Beyond Market Concentration: Using Social Network Analysis to Explore Complex Ownership Structures of Nursing Homes

KEY POINTS

- A CMS rule finalized on November 17, 2023, enhances ownership transparency and policy by requiring detailed disclosures about the ownership and managerial control of nursing homes.
- Publicly available CMS ownership files offer essential information for mapping nursing home structures, assuming the data is accurately reported. However, in some instances, challenges persist due to incomplete data and unclear parent/subsidiary relationships.
- Social Network Analysis (SNA) improved our understanding of shared ownership relationships and provided insights into business and ownership structures.
- Further research is needed to investigate how Social Network Analysis (SNA) can enhance traditional measures of market competition and concentration, such as the Herfindahl-Hirschman Index (HHI), by incorporating shared and cross-market ownership that HHI typically overlooks.

BACKGROUND

The quality of a nursing home facility is influenced by the corporate structure in which it is embedded. Empirical research has linked private equity (PE) ownership, for example, with increased emergency department use, increased hospitalization, greater Medicare costs[1], lower staffing levels, and more quality and safety deficiencies in nursing homes.[2] During the Covid-19 pandemic, PE-owned nursing facilities were less likely to possess adequate supplies of personal protective equipment.[3] A study of merger and acquisition activity among nursing homes found that firms favor lower quality facilities for acquisition, and do not drive quality improvements in the period after acquisition.[4] A more recent study using patient-level Medicare data finds that PE ownership is associated with an 11% increase in mortality in US nursing homes, accompanied by declining measures of patient well-being, nurse staffing, and compliance with care standards. The study attributed these declines to PE's strategic reallocation of operator expenditures away from direct patient-care provision, and toward the payment of management fees, real-estate leasebacks, and interest on debt.[5]

This link between corporate structure and facility quality has led consumers and regulators to call for increased public disclosure of the details of nursing home ownership.[6] In recent years, CMS has undertaken a series of data releases aimed at improving ownership transparency. In April 2022, CMS released the Change of Ownership file, which includes mergers, acquisitions, and changes of ownership beginning in 2016.[7] In September 2022, CMS released common ownership data for all Medicare certified nursing homes.[8] In 2023, in response to a GAO recommendation calling for the incorporation of common ownership data into the consumer-facing Care Compare tool[9], CMS released Care Compare facility measures of quality, staffing, inspection, and other performance indicators aggregated to the level of "affiliated entity".[10] CMS defined affiliated entities as "groups of nursing homes that share common individual or organizational owners, officers, or entities with operational/managerial control"[11], using methods drawn from social network analysis to identify meaningful clusters of facilities.[12]

While acknowledging the strength of prior efforts to bring ownership transparency to the nursing home industry, researchers have identified limitations inherent to the structure of this data. For example, a recent investigation finds discrepancies between CMS ownership data and proprietary versions of the same information, and notes that "the data also cannot be used to identify the hierarchy and structure of ownership levels (for example, an individual might own a percentage of a company that then owns a share of a provider) or identify the parent owner".[13]

Understanding ownership structure and relationships is relevant not only to nursing home quality, but also aides in our understanding of the broader market dynamics in which nursing home care is delivered--particularly with regard to market concentration and competition. Merger guidelines jointly issued in 2023 by FTC and DOJ specified three harms to competition associated with complex webs of common and partial ownership: a partial owner in multiple firms may have an incentive to favor coordination between them; cross-ownership may reduce the incentive for competition between firms; and partial acquisition may allow access to competitive information held by the acquired firm.[14]

CMS-855A and Transparency Policy

Effective January 16, 2024, the new CMS rule titled _Medicare and Medicaid Programs; Disclosures of Ownership and Additional Disclosable Parties Information for Skilled Nursing Facilities and Nursing Facilities; Medicare Providers' and Suppliers' Disclosure of Private Equity Companies and Real Estate Investment Trusts_[15] requires the disclosure of certain ownership, managerial, and other pertinent information for Medicare skilled nursing facilities (SNFs) and Medicaid nursing facilities. This rule also finalizes definitions of PE companies and real estate investment trusts for Medicare provider enrollment purposes and includes revisions to the CMS-855A form.[16] The CMS-855A form, also known as the Medicare Enrollment Application for Institutional Providers, enhances ownership transparency and policy by requiring detailed disclosures about the ownership and managerial control of nursing homes. The goal is to provide greater oversight, ensuring that families and caretakers have access to comprehensive information about who owns and manages these facilities. This increased transparency aims to improve the quality and accountability of care in nursing homes.[17]

In this brief we analyzed CMS ownership data to map and explore nursing home ownership. These files provided detailed information on direct and indirect owners, allowing us to explore and visualize complex ownership structures. Social Network Analysis (SNA) further helped us examine shared ownerships, compare nursing home chain organizations, and highlight differences in business structures. We also calculated the Herfindahl-Hirschman Index (HHI) to analyze market concentration and conducted SNA to compare network density between markets, offering insights into shared ownership dynamics.

DATA AND METHODS

Data

We used the SNF Enrollment (n= 14,529) and SNF All Owners files (n=151,526) (CMS ownership files)[i], to obtain detailed information about nursing home ownership and its chain affiliation. The SNF enrollment data is at the facility level, while all owners' data encompass individual owners of SNFs. These two files were merged as one-to-many, providing a view of ownership of all 14,529 nursing homes. These files primarily originate from the Provider Enrollment, Chain, and Ownership System (PECOS)[ii]. Before receiving payments from Medicare,

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[i] See https://data.cms.gov/provider-characteristics/hospitals-and-other-facilities/skilled-nursing-facility-all-owners.
[ii] See https://pecos.cms.hhs.gov/pecos/login.do#headingLv1.

providers are required to register through PECOS by completing the CMS- 855A application[iii]. The CMS ownership files, a publicly available subset of PECOS, contain information on individuals and organizations that hold 5% or more ownership interests in the provider.

We also utilized the October 2024 NH Provider Information file (n = 14,814) to gather details about nursing homes. This includes the CMS Certification Number (CCN), the number of certified beds, quality ratings, and facility location information (address, city, state, zip code). The NH provider info files are sourced from the Nursing Home Care Compare and the Provider Data Catalog[iv] available from CMS' Care Compare website[v].

Methods

First, we link Enrollment and All Owners files via Enrollment ID to understand the distribution of nursing home owners. We also linked the NH provider info file using CCN to examine the distribution of ownership relative to quality measures. We calculated the mean and standard deviation of owners for each quality rating to provide an overview of the distribution and variability of owners by quality rating. This analysis allowed us to examine nursing home quality by considering the overall distribution of owners, as well as independently owned and chain-owned facilities.

To map the ownership structure of nursing homes, we utilized CMS ownership files, which provided detailed information on both direct and indirect owners. This data included additional owner information, allowing us to differentiate between individual (person) and organizational owners. Additionally, we captured each owner's percent share in the facilities. This data enabled us to construct a nuanced map of ownership, highlighting intricate ownership connections and hierarchies. This approach illustrates the extent and complexity of ownership structures, thereby offering insights into a nursing home's ownership structure.

We also used social network analysis (SNA) to further explore ownership. This method allowed us to visualize and analyze the multifaceted relationships between owners and distinguishing ownership between direct and indirect entities. Additionally, we used SNA to compare two similar nursing home chain organizations to show differences in business structures. This comparison highlighted variations in ownership patterns, levels of interconnectedness, and the distribution of ownership shares, providing deeper insights into how different business strategies are reflected in ownership configurations. Despite the strengths of SNA in representing the connections within ownership networks, our analysis met limitations due to the lack of detailed information on levels of ownership in the data. Consequently, while we could map the overall connections among shared owners, we were not fully confident in accurately representing the hierarchical nature of ownership using dendrograms.

Lastly, to analyze market concentration and potential effects of shared ownerships, we calculated the Herfindahl-Hirschman Index (HHI) using Hospital Referral Regions (HRR)[vi] as geographical units. HHI measures market competitiveness by summing the square of each market participant's percentage of market share, yielding a measure ranging between 0 (perfect competition) and 10,000 (perfect monopoly).[18] This provided insights into the level of competition and market concentration. We focused on two similar markets with a comparable number of beds and number of nursing homes, using NH provider info files. We also compared the HHIs to ensure similar levels of market concentration. We then used SNA to compare network density and modularity between the two markets. This allowed us to assess the interconnectedness and complexity of

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iii See https://www.cms.gov/medicare/cms-forms/cms-forms/downloads/cms855a.pdf.
iv See https://data.cms.gov/provider-data/archived-data/nursing-homes.
v See https://www.medicare.gov/care-compare/.
vi See https://data.dartmouthatlas.org/supplemental/#crosswalks.

ownership networks to further illustrate the distinctions in business structures and ownership dynamics between markets.

Social Network Analysis

Social Network Analysis (SNA) is a methodological approach used to examine social structures using networks and graph theory. It involves mapping and analyzing relationships between individuals, groups, or organizations. In SNA, entities are represented as "nodes," and the connections between them are referred to as "edges." We use a bipartite network, a specific graph used in network analysis where we categorized nodes into two distinct sets (owners [identified by Owner Associate ID] and nursing homes [identified by CCN]) that are connected via edges (ownership interests).

In our analysis, we employed Social Network Analysis (SNA) statistics, specifically edge density and modularity, to gain insights into the network structure. Edge density measures the proportion of actual connections to possible connections within the network, providing an indication of how interconnected the network is. A higher edge density suggests a more tightly knit ownership network. Modularity assesses the degree to which the network can be divided into distinct clusters or communities. Higher modularity values indicate a clearer separation of the network into well-defined clusters, where nodes within each cluster are more densely connected to each other than to nodes in other clusters. By calculating these metrics, we were able to quantify the interconnectedness and community structure of the ownership network, enhancing our understanding of the complex owner relationships within chain organizations and markets.

LIMITATIONS

There are several limitations to our analysis that should be acknowledged. First, the Provider Enrollment, Chain, and Ownership System (PECOS) data is self-reported. This concern is mitigated, however, by prior validation efforts, which indicate that more than 90 percent of investor entities identified in PECOS match those reported in other sources.[18] Second, we faced challenges in mapping the ownership structure due to the extent of missing data. In some instances, it was necessary to infer and make assumptions about the hierarchical structure of ownership, which introduces potential inaccuracies. (See the 2023 ASPE Data Point publication *Ownership of Hospitals* for a proposed methodology for attributing "ultimate" ownership—i.e. "an entity that has a subsidiary … but which is not a subsidiary of another owner"—in existing PECOS data.[19]) Third, the Care Compare merging process resulted in 285 observations (i.e., 0.02%) being dropped. These limitations highlight the need for cautious interpretation of our findings and suggest areas for potential improvement in data collection and validation processes.

RESULTS

Table 1. Distribution of Owners

Quality	Overall		Affiliation			
			Independent		*Chain*	
	Median # of owners	Standard Deviation	Median # of owners	Standard Deviation	Median # of owners	Standard Deviation
1	4	3.7	2	2.4	4	3.9
2	3	3.7	2	2.7	4	3.8
3	3	3.5	2	2.2	4	3.8
4	3	3.6	2	2.5	3	3.8
5	2	3.4	1	2.4	3	3.7

Data used: SNF Enrollments (n=14,524 distinct enrollment IDs), SNF all owners (n=45,659 distinct owners), care compare (n=14,518 distinct CCNs). In this analysis, owners include: 5% or more ownership interest, direct and indirect ownership interest, mortgage and security interests, and partnerships. We did not include any individuals or organizations who were defined under having managerial or operational control only. All data files were accessed in October 2024.

The following table summarizes the median number of owners and the standard deviation for different quality levels, distinguishing between independent and chain-affiliated facilities. In our analysis, we observed that as the quality level of nursing facilities increased, the median number of owners generally decreased. However, the differences in medians were small, especially when considering the standard deviations. This suggests that the variance in the data is large, making it unclear whether these differences are clinically meaningful. Interestingly, the lower median number of owners for independent nursing homes compared to chain-affiliated facilities was expected.
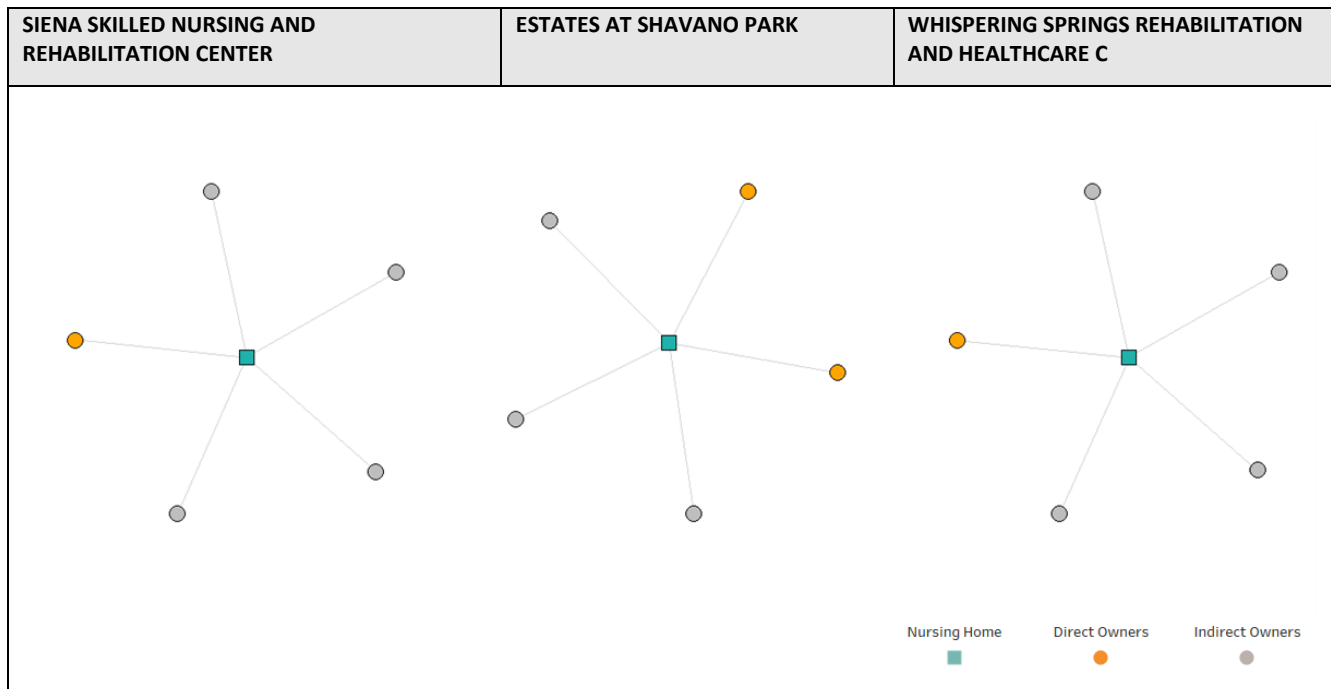
Figure 1. Ownership Structures

SIENA SKILLED NURSING AND REHABILITATION CENTER			ESTATES AT SHAVANO PARK			WHISPERING SPRINGS REHABILITATION AND HEALTHCARE C		
Owners	Person or Organization	Share (%)	Owners	Person or Organization	Share (%)	Owners	Person or Organization	Share (%)
Direct	Organization	100.0%	Direct	Organization	66.7%	Direct	Organization	100%
Indirect	Person	9.2%	Direct	Organization	33.3%	Indirect	Organization	100%
Indirect	Person	78.1%	Indirect	Person	66.7%	Indirect	Person	61%
Indirect	Person	12.7%	Indirect	Person	16.7%	Indirect	Person	35%
Security Interest	Organization		Indirect	Person	16.7%	Indirect	Organization	100%

Data used: SNF Enrollments (n=14,524 distinct enrollment IDs), SNF all owners (n=45,659 distinct owners), care compare (n=14,518 distinct CCNs). In this analysis, owners include: 5% or more ownership interest, direct and indirect ownership interest, mortgage and security interests, and partnerships. We did not include any individuals or organizations who were only defined under having managerial or operational control only. All data files were accessed in October 2024.Three nursing home facilities were used in this example: Siena Skilled Nursing and Rehabilitation Center (CCN 555744, 107 beds), Estates at Shavano Park (CCN 745001, 112 beds), and Whispering Springs Rehabilitation and Healthcare C (CCN 675373, 100 beds). Facilities in this analysis were randomly chosen.

Figure 1 presents three examples of how ownership structures can be mapped using ownership data. When ownership information is correctly reported, these examples illustrate how ownership structure can be mapped hierarchically. However, in Example 3, the relationship between Org 2 and Org 3 remains unclear, leaving us unsure which one is a subsidiary of the other. Our analysis also revealed several facilities where ownership structures could not be completely mapped (see Appendix B). We encountered difficulties linking indirect owners with direct owner holding companies and, in some instances, incomplete data and unclear parent/subsidiary relationships. Appendix B highlights some of these challenges, though it is not an exhaustive illustration of the issues encountered with ownership data.

Figure 2. Provider Ownership Structure

SIENA SKILLED NURSING AND REHABILITATION CENTER	ESTATES AT SHAVANO PARK	WHISPERING SPRINGS REHABILITATION AND HEALTHCARE C

Data used: SNF Enrollments (n=14,524 distinct enrollment IDs), SNF all owners (n=45,659 distinct owners), care compare (n=14,518 distinct CCNs). In this analysis, owners include: 5% or more ownership interest, direct and indirect ownership interest, mortgage and security interests, and partnerships. We did not include any individuals or organizations who were only defined under having managerial or operational control only. All data files were accessed in October 2024.Three nursing home facilities were used in this example: Siena Skilled Nursing and Rehabilitation Center (CCN 555744, 107 beds), Estates at Shavano Park (CCN 745001, 112 beds), and Whispering Springs Rehabilitation and Healthcare C (CCN 675373, 100 beds). Facilities in this analysis were randomly chosen.

The results in Figures 1 and 2 illustrate that facilities are owned by multiple owners, with ownership structures comprising both direct and indirect owners. Using the same three nursing home examples from figure 1, we plotted the shared ownership utilizing Social Network Analysis (SNA). Figure 2 depicts all three nursing homes represented by square nodes, connected by direct (orange) and indirect (gray) owners. In instances where owners are both direct and indirect and are reported twice in the data, SNA represents these owners at the lowest level of ownership (i.e., direct ownership interest). Although SNA effectively connects nursing home ownership interests through edges, a limitation of our analysis is the inability to plot ownership as a hierarchical structure.
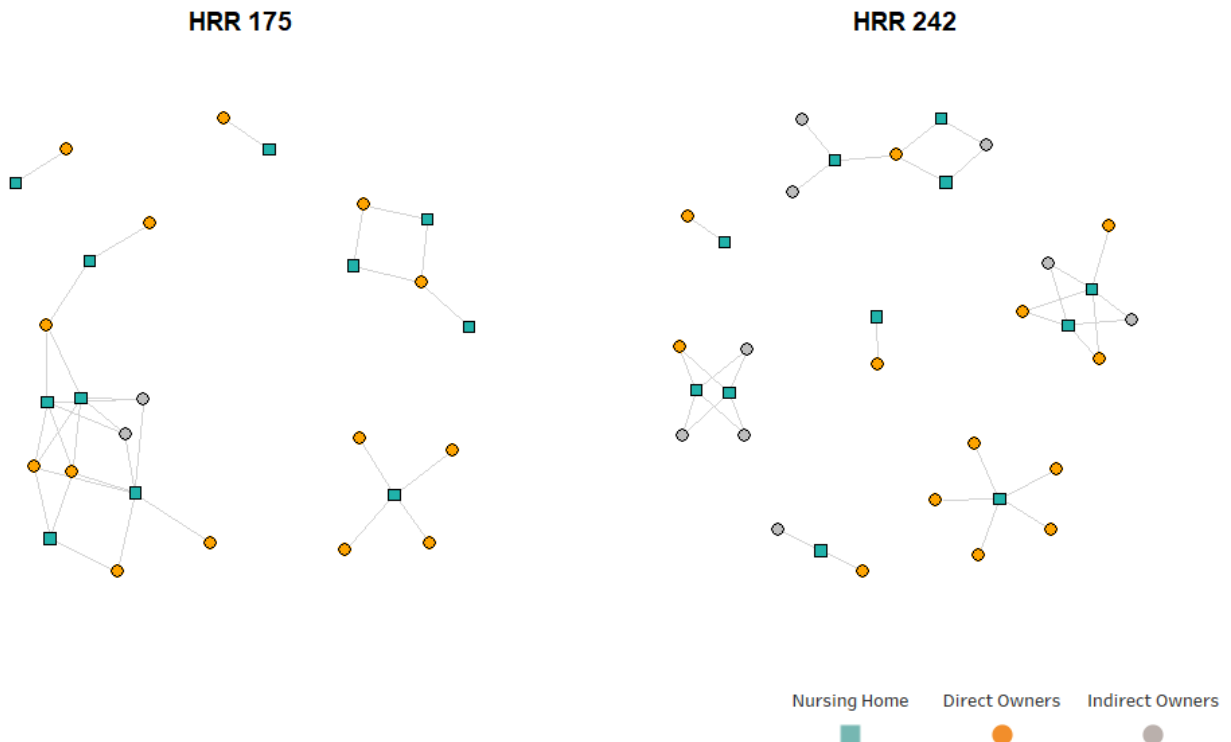
Figure 3. Shared Ownership and Chain Organizations

Chain 1

Chain 2

Nursing Home ■   Direct Owners ●   Indirect Owners ●

Data used: SNF Enrollments (n=14,524 distinct enrollment IDs), SNF all owners (n=45,659 distinct owners), care compare (n=14,518 distinct CCNs). In this analysis, owners include: 5% or more ownership interest, direct and indirect ownership interest, mortgage and security interests, and partnerships. We did not include any individuals and organizations who are only defined under having managerial or operational control only. All data files were accessed in October 2024. Chain 1: Benedictine Health System (density 0.09116809, modularity 0.2944336), 1,811 beds, 23 SNFs in 3 states (MN:13 SNFs, MO: 2, WI 2); Chain 2: Trinity Healthcare (density 0.05413105, modularity 0.8310249), 1,588 beds, 16 SNFs in 1 state (TX). Chains used in this analysis were randomly chosen.

Modularity measures the strength of the division of a network into modules (groups, clusters, or communities), while density measures the overall level of connections between the entities in the network. In our analysis, Chain 1 has one large, interconnected network where all SNFs are linked together, resulting in very high density and low modularity. On the other hand, Chain 2 exhibits a more separate and clustered network with distinct groups of interconnected SNFs, leading to very low density and high modularity. Chain 1 shows a densely interconnected organizational structure, consisting of a single large network with 23 nursing homes and 4 direct owners. Conversely, Chain 2's network structure appears more fragmented, comprising 8 smaller cluster groupings with a total of 16 nursing homes and 11 owners. Despite all these nursing homes being affiliated with the same chain organization, Chain 2's ownership structure suggests that each component is owned independently, with no shared ownership across its different parts. This stark contrast between the two chains underscores the variation in ownership dynamics of chain organizations.

Figure 4. Shared Ownership and Market Structures

HRR 175   **HRR 242**

Nursing Home   Direct Owners   Indirect Owners

Data used: SNF Enrollments (n=14,524 distinct enrollment IDs), SNF all owners (n=45659 distinct owners), care compare (n=14,518 distinct CCNs). In this analysis owners include: 5% or more ownership interest, direct and indirect ownership interest, mortgage and security interests, and partnerships. We did not include any individuals and organizations who are only defined under having managerial or operational control only. All data files were accessed in October 2024. HRR 175: Bloomington, IL, 11 SNFs, (HHI = 1,527, density 0.09116809, modularity 0.5532227). HRR 242: Muskegon, MI, 11 SNFs, (HHI = 1,553, density = 0.0625, modularity = 0.7933884).

Figure 4 shows two markets with similar HHI. However, our analysis finds that HRR 175 has higher network density and lower modularity while HRR 242 has lower network density and higher modularity. In HRR 175, there are five cluster groupings of owners, with two shared owner groups collectively owning more than 70% of the market share (eight out of 11 nursing homes). In contrast, HRR 242 has seven groups of owners, with three shared owner groups owning more than 60% of the market share (seven out of 11 nursing homes). Our findings suggest that HHI may not be capturing all relevant dimensions of concentration. While these markets have similar HHI, social network statistics indicate that shared ownership is more interconnected in HRR 175.

DISCUSSION

Our analysis reveals that as the quality level of nursing facilities increased, the median number of owners generally decreased. As expected, we also observe that the median number of independent owners is lower compared to chain owners. However, the differences in medians were small, especially when considering the standard deviations. This suggests that the variance in the data is large, making it unclear whether these differences are clinically meaningful. We also find that the CMS ownership files provided critical information in mapping nursing home structures, provided the data is accurately reported, though missing data and unclear parent/subsidiary relationships remain a challenge. Ownership structures are inherently complex, and there were instances where reported ownership was not clearly transparent (Appendix A), complicating our analysis. Social Network Analysis (SNA) however enhanced our understanding of shared owner relationships and offered insights into business and ownership structures at various levels, including chain organization and market levels. Additionally, our examination of market concentration highlighted that even with similar market

concentration, network structures can differ. Our findings suggest that HHI may not be capturing all relevant dimensions of concentration. Social Network Analysis (SNA) provides unique insights into market concentration and competition by evaluating the relationships and structures within networks of ownership and control. Additionally, utilizing SNA-specific measures can offer deeper insights into competitive dynamics within markets, beyond what traditional measures like HHI offer.

It is also important to recognize that owners can hold interests in both independent and chain-owned nursing homes. For instance, an owner may partly or wholly own few independent nursing homes while also having ownership stakes in several additional nursing homes affiliated with various chain organizations. This overlapping ownership may have implications for market competition, but more research is needed to fully understand its potential effects and assess the broader impact on markets. Additionally, further research is required to explore how Social Network Analysis (SNA) can enhance traditional measures of market competition and concentration, such as the Herfindahl-Hirschman Index (HHI), by incorporating shared ownership and cross-market ownership that HHI typically overlooks.

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APPENDIX

Appendix A: Data and Definitions

Ownership: Ownership of a provider can involve multiple individuals or entities, each identified by its Tax Identification Number. Direct owners can themselves have owners, known as indirect owners, resulting in several ownership layers. The top-level owner is referred to as the "ultimate parent," while entities below this level are considered subsidiaries.

Provider: Any entity that has submitted an enrollment application through the Medicare Administrative Contractors (MACs) to bill Medicare for services. This includes institutional providers such as hospitals and Skilled Nursing Facilities (SNFs), identified by their Tax Identification Number.

CMS Certification Number (CCN): a 6-digit Medicare certification number assigned to a facility by CMS.

Enrollment ID: a unique 15-digit alphanumeric identifier assigned to each new provider enrollment application. It links all enrollment-level information in PECOS, such as enrollment type and provider specialty. Individual (Person) Enrollment IDs start with an 'I', while organization Enrollment IDs start with an 'O'.

Owner Associate ID: The ID assigned to each owner which identifies ownership or managerial control interest in the nursing home Facility enrollment.

Direct ownership: refers to entities with an immediate ownership stake in a provider, such as when a company wholly or partially owns a nursing home. Indirect ownership occurs when an entity that directly owns a provider is itself owned by another organization or individual, often due to holding companies or parent-subsidiary relationships. While direct owners have actual ownership interests in the provider, indirect owners hold interests in the owning organization.

Indirect ownership: Any ownership interest in an entity that has an ownership interest in the nursing home. Many organizations that directly own a provider are themselves wholly or partly owned by other organizations (or even individuals). This is often the result of the use of holding companies and parent/subsidiary relationships. Such organizations and individuals are considered to be "indirect" owners of the provider.

Affiliation Entity Name or Chain Name: Each SNF that are affiliated with a chain organization are assigned to an affiliated entity name by CMS via network analysis.

Appendix B: Example of SNF where we could not fully map structure.

QUABBIN VALLEY HEALTHCARE			NELLA'S AT AUTUMN LAKE HEALTHCARE		
Owners	Person/Organization	Share (%)	Owners	Person/Organization	Share (%)
Direct Owner	Organization	20.0%	Direct Owner	Organization	100%
Direct Owner	Organization	20.0%	Indirect Owner	Organization	
Direct Owner	Organization	60.0%	Indirect Owner	Organization	
Indirect Owner	Person	20.0%	Indirect Owner	Organization	
Indirect Owner	Person	20.0%	Greater Mortgage Interest	Organization	
Indirect Owner	Person	20.0%	Greater Security Interest	Organization	
Indirect Owner	Person	20.0%			
Indirect Owner	Person	20.0%			

Data used: SNF Enrollments (n=14,524 distinct enrollment IDs), SNF all owners (n=45659 distinct owners). In this analysis owners include: 5% or more ownership interest, direct and indirect ownership interest, mortgage and security interests, and partnerships. We did not include any individuals and organizations who are only defined under having managerial or operational control. All data files were accessed in October 2024. Quabbin Valley Healthcare (CCN 225296, 142 beds) and Nella's at Autumn Lake Healthcare (CCN 515196, 100 beds) were used in this example.

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