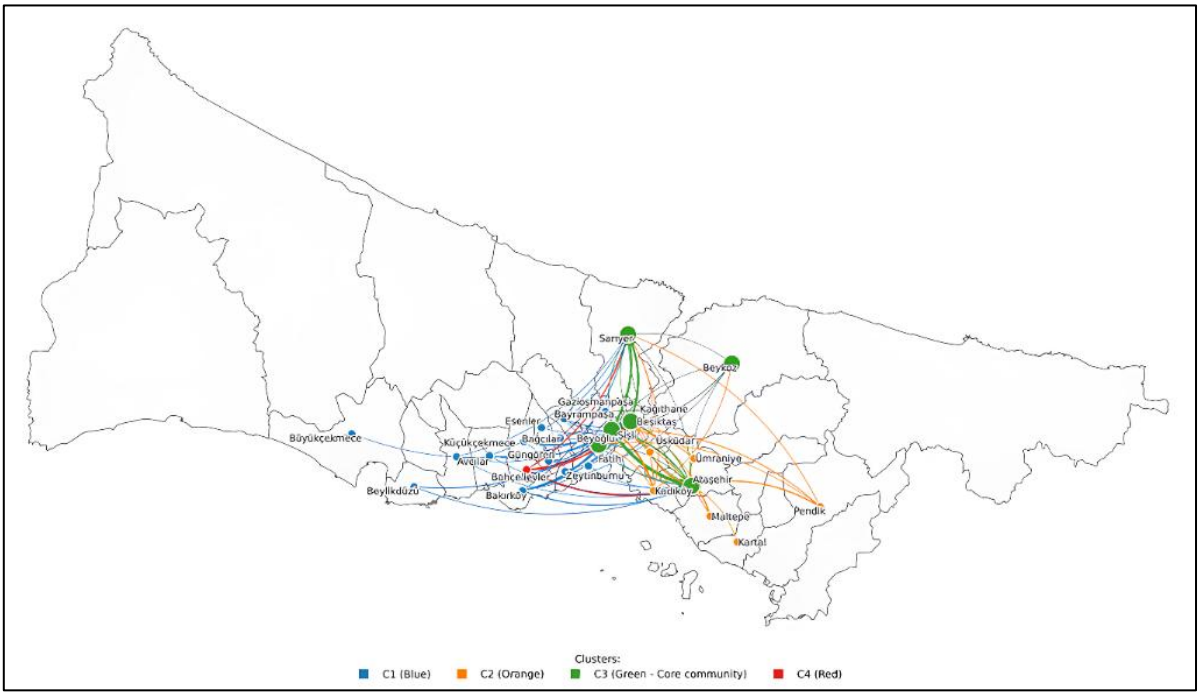
Typology (T)	N	C1 n (%)	C2 n (%)	C3 n (%)	C4 n (%)
T3 (attraction center)	32	8 (25.0)	7 (21.9)	12 (37.5)	5 (15.6)
T4 (low inflow, low diversity)	40	15 (37.5)	14 (35.0)	4 (10.0)	7 (17.5)
T5 (intermediate segment)	96	43 (44.8)	33 (34.4)	16 (16.7)	4 (4.2)

Note. Percentages are within typology, denominator equals typology n.

COMMUNITY, SEDI, AND DISTRICT-TO-DISTRICT FLOWS

Figure 1 summarizes district-level mobility by aggregating hospital-to-hospital transitions (X_ij) to districts and illustrates how the hospital-level C3 "attraction core" corresponds to concentrated inter-district mobility corridors. To improve readability, only the top 80 inter-district flows are displayed, ranked by aggregated transition volume (sum of X_ij across all hospital pairs connecting each origin–destination district pair). Links (origin → destination) represent directed inter-district flows, with line width proportional to total flow volume and color matching the origin district's dominant cluster. Nodes represent districts and are colored by their dominant cluster (C1–C4). Node size reflects district socioeconomic development based on SEDI (lower rank indicates higher development). The strongest flows tend to terminate in districts whose hospital composition is dominated by the core community (C3), consistent with the integrated hospital-level pattern.

FIGURE 1. TOP 80 INTER-DISTRICT PHYSICIAN MOBILITY FLOWS BY AGGREGATED TRANSITION VOLUME AND SEDI



DISCUSSION

STATEMENT OF PRINCIPAL FINDINGS

This study suggests that physician workplace transitions among private hospitals in Istanbul are not randomly distributed but cluster around attraction centers and modular communities. Across 169 hospitals and 3,834 inter-hospital transitions, 44% of total transition weight crossed community boundaries. The resulting pattern is consistent with a segmented yet permeable market: segmentation is reflected in community clustering, while permeability is indicated by substantial cross-community mobility.

District socioeconomic level also varied across communities. SEDI distributions differed significantly (Kruskal Wallis $p<0.001$): C3 showed a more developed profile, whereas C1 and C4 were shifted toward relatively lower profiles. This suggests that mobility patterns may be associated with both institutional dynamics and the socioeconomic context in which hospitals operate. SEDI should be interpreted as a district-level contextual measure and does not represent the socioeconomic characteristics of individual physicians or hospitals. International evidence similarly shows that physician supply can remain socioeconomically uneven even when overall numbers rise [1,14–17].

Typology analyses further showed that socioeconomic differentiation coincided with network roles. Attraction centers (T3) appeared about twice as often as expected in C3 ($O/E\approx1.98$), consistent with a possible core career-node role for hospitals in more developed districts. Prior research identifies income, working conditions, development opportunities, institutional reputation, supportive environments, and professional development as relevant to clinicians' job choices and retention [18–22]. Our results identify relational concentration rather than its causal mechanisms; explaining these patterns would require data on salary, contract terms, specialty, working hours, HR practices, and vacancies.

The high inter-community transition share indicates that physicians do not remain confined to closed mobility loops. The concentration of intermediate hospitals (T5) in C1 and C2 may reflect a possible stepping-stone role, with some organizations connecting physicians to other parts of the market. Such movement may also reflect commuting costs, network ties, and opportunity timing [23]. Network analysis makes this circulation more visible than conventional summaries [7], while prior research suggests that mobility reflects interacting organizational, professional, and contextual factors

[24,25]. This interpretation remains hypothesis-generating because the present study observes movement structure rather than the underlying decision process.

MEANING OF THE STUDY

At the Istanbul level, this structure has managerial relevance because district socioeconomic differences can coincide with disparities in service access and health outcomes [26,27]. If attraction centers cluster in more developed districts, gains in one part of the market may coincide with retention strain elsewhere. Physician mobility networks may therefore provide an intermediate monitoring layer between hospital-level HR indicators and district-level service equity, helping managers and planners identify where workforce concentration and retention pressure are emerging.

In Türkiye, the post-2002 growth of private hospital capacity and physician employment provides a plausible context for stronger inter-institutional competition [28,29]. Hospital groups, brand effects, referral relationships, and localized labor pools may interact with recruitment and retention across metropolitan providers. The contribution of this study is to make such concentration and circulation measurable through the direction and intensity of documented career transitions, without claiming to identify the underlying incentives.

The findings point to two management considerations. First, concentration around the core may create retention pressure in surrounding districts and challenge service continuity. Second, network-based monitoring can identify net attractors, net sources, and concentrated mobility corridors, providing potentially useful signals for workforce planning and targeted retention strategies [19,30].

Taken together, the findings suggest that physician mobility in Istanbul's private hospital ecosystem shows network regularity broadly aligned with district socioeconomic profiles. The framework contributes to health workforce governance by treating mobility as a measurable urban indicator of retention dynamics and inter-organizational competition.

STRENGTHS AND WEAKNESSES OF THE STUDY IN RELATION TO OTHER STUDIES

A key strength is coverage of the full set of 169 active private hospitals, combined with a whole-network, directed and weighted design and integration of hospital-level mobility structure with district-level socioeconomic context. However, CV-based data rely on publicly reported career histories, and the January to May 2024 observation window limits assessment of longer-term network evolution. Missing information on specialty, seniority, salary, contract model, and working hours also limits explanation of the mechanisms underlying observed mobility patterns and precludes causal claims.

UNANSWERED QUESTIONS AND FUTURE RESEARCH

Future research could test the socioeconomic hierarchy hypothesis more directly by combining time-series network analysis, specialty-specific breakdowns, and hospital-level indicators within multilevel designs. Robustness could also be examined using alternative network definitions, including tie weights based on repeated transitions or time intervals.

CONCLUSION

This study shows that physician mobility in Istanbul's private hospital ecosystem can be described through attraction roles, modular flow communities, and district-level socioeconomic stratification. Attraction centers (T3) combine high incoming volume with broad source diversity and strong connectivity, while community structure captures "who moves with whom." Empirically, attraction centers are over-represented in the core mobility community (C3), and this core aligns with more socioeconomically developed destination districts. These findings suggest that intra-urban mobility operates through segmented yet permeable submarkets and may reflect a network-mediated opportunity structure that complements individual-level explanations.

In health sciences, SNA has most often been used to analyse patient-sharing networks or intra-organizational collaboration. Modelling inter-organizational physician career transitions as a network of hospitals and flows offers a

complementary way to monitor attraction and retention dynamics and to detect emerging inequalities in the private sector.

From a policy and managerial perspective, concentration of attraction centers in more developed districts may increase core-periphery vulnerabilities in physician availability and service continuity. Potential responses, including structured rotations, training and clinical pathways, and targeted workforce incentives, may help reduce disparities and support a more balanced workforce distribution.

References

1. Boniol M, Kunjumen T, Nair TS, Siyam A, Campbell J, Diallo K. The global health workforce stock and distribution in 2020 and 2030: a threat to equity and "universal" health coverage? BMJ Glob Heal. 2022 Jun;7(6):1–8.
2. World Health Organization . Governance of dual practice in the public and private health sectors [Internet]. Geneva; 2024. Available from: https://www.who.int/publications/i/item/9789240096615
3. OECD. OECD Reviews of Health Care Quality: Turkey 2014: Raising Standards. OECD Publishing; 2014. 1–139 p.
4. World Bank. Turkey: Transforming Health Care for All [Internet]. 2018. Available from: https://www.worldbank.org/en/about/partners/brief/turkey-transforming-health-care-for-all
5. Barnett ML, Christakis NA, O'Malley J, Onnela JP, Keating NL, Landon BE. Physician Patient-sharing Networks and the Cost and Intensity of Care in US Hospitals. Med Care. 2012;50(2):152–60.
6. Landon BE, Keating NL, Barnett ML, Onnela JP, Paul S, O'Malley AJ, et al. Variation in Patient-Sharing Networks of Physicians Across the United States. JAMA. 2012 Jul 18;308(3):265–73.
7. Francis T, Davidson M, Senese L, Jeffs L, Yousefi-Nooraie R, Ouimet M, et al. Exploring the use of social network analysis methods in process improvement within healthcare organizations: a scoping review. BMC Health Serv Res. 2024;24(1030):1–18.
8. Barrat A, Barthélemy M, Pastor-Satorras R, Vespignani A. The architecture of complex weighted networks. Proc Natl Acad Sci. 2004 Mar 16;101(11):3747–52.
9. Guimerà R, Amaral LAN. Cartography of complex networks: modules and universal roles. J Stat Mech Theory Exp. 2005;P02001:1–13.
10. Borgatti SP, Everett MG. Models of core/periphery structures. Soc Networks. 2000;21(4):375–95.
11. Blondel VD, Guillaume JL, Lambiotte R, Lefebvre E. Fast unfolding of communities in large networks. J Stat Mech Theory Exp [Internet]. 2008;2008(10):P10008. Available from: https://doi.org/10.1088/1742-5468/2008/10/P10008
12. Newman MEJ. Modularity and community structure in networks. Proc Natl Acad Sci. 2006 Jun 6;103(23):8577–82.
13. Acar S, Şahin Cinoglu D, Karagöz T, Kayğısız G, Meydan MC, Işık M. Socio-Economic Development Index of Districts District SEDI-2022 [Internet]. Ankara; 2023. Available from: https://www.sanayi.gov.tr/merkez-birimi/b94224510b7b/sege/ilce-sege-raporlari
14. McIsaac M, Buchan J, Abu-Agla A, Kawar R, Campbell J. Global strategy on human resources for health: Workforce 2030—A five-year check-in. Hum Resour Health. 2024;22(68):1–3.
15. Wu J. Measuring inequalities in the demographical and geographical distribution of physicians in China: Generalist versus specialist. Int J Health Plann Manage. 2018 Oct;33(4):860–79.
16. Nawaz R, Zhou Z, Khalid N, Cao D, Liu G, Ren Y, et al. Income-related inequality in distribution of health human resource among districts of Pakistan. BMC Health Serv Res. 2021 Feb;21(142):1–15.
17. Cacciatore S, Mao S, Nuñez MV, Massaro C, Spadafora L, Bernardi M, et al. Urban health inequities and healthy longevity: Traditional and emerging risk factors across the cities and policy implications. Aging Clin Exp Res. 2025 May;37(143):1–16.
18. Kabbash I, El-Sallamy R, Zayed H, Alkhyate I, Omar A, Abdo S. The brain drain: Why medical students and young physicians want to leave Egypt. East Mediterr Heal J. 2021 Dec;27(11):1102–8.
19. World Health Organization [WHO] Regional Office for the Eastern Mediterranean. Health workforce in the Eastern Mediterranean Region: From COVID-19 lessons to actions. Vol. EM/RC70. 2023 May.
20. Chen D, Zhang Z, Ma S, Yin J, Zhao L, Jiang L. Job preferences and trade-offs in rural health workforce retention: a discrete choice experiment from western China. Health Policy Plan. 2026 Feb 1;41(2):139–49.

21. Mandeville KL, Lagarde M, Hanson K. The use of discrete choice experiments to inform health workforce policy: a systematic review. BMC Health Serv Res [Internet]. 2014;14(1):367. Available from: https://doi.org/10.1186/1472-6963-14-367
22. Teoh KRH, Hassard J, Cox T. Doctors' working conditions, wellbeing and hospital quality of care: A multilevel analysis. Saf Sci. 2021;135(105115):1–10.
23. Saatchi AG, Pallotti F, Sullivan P. Network approaches and interventions in healthcare settings: A systematic scoping review. PLoS One. 2023 Feb 23;18(2):1–40.
24. Raman SSS, McDonnell A, Beck M. Hospital doctor turnover and retention: A systematic review and new research pathway. J Health Organ Manag. 2024;38(9):45–71.
25. Bobak CA, Mohan D, Murphy MA, Barnato AE, O'Malley AJ. Constructing within and between hospital physician social networks for modeling physician research participation. BMC Med Res Methodol. 2023;23(253):1–12.
26. Dogru AO, Kahraman A, Seker DZ, Sivri N. GIS based evaluation of social determinants of children's health in Turkey: Case study of Istanbul. Environ Res. 2019;179(108753):1–10.
27. McMaughan DJ, Oloruntoba O, Smith ML. Socioeconomic Status and Access to Healthcare: Interrelated Drivers for Healthy Aging. Front Public Heal. 2020;8(231):1–9.
28. Ünal E, Yılmaz S. Healthcare sector dynamics in Turkey (2002-2022): Trends, breakpoints, and policy implications (privatization in the hospital sector). Healthcare. 2025 Mar;13(622):1–24.
29. World Health Organization [WHO] Regional Office for the Eastern Mediterranean. Understanding the private health sector in the Eastern Mediterranean Region [Internet]. Cairo, Egypt; 2021. Available from: https://www.emro.who.int/images/stories/health-topics/uhc/understanding_phs_in_emr.pdf
30. World Health Organization [WHO]. Health workforce [Internet]. [cited 2025 Nov 28]. Available from: https://www.who.int/health-topics/health-workforce?utm_#tab=tab_1