

By Marcelo Cerullo, Kelly Kaili Yang, James Roberts, Ryan C. McDevitt, and Anaeze C. Offodile II

Private Equity Acquisition And Responsiveness To Service-Line Profitability At Short-Term Acute Care Hospitals

DOI: 10.1377/hlthaff.2021.00541
HEALTH AFFAIRS 40,
NO. 11 (2021): 1697–1705
©2021 Project HOPE—
The People-to-People Health
Foundation, Inc.

ABSTRACT As private equity firms continue to increase their ownership stake in various health care sectors in the US, questions arise about potential impacts on the organization and delivery of care. Using a difference-in-differences approach, we investigated changes in service-line provision in private equity–acquired hospitals. Relative to nonacquired hospitals, private equity acquisition was associated with a higher probability of adding specific profitable hospital-based services (interventional cardiac catheterization, hemodialysis, and labor and delivery), profitable technologies (robotic surgery and digital mammography), and freestanding or satellite emergency departments. Moreover, private equity acquisition was associated with an increased probability of providing services that were previously categorized as unprofitable but that have more recently become areas of financial opportunity (for example, mental health services). Finally, private equity–acquired hospitals were less likely to add or continue services that have unreliable revenue streams or that may face competition from nonprofit hospitals (for example, outpatient psychiatry), although fewer shifts were noted among unprofitable services. This may reflect a prevailing shift by acute care hospitals toward outpatient settings for appropriate procedures and synergies with existing holdings by private equity firms.

Marcelo Cerullo (marcelo.cerullo@duke.edu) is a resident in the General Surgery Residency Program, Duke University Hospital, in Durham, North Carolina.

Kelly Kaili Yang is a graduate student in the Department of Economics, Duke University, in Durham, North Carolina.

James Roberts is a professor in and chair of the Department of Economics, Duke University, and a research associate with the National Bureau of Economic Research.

Ryan C. McDevitt is a professor in the Fuqua School of Business, Duke University.

Anaeze C. Offodile II is an assistant professor in the Department of Plastic and Reconstructive Surgery, University of Texas MD Anderson Cancer Center, in Austin, Texas, and a nonresident fellow in Domestic Health Policy at the Baker Institute for Public Policy, Rice University, in Houston, Texas. He is the current Gilbert Omenn Fellow of the National Academy of Medicine.

Private equity acquisitions of physician practices, health care facilities, and hospitals have increased sharply during the past two decades. Combined with other investments in biomedical technology and associated industries, private equity acquisitions in health care have totaled more than \$70 billion per year since 2017.^{1–7} It has been estimated that more than 10 percent of all acute care admissions in 2017 were to hospitals that had been acquired by a private equity firm in the preceding fifteen years and that this activity occurred across 36 states and 106 hospital referral regions.⁸

Private equity firms acquire mature health care service providers (for example, acute care hos-

pitals, nursing homes, and ambulatory surgery centers) via leveraged buyouts, using capital from limited partners.⁹ Illustrative limited partners include sovereign wealth funds, pension funds, and people with high net worth. Private equity investments in health care have drawn some controversy because of concerns that limited partners' desire for high annualized returns on their investment and the abbreviated time horizon of private equity ownership (three to seven years) may drive a prioritization of profits over optimizing health care access, quality, and spending—that is, “profit over patients.”¹⁰ A recent study by Joseph Bruch and colleagues showed gains in net income, charge-to-cost ratios, case-mix index, and some aggregate process

measures in hospitals after private equity acquisition.¹¹ In the wake of high-profile hospital closures¹² and the unprecedented financial challenges faced by hospitals as a result of COVID-19, some contend that private equity activity in health care delivery, and the scrutiny surrounding it, will intensify over the coming years.^{10,13,14}

Despite the growing importance of private equity investment in health care, few empirical studies have assessed how the managerial practices and corporate restructurings performed by private equity firms enhance the value of target hospitals and allow them to achieve high investment returns for limited partners.⁹ The strategic choices made by hospitals to maximize returns can manifest in decisions on pricing, the mix of products and services offered, and staffing levels. Because private equity firms are rarely long-term holders of corporate assets, their intent is to make acquisitions more attractive to potential buyers or public shareholders to complete a successful “exit.” Furthermore, the structural changes and operational decisions of private equity firms after acquisition may affect health care spending, the immediate health of patients, and the long-term health of the broader community. Therefore, a better understanding of private equity ownership and its impact on hospital behavior will inform regulatory efforts at both the state and federal level.

Prior research has shown that for-profit hospitals are significantly more likely to offer certain services based on profitability.¹⁵ Profitable service lines are expanded or pared down not only in accordance with a hospital’s profit-maximizing strategy but also in relation to other high-margin services in that hospital’s market.^{16,17} Private equity acquisition, however, presents a unique situation: Although all hospitals might seek to maximize revenue over the long term, hospitals acquired by private equity firms have a heightened short-term focus. Private equity firms may target hospitals that have a greater potential for increased operating margins, but it remains unclear whether they systematically enact specific postacquisition changes in the types and range of services offered.

To explore this issue, we examined the relationship between private equity hospital acquisitions and changes in service lines. Using a predefined categorization of service-line profitability,^{16,17} we used a generalized difference-in-differences framework to estimate the impact of private equity acquisition on the probability of a hospital providing profitable or unprofitable services. As changes in service lines may be associated with concomitant shifts in practice patterns (for example, a move toward an outpatient setting for certain procedures or accompanying

changes in associated service lines), we further contextualize our results by examining changes in hospitals’ contractual relationships or specialty-specific services.

Study Data And Methods

DATA SOURCES Private equity hospital acquisitions that took place between January 1, 2006, and December 31, 2015, were identified using a previously described search methodology that included the proprietary market intelligence reporting platforms Pitchbook, CB Insights, and Zephyr.^{3,8} Transactions classified as either primary leveraged buyout or add-on acquisitions were included. The “index year” was determined as the calendar year in which deal closure (defined as the date when financial control transferred to the private equity firm) occurred. These data were cross-referenced with press releases, industry newsletters, and media focusing on hospitals and health systems.

Facility names and Medicare provider numbers were used to identify hospitals in the Centers for Medicare and Medicaid Services Health-care Provider Cost Reporting Information System¹⁸ and to compile data from the period 2004–18. This time horizon allowed for at least two years preacquisition and up to three years postacquisition (that is, private equity deal activity during 2006–15). This time horizon also reflects major private equity acquisitions (for example, the HCA acquisition by Bain/KKR) and the enactment of key health policy statutes (for example, the Affordable Care Act and the Health Information Technology for Economic and Clinical Health Act).⁸ Facility-level data including physical address, bed size, and teaching status were extracted along with financial and operational data. Rural or urban classification was derived from Rural-Urban Continuum Codes set by the Department of Agriculture’s Economic Research Service. Census data including area-level population estimates and per capita income at the county level were derived from the Area Health Resources Files. Year-specific and facility-level financial data were linked from the Health-care Provider Cost Reporting Information System, using Medicare provider numbers; area-level data were linked using regional identifiers (for example, county Federal Information Processing Series code and hospital referral region) in the Area Health Resources Files. Hospital service provision at the facility or local system level was determined from the American Hospital Association annual survey (described in the online appendix).¹⁹

HOSPITAL SERVICES BY PROFITABILITY Previous research has characterized hospital services

The results show a relationship between private equity acquisition and systematic changes in the central activity of hospitals: providing care.

according to profitability: relatively profitable and relatively unprofitable.^{15,17} These services ranged from the availability of specific technologies (for example, robotic surgery and specialized imaging) to types of treatment (for example, endovascular therapies, child psychiatric services, and HIV/AIDS) and specialty practices (for example, critical care, cardiac surgery, and inpatient psychiatry). Given our focus on hospital behavior in response to financial incentives, examining the provision of medical services that vary in profitability allowed us to identify patterns in management decision making.¹⁷ Furthermore, the transition to or away from a particular service line requires concomitant operational changes—for example, in business development, physician relationships, organizational structure, and support functions such as human resources and information technology.²⁰

PATTERNS IN SERVICE PROVISION AND MODEL ASSUMPTIONS We first explored the probability of a hospital offering a particular service using a nonparametric event study model with coefficients for each year relative to the acquisition year. This allowed us to visually examine patterns in outcomes relative to the event being studied (private equity acquisition). We used a dummy variable for each of the four years before and after acquisition to evaluate the leading and lagging difference-in-differences estimator. To focus on service decisions that are truly marginal, we excluded services provided by more than 90 percent of hospitals, such as emergency department services and outpatient surgery.

To estimate the impact of private equity acquisition on the probability of a hospital offering a particular service, we used a generalized difference-in-differences approach in a linear probability model. Comparator hospitals included all nonacquired hospitals that had at least seven

years of continuous data reported. We adjusted for the following features: transition to critical access status (yes or no), bed size category (up to 100 beds, 101–400 beds, and more than 400 beds), for-profit status (versus government-owned or nonprofit), teaching status (yes or no), and market share (as a percentage of beds in the hospital referral region), including year and hospital-level fixed effects. Because private equity groups are likely to exit their investment between three and seven years postacquisition,²¹ we excluded observations for acquired hospitals more than five years after acquisition.

The principal assumption that ensures internal validity of our difference-in-differences approach is that measured outcomes for never-acquired (that is, control) hospitals and acquired hospitals before acquisition have parallel trends. Absent private equity acquisition, the difference in the propensity to offer a particular service line between private equity-target hospitals and control hospitals would remain constant over time. We examined this assumption by jointly testing the equivalence of preacquisition event study coefficients. Only services that had parallel trends in the preacquisition period were examined using a difference-in-differences analysis. Standard errors were clustered at the hospital or health system level. Further details about the definition of services and model specifications are in the appendix.¹⁹ This study was approved by the Institutional Review Board of the Duke University Health System.

LIMITATIONS Our study was subject to certain limitations stemming from both the data and the assumptions of the analytical framework. First, the identification of private equity acquisitions involving short-term acute care hospitals came from the reporting of individual transactions in the financial and lay press. Private transactions are unique in that the details of these deals, including their total value or debt restructuring agreements, are often opaque. However, our study design (a generalized difference-in-differences design) is suited for identifying discontinuities in the propensity to shift service lines irrespective of underlying financial motivations. Second, decisions to begin or terminate a service line (or offer a technology or procedure) often depend on regional factors, including the specialty, reputation, and market share of local competitors. However, our principal model specification included both year and hospital fixed effects, which allowed us to account for both secular trends and potentially unobserved variation within hospitals. Third, any analysis of private equity acquisition of short-term acute care hospitals includes the leveraged buyout of HCA, which accounts for more than half of all facilities

acquired. To examine the impact of this deal on our findings, we conducted a sensitivity analysis excluding HCA hospitals. Finally, our study depended on data that, ultimately, were self-reported. However, the American Hospital Association annual survey remains the most comprehensive and widely used source of information on the breadth and diversity of hospital and health system services and has broad buy-in from administrators, policy makers, and researchers as reliable and consistent in its definitions.

Study Results

Our study sample consisted of 4,781 hospitals, including 228 that were acquired by private equity. Overall, private equity-acquired hospitals were more likely to be urban, in the medium bed-size category, nonteaching, and for-profit (appendix exhibits A-1 and A-2).¹⁹ For each year, the proportion of hospitals that reported offering each service line was calculated, and this trend was examined over time. We calculated the variation in the provision of a particular service line as the percentage change in the proportion of hospitals that provided it between the first and last years in our study period (exhibits 1 and 2).

The five service lines with the largest percentage increase were all in the profitable category: robotic surgery (+572 percent), digital mammography (+356 percent), freestanding or satellite emergency departments (+157 percent), adult cardiac surgery (+58 percent), and adult interventional cardiac catheterization (+52 percent) (exhibit 1). Two service lines decreased in their prevalence over this period: adult day care (−16 percent; exhibit 2) and birthing room or labor and delivery (−7 percent; exhibit 1).

PREACQUISITION TRENDS In the event study approach, we estimated the probability of each service line being offered in the years before and after acquisition for private equity-acquired hospitals relative to never-acquired hospitals. For both profitable and unprofitable services, there were no differences overall between private equity-acquired hospitals in the year before their acquisition and never-acquired hospitals (appendix exhibits A-3 and A-4).¹⁹

PROFITABLE AND UNPROFITABLE SERVICE PROVISION Private equity acquisition was associated with a significant increase in the probability of hospitals providing six of the eleven profitable services for which difference-in-differences estimators were calculated (exhibit 3). Specific prof-

EXHIBIT 1

Prevalence of profitable service lines in hospitals at the beginning and end of the study period, from largest to smallest percent change, 2004–18

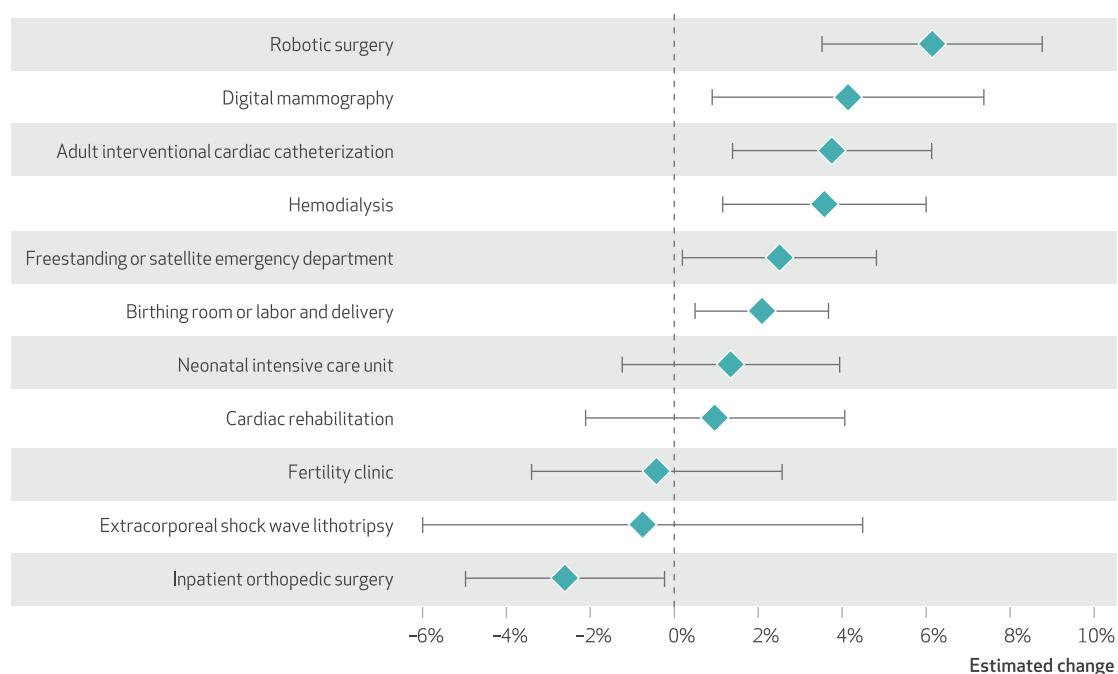
| Profitable service lines | Hospitals providing service (%) | | | Parallel pre-trends confirmed |
|--|---------------------------------|------|---------------------|-------------------------------|
| | Beginning | End | Change ^a | |
| Robotic surgery ^b | 5.4 | 35.9 | 571.7 | Yes |
| Digital mammography ^b | 17.0 | 77.6 | 356.0 | Yes |
| Freestanding or satellite ED ^b | 3.0 | 7.7 | 157.3 | Yes |
| Adult cardiac surgery | 26.2 | 43.2 | 57.7 | No |
| Adult interventional cardiac catheterization | 24.7 | 39.4 | 51.6 | Yes |
| Urgent care center | 32.6 | 48.4 | 50.2 | No |
| Fertility center | 12.7 | 17.4 | 37.1 | Yes |
| Cardiac rehabilitation ^b | 53.1 | 71.4 | 34.5 | Yes |
| Extracorporeal shock wave lithotripsy | 41.8 | 55.7 | 32.5 | Yes |
| Neonatal intensive care unit | 28.3 | 37.5 | 32.7 | Yes |
| Women's health center | 53.3 | 67.2 | 25.8 | No |
| Fitness center | 37.2 | 46.6 | 24.7 | No |
| Inpatient orthopedic surgery | 68.1 | 83.8 | 22.3 | Yes |
| Hemodialysis | 28.7 | 33.2 | 15.1 | Yes |
| Cardiac intensive care unit | 40.3 | 41.9 | 4.1 | No |
| Outpatient surgery | 89.6 | 92.6 | 3.4 | — ^c |
| Birthing room or labor and delivery | 66.8 | 62.1 | −7.1 | Yes |

SOURCE Data extracted from American Hospital Association annual survey responses (2004–18). **NOTES** Data only available beginning in 2005. Parallel trends in the preacquisition period for private equity-acquired hospitals relative to control hospitals are noted in the rightmost column. ED is emergency department. ^aValues may vary from calculations based on what is shown in the "Beginning" and "End" columns because of rounding. ^bData only available beginning in 2005. ^cNot applicable; services offered by more than 90 percent of hospitals were not examined in a difference-in-differences analysis.

EXHIBIT 2**Prevalence of unprofitable service lines in hospitals at the beginning and end of the study period, from largest to smallest percent change, 2004-18**

| Unprofitable service lines | Hospitals providing service (%) | | | Parallel pre-trends confirmed |
|--------------------------------|---------------------------------|------|---------------------|-------------------------------|
| | Beginning | End | Change ^a | |
| Trauma center | 38.8 | 53.4 | 37.6 | No |
| Outpatient psychiatric care | 35.7 | 49.1 | 37.3 | Yes |
| Hospice services | 55.6 | 66.6 | 19.7 | No |
| Inpatient psychiatric care | 39.9 | 46.0 | 15.4 | No |
| Inpatient detox program | 18.2 | 20.7 | 13.7 | Yes |
| Psychiatric emergency services | 32.8 | 37.0 | 12.7 | Yes |
| Burn treatment center | 10.3 | 11.6 | 11.7 | Yes |
| HIV-AIDS treatment | 31.0 | 34.7 | 11.7 | Yes |
| Volunteer services | 76.3 | 82.7 | 8.4 | No |
| Social work services | 85.1 | 89.2 | 4.9 | No |
| Emergency department | 93.1 | 97.5 | 4.8 | — ^b |
| Psychiatric partial hospital | 25.8 | 26.4 | 2.6 | Yes |
| Adult day care program | 13.7 | 11.5 | -15.9 | Yes |

SOURCE Data extracted from American Hospital Association annual survey responses (2004-18). **NOTES** Parallel trends in the preacquisition period for private equity-acquired hospitals relative to control hospitals are noted in the rightmost column. ^aValues may vary from calculations based on what is shown in the "Beginning" and "End" columns because of rounding. ^bNot applicable; services offered by more than 90 percent of hospitals were not examined in a difference-in-differences analysis.

EXHIBIT 3**Difference-in-differences estimates of the probability of hospitals offering specific profitable services after private equity acquisition**

SOURCE Data extracted from American Hospital Association annual survey responses (2004-18). **NOTE** Error bars represent 95% confidence intervals.

itable services that were more likely to be offered after private equity acquisition included robotic surgery (+6.2 percent; $p < 0.001$), digital mammography (+4.1 percent; $p = 0.02$), and adult interventional cardiac catheterization (+3.8 percent; $p = 0.01$). In addition, private equity acquisition was associated with a greater increase in the probability of providing in-hospital hemodialysis (+3.6 percent; $p = 0.01$), of having a free-standing or satellite emergency department (+2.5; $p = 0.03$), and of having a birthing room or labor and delivery (+2.1 percent; $p = 0.01$). Of note, one profitable service (inpatient orthopedic surgery) had a lower probability of being provided after private equity acquisition (-2.6 percent; $p = 0.03$).

Among unprofitable services, private equity-target hospitals exhibited a lower probability of providing outpatient psychiatric care (-4.0 percent; $p = 0.001$) after acquisition. Conversely, acquisition resulted in a higher probability of offering psychiatric emergency services (+4.0 percent; $p = 0.01$) (exhibit 4).

SENSITIVITY ANALYSIS After excluding hospitals involved in the HCA leveraged buyout finalized in November 2006, we repeated the difference-in-differences analysis of profitable and unprofitable service provision. Among the eighty-four non-HCA private equity-acquired hospitals, the directionality of our main findings was preserved for all six of the services with statistically significant findings (robotic surgery, digital mammography, adult interventional cardiac catheterization, hemodialysis, free-standing or satellite emergency department, and birthing room or labor and delivery). Simi-

larly, the directionality and significance of estimates for unprofitable services was preserved for the two services identified in the full analysis (psychiatric emergency services and outpatient psychiatric care; appendix exhibits A-5 and A-6).¹⁹

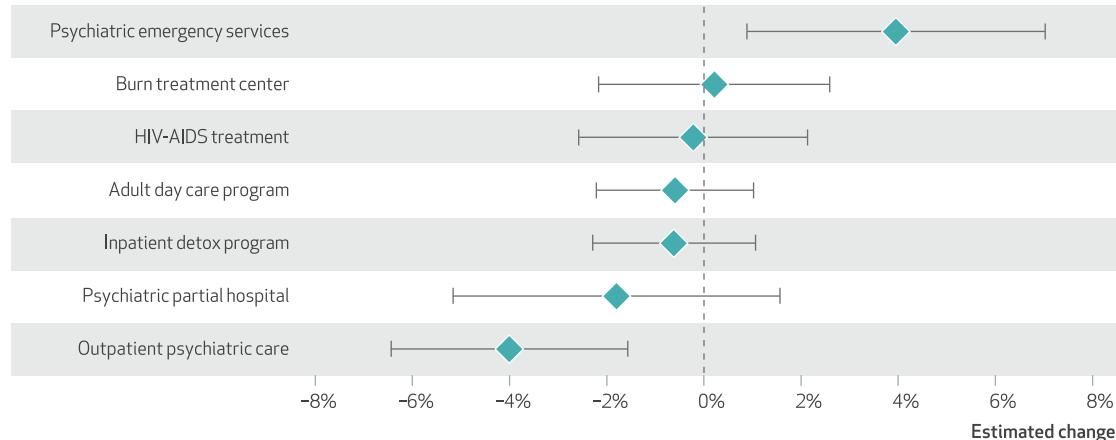
ASSOCIATED SERVICES AND CONTRACTUAL ARRANGEMENTS Finally, we examined potential trends in associated services and contractual arrangements that short-term acute care general hospitals may have adopted during this period, focusing on the services for which private equity acquisition resulted in significant shifts.

First, we examined the prevalence of reported contracts with limited-service hospitals and ambulatory surgical centers that may have accompanied shifts in inpatient services. These joint ventures have been touted as advantageous for private equity firms' short time horizons.²² Over the course of our study period, the prevalence of ambulatory surgical center joint ventures increased 159 percent (from 7.0 percent of hospitals in 2005 to 18.1 percent in 2018; data not shown). Because we did not observe parallel pre-trends in joint venture adoption between private equity-acquired hospitals and never-acquired hospitals, a difference-in-differences analysis was not conducted.

We also examined hospital or health system provision of ambulance services, which had not been identified among the list of profitable or unprofitable services but may be associated with emergency care. During our study period, hospital or health system ambulance service provision increased 32 percent (from 39.7 percent to 52.5 percent; data not shown). However, after

EXHIBIT 4

Difference-in-differences estimates of the probability of hospitals offering specific unprofitable services after private equity acquisition



SOURCE Data extracted from American Hospital Association annual survey responses (2004–18). **NOTE** Error bars represent 95% confidence intervals.

These shifts may elucidate the mechanisms by which private equity-acquired hospitals generate financial returns for their owners.

ascertaining parallel pretrends between private equity-acquired hospitals and never-acquired hospitals (appendix exhibit A-4),¹⁹ a difference-in-differences analysis found that private equity acquisition resulted in a 4.9 percent decrease in the probability of offering this service ($p < 0.001$).

Discussion

The considered entry of private equity into the health care provider market has affected the provision of both elective and emergent care. Since the \$33 billion buyout of HCA by Bain/KKR in 2006,²³ private equity's effects on the unique functions of short-term, nonspecialized facilities remain relatively unstudied. Using a matched difference-in-differences framework, Bruch and colleagues showed that private equity acquisition was associated with a small increase in charge-to-cost ratio and net income,¹¹ although it is unclear whether this change is due to higher prices, lower overall expenditures, or both.^{24,25} The results presented in this study show a relationship between private equity acquisition and systematic changes in the central activity of hospitals: providing care. Specifically, private equity acquisition was associated with an increased probability of hospitals providing six of the eleven profitable services studied. Conversely, among unprofitable services, private equity acquisition was associated with a decreased probability of offering one (of seven) services (outpatient psychiatric care).

These shifts must be considered within the broader context of how services and technologies provided by short-term acute care hospitals have changed. Many hospitals—not just private equity-acquired hospitals—have adopted profitable services such as robotic surgery, digital

mammography, and freestanding or satellite emergency departments. However, this trend may belie an “acceleration” of service adoption by private equity-acquired hospitals ahead of profit-seeking changes in service lines exhibited by all hospitals, irrespective of the value these services may provide for patients. For example, the first results of a randomized controlled trial of digital mammography versus all-film mammography reported in 2005 showed no difference in diagnostic accuracy for asymptomatic screening and indicated that digital mammography was not cost-effective under Medicare reimbursement at that time.²⁶⁻²⁸ Robotic surgery has been similarly heralded as a frontier technology in operative technique, despite documented variation in outcomes, a difficult learning curve for surgeons, high up-front costs for institutions, and overall higher charges for patients and payers.²⁹⁻³¹

We also identified instances in which private equity acquisition was associated with effects opposite of those hypothesized. In particular, the period after private equity acquisition was associated with an increase in the probability that hospitals would provide psychiatric emergency services (an unprofitable service) and a decrease in inpatient orthopedic surgery (a profitable service). This may be explained by changes in the relative profitability of certain services over time. For instance, a 2014 study found that psychiatric emergency services, despite their relative paucity nationwide, were associated with positive net revenue and were buoyed by expansions in insurance coverage under the Affordable Care Act.³² Moreover, a 2020 study found that more than half of recent acquisitions in the behavioral and mental health care sector were made by private equity firms.³³ Our finding that private equity acquisition was associated with an increased probability of offering emergency psychiatric services might be related to the trend toward private equity acquisition of behavioral and mental health services, as well as to the likelihood that these services are value driven.³⁴

The provision of certain services cannot be viewed only as an inpatient phenomenon, given the growing movement toward outpatient and ambulatory care for procedures that have historically been relegated to inpatient settings.³⁵ Indeed, 66 percent of all surgical therapies were delivered in outpatient settings in 2014 (up from 57 percent in 1994);³⁶ moreover, the proportion of outpatient procedures performed in ambulatory surgical centers (as opposed to hospital inpatient settings) increased from 32 percent in 2005 to just over 50 percent in 2017.³⁷

This trend may help clarify our finding that the period after private equity acquisition was asso-

ciated with a decrease in the probability that acquired hospitals would provide inpatient orthopedic services. As procedures shift to an outpatient setting and outpatient services become concentrated in freestanding ambulatory surgical centers, this sector has become primed for consolidation.³⁸ In our study sample, joint ventures with ambulatory surgical centers or limited-service hospitals more than doubled during this period. Although we cannot draw a link between contractual participation with ambulatory surgical centers and surgical volume of private equity-acquired hospitals, we suspect that it may signal the bundling of certain investments in this clinical area.³⁹

These shifts may elucidate the mechanisms by which private equity-acquired hospitals generate financial returns for their owners. Taken together, they underscore the fact that private equity acquisitions are hardly isolated, and operational changes in short-term acute care likely occur in tandem with other managerial decisions. These trends reinforce a prevailing shift away from acute, nonelective inpatient care, for which profitability is more volatile compared with elective care.⁴⁰ The shift away from emergency services that are integrated with hospitals and health systems may ultimately affect the ex-

tent of patients' access to care. This may also affect the provision of services at other hospitals in a particular service area. The cessation of crucial, but less profitable, services at one facility may force other facilities in the same service area to expand these service lines. Therefore, regulation that mitigates this "spillover" must address population-level metrics of health, not just outcomes specific to acquired hospitals.

Conclusion

Our findings suggest that private equity-acquired hospitals are different from their non-acquired counterparts. Private equity-acquired hospitals adopt technology in response to a profit incentive and pivot toward service lines and contractual arrangements that are rewarded by payers. Not only do private equity-acquired hospitals add profitable services faster, but also the changes they make to hospital operations may have broad implications for policy makers seeking to mitigate the potentially negative impacts of service-line disruptions and hospital market concentration. Policy makers may want to explore regulatory levers for ensuring equitable access and delivery of care in the face of private equity hospital acquisitions. ■

Salary support for Marcelo Cerullo was provided by the Veterans Affairs (VA) Office of Academic Affiliations through the National Clinician Scholars Program at Duke University. The contents do not

represent the views of the Department of Veterans Affairs or the United States government. Anaeze Offodile II has received funding from the Blue Cross Blue Shield Affordability Cures

Consortium and National Academy of Medicine that is unrelated to the submitted work.

NOTES

- 1 Gondi S, Song Z. Potential implications of private equity investments in health care delivery. *JAMA*. 2019;321(11):1047-8.
- 2 Zhu JM, Hua LM, Polsky D. Private equity acquisitions of physician medical groups across specialties, 2013-2016. *JAMA*. 2020;323(7):663-5.
- 3 Tan S, Seiger K, Renehan P, Mostaghimi A. Trends in private equity acquisition of dermatology practices in the United States. *JAMA Dermatol*. 2019;155(9):1013-21.
- 4 Pradhan R, Weech-Maldonado R, Harman JS, Laberge A, Hyer K. Private equity ownership and nursing home financial performance. *Health Care Manage Rev*. 2013;38(3):224-33.
- 5 Chen EM, Cox JT, Begaj T, Armstrong GW, Khurana RN, Parikh R. Private equity in ophthalmology and optometry: analysis of acquisitions from 2012 through 2019 in the United States. *Ophthalmology*. 2020;127(4):445-55.
- 6 Casalino LP, Saiani R, Bhidya S, Khullar D, O'Donnell E. Private equity acquisition of physician practices. *Ann Intern Med*. 2019;171(1):78.
- 7 Scheffler RM, Alexander LM, Godwin JR. Soaring private equity investment in the healthcare sector [Internet]. Berkeley (CA): University of California Berkeley; 2021 May [cited 2021 Oct 6]. Figure 1. Available from: <https://publichealth.berkeley.edu/wpcontent/uploads/2021/05/Private-Equity-1-Healthcare-Report-FINAL.pdf>
- 8 Offodile AC II, Cerullo M, Bindal M, Rauh-Hain JA, Ho V. Private equity investments in health care: an overview of hospital and health system leveraged buyouts, 2003-17. *Health Aff (Millwood)*. 2021;40(5):719-26.
- 9 Robbins CJ, Rudenske T, Vaughan JS. Private equity investment in health care services. *Health Aff (Millwood)*. 2008;27(5):1389-98.
- 10 Braun RT, Yun H, Casalino LP, Myslinski Z, Kuwonda FM, Jung H-Y, et al. Comparative performance of private equity-owned US nursing homes during the COVID-19 pandemic. *JAMA Netw Open*. 2020;3(10):e2026702.
- 11 Bruch JD, Gondi S, Song Z. Changes in hospital income, use, and quality associated with private equity acquisition. *JAMA Intern Med*. 2020;180(11):1428-35.
- 12 D'Mello K. Hahnemann's closure as a lesson in private equity healthcare. *J Hosp Med*. 2020;15(5):318-20.
- 13 Lexa FJ, Lexa FJ. Private equity-backed hospital investments and the impact of the coronavirus disease 2019 (COVID-19) epidemic. *J Am Coll Radiol*. 2020;17(8):1049-52.
- 14 Kutscher B. Daughters of Charity gets \$250M lifeline from private-equity firm. *Modern Healthcare* [serial on the Internet]. 2015 Jul 17 [cited 2021 Sep 15]. Available from: <https://www.modernhealthcare.com/article/20150717/NEWS/150719916/daughters-of-charity-gets-250m-lifeline-from-private-equity-firm>
- 15 Horwitz JR. Making profits and providing care: comparing nonprof-

- it, for-profit, and government hospitals. *Health Aff (Millwood)*. 2005; 24(3):790–801.
- 16** Horwitz JR, Nichols A. What do nonprofits maximize? Nonprofit hospital service provision and market ownership mix. Cambridge (MA): National Bureau of Economic Research; 2007 Jul [last updated 2008 Jun; cited 2021 Sep 15]. (NBER Working Paper No. 13246). Available from: <https://www.nber.org/papers/w13246>
- 17** Horwitz JR, Nichols A. Hospital ownership and medical services: market mix, spillover effects, and nonprofit objectives. *J Health Econ*. 2009;28(5):924–37.
- 18** CMS Hospital Cost Report (HCRIS) data 2000–2019. GitHub [serial on the Internet]. 2020 [cited 2021 Sep 15]. Available from: <https://github.com/asacarny/hospital-cost-reports>
- 19** To access the appendix, click on the Details tab of the article online.
- 20** Baghai R, Levine EH, Sutaria SS. Service-line strategies for US hospitals. *McKinsey Quarterly* [serial on the Internet]. 2008 Jul [cited 2021 Sep 15]. Available from: <https://healthcare.mckinsey.com/service-line-strategies-for-us-hospitals/>
- 21** Murphy K, Jain N. Global healthcare private equity and corporate M&A report 2020 [Internet]. Boston (MA): Bain and Company; 2020 Dec 3 [cited 2021 Sep 15]. Available from: https://www.bain.com/global/assets/noindex/2020/bain_report_global_healthcare_private_equity_and_corporate_ma_report_2020.pdf
- 22** Dalton A, Laser PT. An analysis of joint ventures and partnerships: health care entities and private equity firms [Internet]. Washington (DC): American Health Lawyers Association; 2019 Nov 20 [cited 2021 Sep 15]. Available from: <https://www.bradley.com/-/media/files/insights/publications/2019/11/an-analysis-of-joint-ventures-and-partnerships-health-care-entities-and-private-equity-firms.pdf>
- 23** Sorkin AR. HCA buyout highlights era of going private. *New York Times* [serial on the Internet]. 2006 Jul 25 [cited 2021 Sep 15]. Available from: <https://www.nytimes.com/2006/07/25/business/25buyout.html>
- 24** Harrington C, Olney B, Carrillo H, Kang T. Nurse staffing and deficiencies in the largest for-profit nursing home chains and chains owned by private equity companies. *Health Serv Res*. 2012;47(1 Pt 1):106–28.
- 25** Gustafsson L, Seervaiand S, Blumenthal D. The role of private equity in driving up health care prices. *Harvard Business Review* [serial on the Internet]. 2019 Oct 29 [cited 2021 Sep 15]. Available from: <https://hbr.org/2019/10/the-role-of-private-equity-in-driving-up-health-care-prices>
- 26** Tosteson ANA, Stout NK, Fryback DG, Acharyya S, Herman BA, Hannah LG, et al. Cost-effectiveness of digital mammography breast cancer screening. *Ann Intern Med*. 2008;148(1):1–10.
- 27** Pisano ED, Gatsonis C, Hendrick E, Yaffe M, Baum JK, Acharyya S, et al. Diagnostic performance of digital versus film mammography for breast-cancer screening. *N Engl J Med*. 2005;353(17):1773–83.
- 28** Hubbard RA, Zhu W, Onega TL, Fishman P, Henderson LM, Tosteson ANA, et al. Effects of digital mammography uptake on downstream breast-related care among older women. *Med Care*. 2012;50(12):1053–9.
- 29** Jeong IG, Khandwala YS, Kim JH, Han DH, Li S, Wang Y, et al. Association of robotic-assisted vs laparoscopic radical nephrectomy with perioperative outcomes and health care costs, 2003 to 2015. *JAMA*. 2017;318(16):1561–8.
- 30** Jayne D, Pigazzi A, Marshall H, Croft J, Corrigan N, Copeland J, et al. Effect of robotic-assisted vs conventional laparoscopic surgery on risk of conversion to open laparotomy among patients undergoing resection for rectal cancer: the ROLARR randomized clinical trial. *JAMA*. 2017;318(16):1569–80.
- 31** Childers CP, Maggard-Gibbons M. Estimation of the acquisition and operating costs for robotic surgery. *JAMA*. 2018;320(8):835–6.
- 32** Wilson M, Cutler D. Emergency department profits are likely to continue as the Affordable Care Act expands coverage. *Health Aff (Millwood)*. 2014;33(5):792–9.
- 33** Brown B, O'Donnell E, Casalino LP. Private equity investment in behavioral health treatment centers. *JAMA Psychiatry*. 2020;77(3):229–30.
- 34** Parwani V, Goldenberg M, Venkatesh A. Emergency department psychiatric observation units: good care and good money? *Acad Emerg Med*. 2021;28(1):141–3.
- 35** DeCook CA. Outpatient joint arthroplasty: transitioning to the ambulatory surgery center. *J Arthroplasty*. 2019;34(7S, 7s):S48–50.
- 36** Steiner CA, Karaca Z, Moore BJ, Imshaug MC, Pickens G. Surgeries in hospital-based ambulatory surgery and hospital inpatient settings, 2014 [Internet]. Rockville (MD): Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project; 2017 May [cited 2021 Sep 15]. (HCUP Statistical Brief No. 223). Available from: <https://www.hcup-us.ahrq.gov/reports/stat-briefs/sb223-Ambulatory-Inpatient-Surgeries-2014.pdf>
- 37** van Biesen T, Johnson T. Ambulatory surgery center growth accelerates: is medtech ready? [Internet]. Boston (MA): Bain and Company; 2019 Sep 23 [cited 2021 Sep 15]. Available from: <https://www.bain.com/insights/ambulatory-surgery-center-growth-accelerates-is-medtech-ready/>
- 38** Frack B, Grabenstatter K, Williamson J. Ambulatory surgery centers: becoming big business. *Executive Insights* [serial on the Internet]. 2017 [cited 2021 Sep 15]. Available from: https://www.lek.com/sites/default/files/insights/pdf-attachments/1925_Ambulatory_Surgery_Centers_Executive_Insights_v2.pdf
- 39** Badlani N. Ambulatory surgery center ownership models. *J Spine Surg*. 2019;5(Suppl 2):S195–203.
- 40** Rodriguez JL, Polk HC Jr. Profitable versus unprofitable expansion of trauma and critical care surgery. *Ann Surg*. 2005;242(4):603–6, discussion 606–9.