Quality-of-Care Outcomes in Vertical Relationships Between Physicians and Health Systems

Katherine M. Ianni, BA; Anna D. Sinaiko, PhD; Vilisa E. Curto, PhD; Mark Soto, MA; Meredith B. Rosenthal, PhD

Abstract

**IMPORTANCE** Vertical relationships (ownership, affiliations, joint contracting) between physicians and health systems are increasing in the US. Many proponents of vertical relationships argue that increased spending associated with consolidation is accompanied by improvements in quality of care.

**OBJECTIVE** To assess the association of vertical relationships between primary care physicians (PCPs) and large health systems and quality of care.

**DESIGN, SETTING, AND PARTICIPANTS** This stacked difference-in-differences study compared outcomes for patients whose attributed PCP entered a vertical relationship with a large system in 2015 or 2017 to patients whose PCP was either never or always in a vertical relationship with a large system from 2013 to 2017. Models account for differences between PCPs, patient characteristics, market concentration, and secular trends. Data were derived from the 2013 to 2017 Massachusetts All-Payer Claims Database. The study population included commercially insured individuals attributed to a PCP in the Massachusetts Health Quality Partners’ Massachusetts Provider Database in 2013, 2015, or 2017. Analyses were conducted between January 2021 and January 2024.

**EXPOSURE** PCPs attributed to patients in the study entering a vertical relationship with a large health system in 2015 or 2017.

**MAIN OUTCOMES AND MEASURES** Low-value care utilization, posthospitalization follow-up, utilization among patients with ambulatory care-sensitive conditions, practice site visit fragmentation, and timeliness of specialty care.

**RESULTS** The study population included 4,603,172 patient-year observations from 2013 to 2017. Among all patients in the study, 53.5% were female, 35.3% had any chronic condition, and the mean (SD) age was 38.9 (20.3) years. There was no association between vertical relationships and low-value care or ambulatory care-sensitive conditions utilization. A patient’s PCP entering a vertical relationship had no association with the probability of follow-up within 90 days of cancer diagnosis with any oncologist but was associated with a 7.34–percentage point (pp) (95% CI, 2.28-12.40; \(P = .01\)) increase in the probability of follow-up with an oncologist in the health system. Vertical relationships were associated with increased posthospitalization follow-up with a physician in the health system by 7.51 pp (95% CI, 2.96-12.06; \(P = .001\)) in the 2015 subgroup. PCP-health system vertical relationships were associated with a significant decrease in fragmentation of practice site visits of −1.05 pp (95% CI, −2.05 to 0.05; \(P = .04\)).

**CONCLUSIONS AND RELEVANCE** In this study, vertical relationships between PCPs and large health systems were associated with patient steering and changes in care delivery processes, but not necessarily improvements in patient outcomes.
Introduction

The integration of physicians with hospitals and health systems has increased over the last decade. The share of physicians working in private practice fell from 60% to 47% between 2012 and 2022 while the share of physicians directly employed by or contracted with hospitals or health systems increased from 29% to 41%. The predominant concern with consolidation is that physician-hospital or physician–health system ownership and affiliations (which we term vertical relationships) result in higher prices because physicians gain negotiating power through their acquirers. Several empirical studies show that vertical relationships increase spending, largely through higher prices.

Physician–health system integration could also affect quality of care, particularly when the relationship is formed between primary care physicians (PCPs) and systems. Vertical relationships between PCPs and systems could improve access through an expanded network of system resources, hospitals, and specialists and reduce redundant or low-value care through better coordination or information sharing. Increased access to specialists is especially important for chronic disease management and preventing admissions or emergency department (ED) use for conditions that can be effectively managed through outpatient care, sometimes referred to as ambulatory care–sensitive conditions (ACSCs). System connections across clinicians may improve timeliness of posthospitalization follow-up or specialist visits after an initial diagnosis. Finally, studies show that fragmentation of health care is associated with worse quality of care. Vertical relationships may reduce fragmentation if they provide PCPs with integrated electronic health records or other tools that facilitate tracking visits, scheduling follow-ups, and directing patients back to the same physician or physicians in a practice.

Studies have begun to examine the claim that vertical integration improves quality of care, finding no effect of vertical integration on patient outcomes such as readmissions or risk-adjusted mortality. One analysis found that multispecialty clinic–health system integration led to a small increase in cancer screening rates and appropriate ED use, while other studies have found positive associations between physician-hospital integration and unnecessarily intensive service utilization. Further, physician-hospital integration is associated with implementation of health information technology and care management processes. One gap in the literature is the effect of vertical relationships among PCPs on measures that could be improved due to PCP access to expanded resources, including those related to care timeliness, continuity, low-value service use, and preventable inpatient and ED utilization. In this difference-in-differences study, we investigate the association of PCP–health system vertical relationships with these measures of quality of care, including low-value service use, ACSC utilization, posthospitalization follow-up, timeliness of specialty care, and practice-site fragmentation.

Methods

This difference-in-differences study was deemed exempt by the Harvard University Longwood Area Institutional Review Board with waivers of Health Insurance Portability and Accountability Act authorization and informed consent. We followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline.

Data Sources

We used the Center for Health Information and Analysis Massachusetts Hospital Cost Reports for 2013, 2015, and 2017 to measure hospital ownership by health systems and hospital referral regions. Second, we used the Massachusetts Health Quality Partners Massachusetts Provider Database (MPD) for 2013, 2015, and 2017 to identify corporate affiliations (ownership) or contracting affiliations between physicians and health systems. The MPD maps physicians to practice sites, medical groups, and health systems in Massachusetts. Data were collected from medical groups and systems and validated annually by approximately 95% of organizations through an online validation.
tool. Third, we analyzed claims from the Massachusetts All-Payer Claims Database (APCD) between 2013 and 2017 to attribute patients to physicians and construct patient-level covariates and outcomes. From 2013 to 2015, the APCD included all commercial enrollees and medical claims in Massachusetts. Beginning in 2016, employers offering self-insured plans could decline to submit data to state APCDs. The 2016 to 2017 APCD included all fully insured commercial plans and some self-insured plans, including the largest purchaser of commercial insurance in Massachusetts (eAppendix in Supplement 1).

Study Population
We studied commercially insured individuals younger than 65 years in Massachusetts. The unit of analysis was patient-year. We included patient-years in which the individual had at least 7 months of total enrollment in any commercial plan in the APCD and at least 1 evaluation and management claim with a physician in the MPD. Following methods published previously, we attributed each patient-year to the PCP in the MPD associated with the plurality of the patient’s evaluation and management claims in that year (eAppendix in Supplement 1). Attribution was completed for each patient-year separately.

Measure of Vertical Relationships
We identified health system ownership of hospitals using the Center for Health Information and Analysis Massachusetts Hospital Cost Reports and classified a system as large, if the share of total discharges from any of its hospitals was at least 20% of total hospital referral region discharges. We used the MPD to identify vertical relationships between large systems and PCPs in 2013, 2015, and 2017. Our measure captures a broader range of vertical relationships by including both full integration (ownership or corporate affiliation) and partial integration (joint contracting or contracting affiliation). This differs from some previously used measures of vertical integration that refer to ownership only. Because we did not have MPD data for 2014 and 2016, we applied the PCP’s vertical relationship measure from the prior year (ie, the 2013 measure to 2014).

Outcomes
We constructed outcomes across 3 categories of quality of care: (1) low-value care, (2) care timeliness and continuity, and (3) ED visits and admissions for ACSCs. First, we used 2 measures of low-value care utilization: head imaging for uncomplicated headaches and back imaging for patients with nonspecific low back pain, chosen due to their prevalence and relevance to the younger than 65 years, commercially insured population. Measures were constructed using definitions from previous literature that has operationalized low-value care services from guidelines such as the American Board of Internal Medicine Foundation’s Choosing Wisely initiative, the US Preventive Services Task Force D recommendations, and the National Institute for Health and Care Excellence “do not do” recommendations.

Second, we measured the probability of outpatient follow-up within 14 days of a hospital discharge, defined by a patient having an evaluation and management visit with a physician within 14 days of discharge. This measure was calculated for a visit with any physician and for visits with physicians within the health system with which the PCP had a vertical relationship. We refer to visits taking place within the PCP’s health system as within-system utilization. In sensitivity analyses, we examined outpatient follow-up within 7 and 21 days of hospital discharge (eTable 4 in Supplement 1).

We also measured the probability of an oncologist visit within 90 days of a new cancer diagnosis that was initiated in the primary care setting. This outcome is motivated by time-to-treatment measures used in oncology literature. We included all patients with a diagnosis of cancer, measured using hierarchical condition categories (HCCs) and no prior diagnosis of cancer in the previous 12 months. We define a new diagnosis as being initiated in the primary care setting when there is at least 1 PCP visit and no oncologist visits within a 90-day lookback period prior to the diagnosis. We then measured oncologist visits (any claim with an oncologist) within 90 days of the
initial cancer diagnosis. This measure was calculated for any oncologist and within-system oncologists. In sensitivity analyses, we measured oncologist follow-up within 30 and 180 days of a new diagnosis (eTable 4 in Supplement 1).

We calculated care fragmentation, a measure of the spread of an individual's care across practice sites. We constructed a measure of fragmentation from previous studies, which was modeled after the Herfindahl-Hirschman Index. To measure fragmentation across practice sites we used the MPD data, which includes a physician-to-practice site mapping. We calculated the share of patient visits accounted for by each practice, summed the squared shares over all practices for each patient, and subtracted that value from 1. The resulting fragmentation index is from 0 to 1 and can be multiplied by 100 to be reported as 0 to 100, with larger numbers reflecting a greater degree of fragmentation. Zero would indicate that all patient care was delivered by a single practice site and a value of 100 would reflect that a patient’s care was split equally across many practice sites.

Finally, we measured the probability of potentially preventable ED visits and hospital admissions among patients with asthma and the probability of potentially preventable admissions among patients with diabetes. We used the Agency for Healthcare Research and Quality Prevention Quality Indicators and preventable ED visit measures, designed to identify admissions and ED utilization that could have been avoided through well-managed outpatient care (eAppendix in Supplement 1). The diabetes measures were stratified by clinical severity (short-term complications, long-term complications, and uncontrolled), and the asthma measures were stratified by patient age (2-17 years, 18-39 years, and 40 years or older) (see eAppendix in Supplement 1 for additional study variable details).

Covariates
We extracted patient sex, age, chronic conditions (measured using HCCs), and number of months enrolled in any plan within 1 year from the APCD. We used HCCs for the individual and small group marketplace and from a commercially insured population younger than 65 years. We included the physician’s Herfindahl-Hirschman Index in the 3-digit zip code where the patient lives to control for horizontal market concentration that may occur with vertical consolidation (eg, if a system that already “owns” physicians acquires additional physicians or multiple physicians at once, both vertical and horizontal market concentrations increase).

Statistical Analysis
We used a stacked difference-in-differences (DID) design to estimate the association of PCP vertical relationships and outcomes. Because PCPs formed vertical relationships in either 2015 or 2017, we used a stacked DID rather than a traditional DID or 2-way fixed-effects estimator to avoid bias that can occur with staggered treatment adoption. In sensitivity analyses, we estimated separate DID for 2015 and 2017 (eAppendix in Supplement 1). We excluded patients whose assigned PCP changed between large systems across years (13.10% of patient-years) to avoid measuring the association of both vertical relationships and change of system. We excluded patient-years where a PCP changed health systems more than once during the study period due to the inability to separately estimate the associations of multiple vertical relationships (1.06% of patient-years).

The comparison group comprised patients whose PCPs were never (never treated) or always (always treated) in a vertical relationship with a large health system between 2013 and 2017. There are some concerns regarding the validity of the counterfactual when using always-treated units in the comparison group. We included these units in our comparison because always-treated PCPs may be more similar to newly integrated PCPs due to their engagements in vertical relationships, and we use the always-treated group to measure within-system outcomes (never-treated do not have within-system outcomes). To test the conditional parallel trends assumption, we plotted event studies of our main specification to show adjusted trends in our study outcomes over time (eFigure 2 in Supplement 1). We also calculated estimates using the pooled comparison group.
(always and never treated), the always treated only, and the never treated only and found similar results across iterations (eTable 3 in Supplement 1).

We estimated a stacked DID using linear regression with PCP fixed effects to control for unobservable, time-invariant characteristics of physicians, calendar year fixed effects, and experiment fixed effects (indicators for treatment in 2015 or 2017). Models included covariates for patient age, sex, the interaction of age and sex, clinical risk (0, 1, 2, 3, 4, or ≥5 HCCs), and physician market concentration. Because physicians in this study population were organized into medical groups, we used robust standard errors clustered by medical group. Unpaired, 2-tailed t tests with a threshold of 2-sided \( P < .05 \) were used to determine statistical significance (eAppendix in Supplement 1). Analyses were conducted using Stata, version 16 (StataCorp).

### Results

The study population included 4,603,172 patient-year observations from 2013 to 2017. Of the patients included in the study, 53.5% were female, 35.3% had any chronic condition, and the mean (SD) age was 38.9 (20.3) years (Table). The share of patients with a new asthma diagnosis was 0.7% for children aged 2 to 17 years, 0.8% for adults aged 18 to 39 years, and 1.7% for adults 40 years or older.

#### Table. Study Population Summary Statistics of Patient-Years From 2013 to 2017

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD)</th>
<th>Overall</th>
<th>Treatment group</th>
<th>Always treated</th>
<th>Never treated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient-year observations, No.</td>
<td>2,192,258</td>
<td>86,770</td>
<td>691,347</td>
<td>1,414,141</td>
<td></td>
</tr>
<tr>
<td>Age, y</td>
<td>38.9 (20.3)</td>
<td>41.2 (19.2)</td>
<td>40.1 (20.0)</td>
<td>38.1 (20.5)</td>
<td></td>
</tr>
<tr>
<td>Sex, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>53.5 (49.9)</td>
<td>54.3 (49.8)</td>
<td>54.6 (49.8)</td>
<td>52.9 (49.9)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>46.5 (49.9)</td>
<td>45.7 (49.8)</td>
<td>45.4 (49.8)</td>
<td>47.1 (49.9)</td>
<td></td>
</tr>
<tr>
<td>Any chronic conditions (HCC), %</td>
<td>35.3 (47.8)</td>
<td>35.3 (47.8)</td>
<td>36.1 (48.0)</td>
<td>34.9 (47.7)</td>
<td></td>
</tr>
<tr>
<td>New asthma diagnosis in patients aged 2-17 y, %</td>
<td>0.7 (8.4)</td>
<td>0.6 (7.7)</td>
<td>0.6 (7.8)</td>
<td>0.8 (8.7)</td>
<td></td>
</tr>
<tr>
<td>New asthma diagnosis in patients aged 18-39 y, %</td>
<td>0.8 (8.9)</td>
<td>0.9 (9.2)</td>
<td>0.8 (8.7)</td>
<td>0.8 (8.9)</td>
<td></td>
</tr>
<tr>
<td>New asthma diagnosis or COPD in patients aged ≥40 y, %</td>
<td>1.7 (13.0)</td>
<td>1.9 (13.3)</td>
<td>1.8 (13.2)</td>
<td>1.7 (12.8)</td>
<td></td>
</tr>
<tr>
<td>New diabetes diagnosis in patients aged ≥18 y, %</td>
<td>1.0 (9.8)</td>
<td>1.0 (9.9)</td>
<td>1.0 (9.8)</td>
<td>1.0 (9.8)</td>
<td></td>
</tr>
<tr>
<td>Head imaging for uncomplicated back pain, %</td>
<td>13.0 (33.6)</td>
<td>14.2 (34.9)</td>
<td>12.9 (33.5)</td>
<td>12.9 (33.5)</td>
<td></td>
</tr>
<tr>
<td>Back imaging for nonspecific low back pain, %</td>
<td>24.4 (43.0)</td>
<td>25.6 (43.6)</td>
<td>24.5 (43.0)</td>
<td>24.3 (42.9)</td>
<td></td>
</tr>
<tr>
<td>Outpatient follow-up within 14 d of hospitalization, %</td>
<td>74.5 (42.9)</td>
<td>73.4 (43.5)</td>
<td>73.7 (43.3)</td>
<td>74.9 (42.7)</td>
<td></td>
</tr>
<tr>
<td>Oncology follow-up within 90 d of initial diagnosis, %</td>
<td>17.0 (37.6)</td>
<td>19.8 (39.8)</td>
<td>16.1 (36.8)</td>
<td>17.5 (38.0)</td>
<td></td>
</tr>
<tr>
<td>Fragmentation of practice site visits%</td>
<td>56.3 (32.5)</td>
<td>59.6 (32.7)</td>
<td>57.6 (32.4)</td>
<td>55.4 (32.5)</td>
<td></td>
</tr>
<tr>
<td>Inpatient admissions, asthma in patients aged 2-17 y, %</td>
<td>1.5 (12.1)</td>
<td>1.4 (11.7)</td>
<td>1.3 (11.4)</td>
<td>1.6 (12.5)</td>
<td></td>
</tr>
<tr>
<td>Inpatient admissions, asthma in patients aged 18-39 y, %</td>
<td>0.3 (5.3)</td>
<td>0.4 (6.2)</td>
<td>0.2 (5.0)</td>
<td>0.3 (5.4)</td>
<td></td>
</tr>
<tr>
<td>Inpatient admissions, asthma or COPD in patients aged ≥40 y, %</td>
<td>1.5 (12.2)</td>
<td>1.7 (12.7)</td>
<td>1.4 (11.9)</td>
<td>1.5 (12.3)</td>
<td></td>
</tr>
<tr>
<td>Inpatient admissions, diabetes, short-term complications in patients aged ≥18 y, %</td>
<td>0.4 (6.1)</td>
<td>0.5 (7.0)</td>
<td>0.4 (6.3)</td>
<td>0.4 (5.9)</td>
<td></td>
</tr>
<tr>
<td>Inpatient admissions, diabetes, long-term complications in patients aged ≥18 y, %</td>
<td>0.5 (6.8)</td>
<td>0.3 (5.3)</td>
<td>0.5 (6.9)</td>
<td>0.5 (6.9)</td>
<td></td>
</tr>
<tr>
<td>Inpatient admissions, diabetes, uncontrolled in patients aged ≥18 y, %</td>
<td>0.6 (7.5)</td>
<td>0.4 (6.6)</td>
<td>0.5 (7.1)</td>
<td>0.6 (7.8)</td>
<td></td>
</tr>
<tr>
<td>ED visits, asthma in patients aged 2-17 y, %</td>
<td>5.7 (23.2)</td>
<td>5.2 (22.2)</td>
<td>6.3 (24.2)</td>
<td>5.5 (22.8)</td>
<td></td>
</tr>
<tr>
<td>ED visits, asthma in patients aged 18-39 y, %</td>
<td>2.6 (15.8)</td>
<td>2.7 (16.2)</td>
<td>2.5 (15.7)</td>
<td>2.6 (15.9)</td>
<td></td>
</tr>
<tr>
<td>ED visits, asthma or COPD in patients aged ≥40 y, %</td>
<td>3.1 (17.3)</td>
<td>3.3 (17.9)</td>
<td>2.9 (16.8)</td>
<td>3.1 (17.4)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: COPD, chronic obstructive pulmonary disease; ED, emergency department; HCC, hierarchical condition category.

* Authors’ analysis of Massachusetts Health Quality Partners data 2013, 2015, and 2017 and All Payer Claims Data, 2013 to 2017.

* Values represent the mean share across patient-years.

* New asthma and diabetes diagnosis refers to diagnoses made in a patient-year when that patient had no prior asthma or diabetes diagnosis in the previous year.

* For the asthma measure among adults aged 40 years and older, COPD is included in the definition due to its prevalence in that age group and relevance as a potentially manageable respiratory condition similar to asthma.

* Utilization measures may have different denominators based on the variable definition. For example, the denominator for head imaging for uncomplicated headache is the subset of patient-year observations with diagnosis codes indicating uncomplicated headache.
older. Among patients aged 18 years and older, 1.0% of patient-years had a new diagnosis of diabetes (Table). See eTable 1 in Supplement 1 for summary statistics for the years 2013 to 2014 (the preperiod for the stacked DID). There are very small differences in patient characteristics between treatment and control groups (eTable 1 in Supplement 1). There were no changes in low-value care utilization after PCP-health system vertical relationships formed (Figure 1).

**Timeliness and Continuity of Care**

There were no statistically significant changes in outpatient follow-up within 14 days of hospitalization after vertical relationships were formed. There was a significant association between vertical relationships and within-system physician follow-up of 7.51 percentage points (pp) (95% CI, 2.96-12.06; P = .001) in the subpopulation of patients attributed to PCPs that entered vertical relationships in 2015 (eTable 4 in Supplement 1). This finding reflects a trend of increasing within-system outpatient follow-up after vertical relationships were formed (Figure 3 in Supplement 1). A patient’s PCP entering a vertical relationship with a large health system had no association with a patient’s probability of oncology follow-up after a cancer diagnosis but was associated with an increased probability of within-system oncology follow-up of 7.34 pp (95% CI, 2.28-12.40; P = .01) (Figure 2). Thus, overall utilization of oncology follow-up does not change but the proportion of oncology follow-up visits that occur within-system increased. Vertical relationships were also associated with a significant decrease in fragmentation of practice site visits of −1.05 pp (95% CI, −2.05 to 0.05; P = .04) (Figure 1). A decrease in fragmentation reflects that more of a patient’s care was being delivered by fewer practice sites. There were no changes in ACSC admissions or ED visits for patients with asthma, or in admissions for patients with diabetes associated with vertical relationships (Figure 3).

### Figure 1. Association of Vertical Relationships With Fragmentation of Care and Low Value

<table>
<thead>
<tr>
<th>Source</th>
<th>Comparison group mean</th>
<th>Percentage points (95% CI)</th>
<th>Percent change, %</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fragmentation of practice site visits</td>
<td>56.24</td>
<td>-1.05 (-2.05 to -0.05)</td>
<td>-1.87</td>
<td>.04</td>
</tr>
<tr>
<td>Back imaging for low-back pain</td>
<td>24.31</td>
<td>1.34 (-0.23 to 2.90)</td>
<td>5.49</td>
<td>.09</td>
</tr>
<tr>
<td>Head imaging for uncomplicated headache</td>
<td>12.84</td>
<td>0.26 (-0.80 to 1.32)</td>
<td>1.99</td>
<td>.63</td>
</tr>
</tbody>
</table>

Authors’ analysis of Massachusetts Health Quality Partners data from 2013, 2015, and 2017 and All-Payer Claims Data from 2013 to 2017. Percent change reports treatment group percent change over the comparison group baseline. Comparison group baseline is the pooled comparison group, patient-year mean for years from 2013 to 2017 for each outcome. See eTable 1 in Supplement 1 for baseline means for all patient-years as well as treatment and comparison groups.

### Figure 2. Association of Vertical Relationships and Follow-Up Care

<table>
<thead>
<tr>
<th>Source</th>
<th>Comparison group mean</th>
<th>Percentage points (95% CI)</th>
<th>Percent change, %</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outpatient follow-up within 14 d with in-system physician</td>
<td>49.75</td>
<td>2.58 (-1.09 to 6.24)</td>
<td>5.18</td>
<td>.17</td>
</tr>
<tr>
<td>Outpatient follow-up within 14 d with any physician</td>
<td>74.47</td>
<td>1.92 (-1.35 to 5.19)</td>
<td>2.57</td>
<td>.25</td>
</tr>
<tr>
<td>Oncology follow-up within 90 d with in-system physician oncologist</td>
<td>23.96</td>
<td>-4.08 (-9.62 to 1.47)</td>
<td>-17.01</td>
<td>.15</td>
</tr>
<tr>
<td>Oncology follow-up within 90 d with any physician oncologist</td>
<td>15.12</td>
<td>7.34 (2.28 to 12.40)</td>
<td>48.57</td>
<td>.01</td>
</tr>
</tbody>
</table>

Authors’ analysis of Massachusetts Health Quality Partners data from 2013, 2015, and 2017 and All-Payer Claims Data from 2013 to 2017. Percent change reports treatment group percent change over the comparison group baseline. Comparison group mean is the pooled comparison group, patient-year mean for years from 2013 to 2017 for each outcome. See eTable 1 in Supplement 1 for baseline means for all patient-years as well as treatment and comparison groups.
Discussion

As health care becomes increasingly consolidated, studying the effects of vertical relationships between PCPs and health systems is critical for evaluating the association of integration and quality of care. In this difference-in-differences study of commercially insured individuals in Massachusetts, we found no evidence that PCP–health system vertical relationships changed patients’ low-value care utilization, ACSC inpatient admissions, or ACSC ED visits. We found that vertical relationships were associated with small changes in timeliness and continuity of care.

We found no change in outpatient follow-up after hospitalization and a small positive change in within-system follow-up among the treatment group that was observed for 3 years after forming a vertical relationship (2015 subgroup). It is possible that improved continuity takes time to materialize if newly consolidated PCPs need to onboard to system electronic health records or patient portals, for example.

The findings of decreased practice site fragmentation and increased within-system oncology follow-up can be described as patient steering, which has been shown to increase spending, largely through higher prices. Less fragmentation of practice site visits and more timely follow-up may improve patient experiences. However, steering privately insured individuals to large health systems could have market-level effects, such as reduced revenue from the commercially insured among nonsystem, smaller physicians, and hospitals. Coupled with the results of our study that showed no improvement across a large set of low-value care and ACSC utilization measures, this suggests that steering patients within large health systems results in less efficient care (ie, higher spending for equal quality). These results are consistent with prior studies of physician-hospital integration that report no effects on quality of care but increased spending and use of high-intensity services.

One potential explanation for these results is the context in which consolidation occurs, namely the underlying incentives of fee-for-service payment. Quality-of-care changes can be revenue-losing, revenue-neutral, or revenue-generating, and these distinctions may explain the pattern of observed changes. The low-value care services we examined are revenue-generating, and because the fee-for-service incentives are unchanged through vertical consolidation, this could be a reason we do not observe changes in the outcome. While admissions and ED visits are costly to the patient and payers, health systems with hospitals are not penalized for such utilization, unless they are part of a contract that is structured to significantly disincentivize avoidable admissions and ED visits. Revenue-generating incentives are also consistent with our within-system follow-up and practice site fragmentation results. Further, systems and physicians in risk-bearing contracts may have incentives

Authors’ analysis of Massachusetts Health Quality Partners data 2013, 2015, and 2017 and All Payer Claims Data, 2013-17. Percent change reports treatment group percent change over the comparison group baseline. Comparison group mean is the pooled comparison group, patient-year mean for years from 2013 to 2017 for each outcome.

See eTable 1 in Supplement 1 for baseline means for all patient-years as well as treatment and comparison groups. COPD indicates chronic obstructive pulmonary disease; ED, emergency department.
to both avoid admissions and ED visits and steer patients within the system. The results of this study suggest that there is little to no measurable difference in the quality of care between physicians with or without vertical relationships with health systems.

Limitations
There are several limitations of the study. First, we applied measures of vertical relationships in 2013 and 2015 to study years 2014 and 2016, respectively, which may introduce some measurement error. However, this type of error would likely bias results toward the null by missing new vertical relationships in those years. Second, although our measure of vertical relationships is novel and captures a breadth of relationships, it does not distinguish between ownership and joint contracting. Third, our study population consists of commercially insured individuals in the state of Massachusetts for a 5-year period, which may limit generalizability. However, Massachusetts has a health care delivery landscape similar to many other US markets, including large health systems competing with smaller systems or independent practices across both metropolitan and rural areas. Finally, our analytic design leverages changes in an individual PCP's vertical relationship status with a health system. This does not rule out the possibility that other market-level factors could be correlated with both vertical consolidation and outcomes. However, such a confounder would need to be related to both vertical relationships and trends in outcomes over time differentially within Massachusetts.

Conclusions
In this difference-in-differences study of vertical relationships between PCPs and large health systems across Massachusetts, we found no association of vertical relationships with low-value care, hospital admissions, or ED visits for ACSCs among the commercially insured. We found that vertical relationships were associated with small reductions in care fragmentation and increases in within-system physician follow-up. These findings are consistent with vertical relationships being associated with patient steering but not necessarily improvements in patient outcomes. Because steering within health systems has been shown to increase spending, largely through prices,\(^{24,49}\) this suggests that vertical relationships may result in insurers paying more for the same quality of care. The results of this study should be taken into account by policymakers and antitrust regulators when considering the potential benefits against the demonstrated harms (ie, spending increases) of vertical consolidation.
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REFERENCES


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**SUPPLEMENT 2.**
Data Sharing Statement