Supplementary Online Content

Braun RT, Jung HY, Casalino LP, Myslinski Z, Unruh MA. Association of private equity investment in US nursing homes with the quality and cost of care for long-stay residents. *JAMA Health Forum.* 2021;2(11):e213817. doi:10.1001/jamahealthforum.2021.3817

This supplementary material has been provided by the authors to give readers additional information about their work.

eAppendix. Identification of Private Equity Nursing Homes

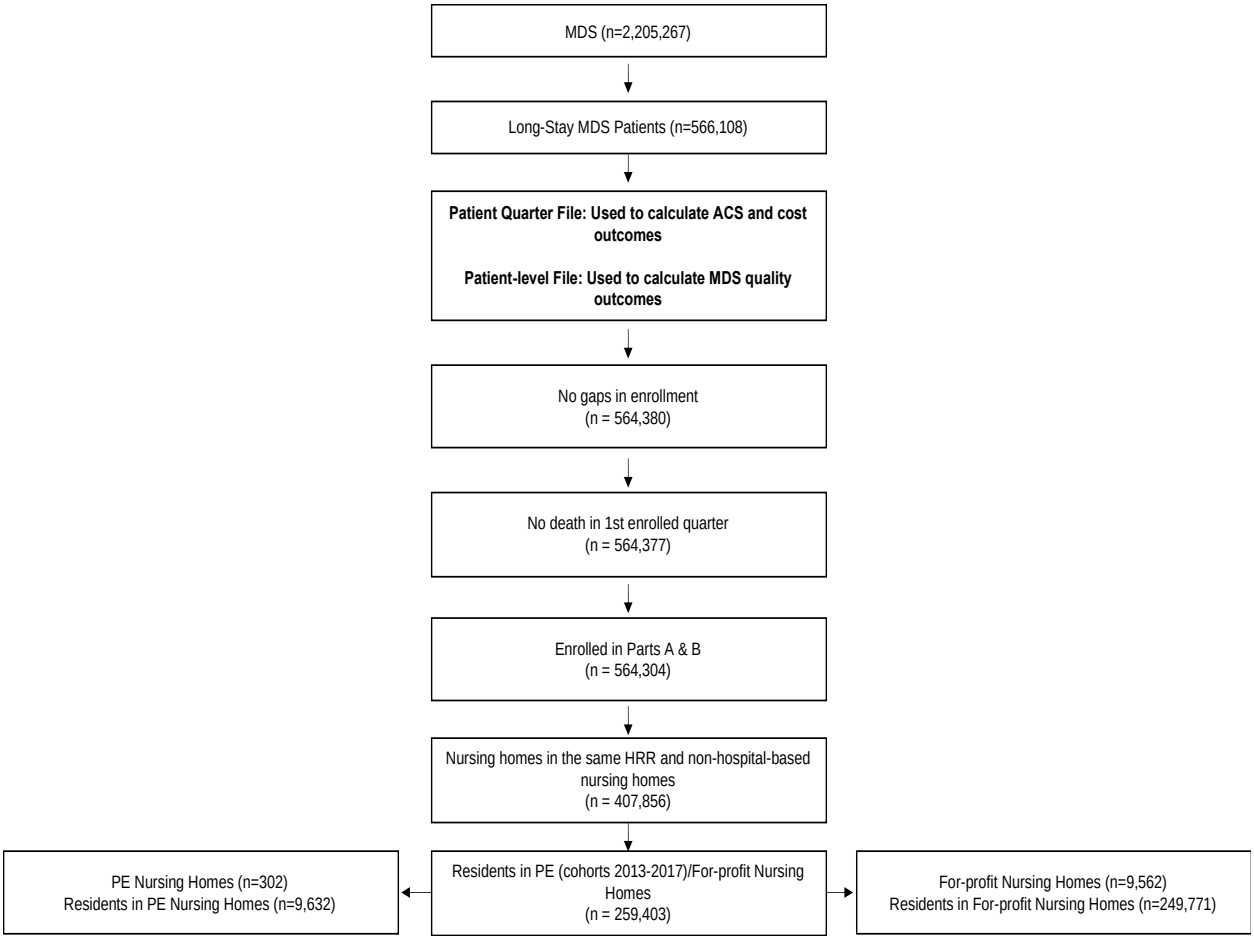
We identified nursing home acquisitions by private equity (PE) firms using a previously established methodology.[1] Acquisitions were identified from 2010 to 2020 using the S&P Capital IQ, Irving Levin Associates Health Care M&A, and Centers for Medicare & Medicaid Services (CMS) Nursing Home Compare Ownership databases, followed by web-based searches. These databases report transactions, including the acquisition announcement date, the name of the acquired nursing home, the platform nursing home that acquired the nursing home, and the PE firm that owns the nursing home. The Nursing Home Compare database provides a CMS Certification Number (CCN), nursing home name, address, owner name, and the date that ownership began.

We confirmed PE acquisitions in the S&P and Irving Levin databases by manually reviewing each acquirer's business profile using the CB Insights, Bloomberg Businessweek, Pitchbook, the acquirer's websites, and web-based searches to examine whether they were a PE firm or PE-backed platform nursing home. Next, we used key word searches in the Nursing home Compare database to identify PE firms and PE-backed platform nursing homes that were not in the S&P and Irving Levin databases. Identified acquisitions were then matched to the CMS Provider of Services file using nursing home name and address to obtain the CCN. More details on the list of PE firms that acquired nursing homes are provided in eTable 1.

eReference.

1. Braun RT, Yun H, Casalino LP, et al. Comparative Performance of Private Equity–Owned US Nursing Homes During the COVID-19 Pandemic. JAMA network open 2020;3:e2026702-e.

eFigure. Sample Selection



MDS: Minimum Data Set; ACS: ambulatory care sensitive; HRR: Hospital Referral Region; PE: private equity

eTable 1. Total Acquisitions by Private Equity Firms

PE Firms	Number of Transactions[1]	Number of Transactions in Cohorts (2013-2017)[1]
Arcapita	1	0
BayBridge Capital	8	6
Beechwood Capital	1	0
Birchwood Healthcare	5	3
Blue Ridge Capital	1	0
BlueMountain Capital	2	1
Cambridge Investment & Finance	1	0
Capital Senior Ventures	1	1
Capital Square 1031	1	0
Cascade Partners	8	3
Centre Partners	6	0
Colonial Care	1	0
Colony Capital	1	1
Consulate Health Care	1	0
EEF Capital	5	1
Esplanade Capital	1	0
Falcon Capital	2	2
Focus Healthcare Partners	1	0
Formation Capital	4	1
Fortress Investment Group	1	0
Fulcrum Growth Partners	2	2
Genesis Healthcare	49	0
GI Partners	1	0
Golden Gate National Senior Care	1	0
Grubb & Ellis Equity Advisors	1	0
Harrison Street Real Estate Capital	1	0
HCR Manor Care	5	0
Investment360	2	2
Javelin Capital Partners	1	0
Jeffersontown Opco	1	0
JER Partners	2	0
Kindred Healthcare	2	0
KKR & Co.	1	0
Liberty Group	1	1
Madison Partners	2	2
Millennium Management	1	0
Mission Healthcare	7	2
MVI Health Center	1	0

National Senior Care	4	2
Nationwide Health Properties	1	0
O&M Investments	6	2
Onex	8	7
Pathfinder Partners	1	1
Peace Capital	4	2
Pearl Senior Care	2	0
Plum Healthcare Group	1	0
Pritok Capital	5	5
ROC Seniors Australia Investment Company	1	1
ROC Seniors Housing Holdings	3	2
RSF Partners	1	1
Signature Healthcare	16	8
Silverstone Health Care	1	0
Stockwell Capital	1	0
TD Capital	1	0
The Carlyle Group	1	0
The Portopiccolo Group	1	0
Tiptree Financial Partners	1	0
Trilogy Health Services	9	3
Tryko Partners	9	5
Vanguard Healthcare	4	1
Vista Healthcare Investments	1	1
Warburg Pincus	1	0
Windward Health Partners	3	3
Unidentified Investor Groups	23	7
Total Transactions	**242**	**79**

[1] There were a total of 242 transactions merged on to claims data. Of the 242 transactions, 79 were between 2013-2017.

eTable 2. Chronic and Potentially Disabling Conditions[1]

	Chronic Condition
1	chronic_alzh_demen
2	chronic_alzh
3	chronic_ami
4	chronic_anemia
5	chronic_asthma
6	chronic_atrial_fib
7	chronic_cancer_breast
8	chronic_cancer_colorectal
9	chronic_cancer_endometrial
10	chronic_cancer_lung
11	chronic_cancer_prostate
12	chronic_cataract
13	chronic_chf
14	chronic_chronickidney
15	chronic_copd
16	chronic_depression
17	chronic_diabetes
18	chronic_glaucoma
19	chronic_hip_fracture
20	chronic_hyperl
21	chronic_hyperp
22	chronic_hypert
23	chronic_hypoth
24	chronic_ischemicheart
25	chronic_osteoporosis
26	chronic_ra_oa
27	chronic_stroke_tia
28	chronic_acp
29	chronic_alco
30	chronic_anxi
31	chronic_autism
32	chronic_bipl
33	chronic_brainj
34	chronic_cerpal
35	chronic_cysfib
36	chronic_depsn
37	chronic_drug
38	chronic_epilep
39	chronic_fibro
40	chronic_hearim

41	chronic_hepviral
42	chronic_hivaids
43	chronic_intdis
44	chronic_leadis
45	chronic_leuklymph
46	chronic_liver
47	chronic_migraine
48	chronic_mobimp
49	chronic_mulscl
50	chronic_musdys
51	chronic_obesity
52	chronic_othdel
53	chronic_oud_any
54	chronic_oud_dx
55	chronic_oud_hosp
56	chronic_oud_mat
57	chronic_psds
58	chronic_ptra
59	chronic_pvd
60	chronic_schi
61	chronic_schiot
62	chronic_spibif
63	chronic_spiinj
64	chronic_toba
65	chronic_ulcers
66	chronic_visual

1. Centers for Medicare and Medicaid Services. Chronic Conditions Data Warehouse. (Accessed January 25, 2021, at https://www2.ccwdata.org/web/guest/condition-categories)

eTable 3. Changes in Quality and Costs After Private Equity Acquisition Compared With For-Profit Nursing Homes Without Private Equity Ownership Using a Washout Period

Outcome	Adjusted	P-Value
Quality Measures		
Emergency Department visit (binary, n = 2,369,600)	2.0 [0.0-3.0]	.027
Hospitalization (binary, n = 2,369,600)	1.0 [0.0-1.0]	.021
Cost Measures		
Total costs (n=2,369,600) — $	217.53 [-77.60-512.66]	.15
Minimum Data Set Quality Measures		
Antipsychotic medications (binary, n = 229,520)	.00 [-1.0-2.0]	> 0.1
Severe pain (binary, n = 216,302)	.00 [-1.0-2.0]	> 0.1
Pressure ulcers (binary, n = 276,979)	1.0 [-0.4-1.0]	> 0.1

Observations in the year of acquisition were considered the washout period and excluded from the analysis.

Linear regressions were used for estimation. All models included the following covariates: age (65-69, 70-74, 75-79, 80-84, 85+), race (white, black, other non-white race), sex, dual-eligibility for Medicare and Medicaid, indicators for 66 chronic and potentially disabling conditions used for risk adjustment (see eTable 2 for a list of the chronic conditions), activities of daily living (ADL) score at initial assessment (scale 1-28), and severe cognitive impairment (scores greater than 3 on the 4-point Cognitive Function Scale). Nursing home characteristics included occupancy rate, an indicator for multi-facility chain affiliation, total number of beds, terciles of the distributions of the percentage of patients covered by Medicare and the percentage covered by Medicaid. Other covariates included fixed-effects for quarter, year, nursing home, Hospital Referral Region (HRR), and HRR interacted with year.

Standard errors were adjusted for clustering at the level of the nursing home.

95% confidence intervals in brackets

[1] Relative changes were derived from the sample by dividing the adjusted estimates for all outcomes by the unadjusted mean of the outcomes in the pre-acquisition period (year 2012).

eTable 4. Changes in Quality and Costs After Private Equity Acquisition Compared With For-Profit Nursing Homes Without Private Equity Ownership Using a Balanced Nursing Home Panel

	Preacquisition, 2012		Differential Change		
Outcome	**Complete Sample**		**Adjusted**	**P-Value**	**Relative Change[1]**
Quality Measures					
Emergency Department visit (binary, n = 2,235,339)	15.0		2.0 [0.3-3.3]	.019	13.3%
Hospitalization (binary, n = 2,235,339)	11.0		1.0 [0.3-1.0]	.002	9.1%
Cost Measure					
Total costs (n = 2,235,339) — $	6,945.90		310.90 [76.82 – 545.10]	.009	4.5%
Minimum Data Set Quality Measures					
Antipsychotic medications (n = 182,982)	22.0		0.2 [-1.14-2.0]	> .1	.9%
Severe pain (n = 171,186)	9.0		1.0 [-1.0-2.0]	> .1	11.1%
Pressure ulcers (n = 219,049)	4.0		1.0 [-.4 - 1.4]	> .1	25%

When we restrict the sample to nursing homes that were present across all years of the study period, there were 275 private equity-owned nursing homes and 8,407 for-profit nursing homes never owned by private equity firms in the same Hospital Referral Regions.

Linear regressions were used for estimation. All models included the following covariates: age (65-69, 70-74, 75-79, 80-84, 85+), race (white, black, other non-white race), sex, dual-eligibility for Medicare and Medicaid, indicators for 66 chronic and potentially disabling conditions used for risk adjustment (see eTable 2 for a list of the chronic conditions), activities of daily living (ADL) score at initial assessment (scale 1-28), and severe cognitive impairment (scores greater than 3 on the 4-point Cognitive Function Scale). Nursing home characteristics included occupancy rate, an indicator for multi-facility chain affiliation, total number of beds, terciles of the distributions of the percentage of patients covered by Medicare and the percentage covered by Medicaid. Other covariates included fixed-effects for quarter, year, nursing home, Hospital Referral Region (HRR), and HRR interacted with year.

Standard errors were adjusted for clustering at the level of the nursing home.

95% confidence intervals in brackets

[1] Relative changes were derived from the sample by dividing the adjusted estimates for all outcomes by the unadjusted mean of the outcomes in the pre-acquisition period (year 2012).

eTable 5. Pre-Trend Tests to Examine Outcomes of Private Equity Nursing Homes and For-Profit Nursing Homes Without Private Equity Ownership Prior to Acquisition

	Emergency Department Visits (n = 2,383,491)		Hospitalizations (n = 2,383,491)		Total Cost of Care (n = 2,383,491)	
yminus5	-3**	[-5, -1]	-1**	[-2, -0.3]	136.4	[-223.5, 496.4]
yminus4	-2	[-5, 2]	-1	[-1, 0.2]	-272.0	[-704.8, 160.9]
yminus3	0.2	[-2, 3]	-1**	[-2, -0.4]	-383.9*	[-688.6, -79.10]
yminus2	-0.2	[-2, 2]	-0.1	[-1, 0.4]	-50.24	[-319.3, 218.8]
yminus1	N/A	N/A	N/A	N/A	N/A	N/A
yplus0	1*	[0.3, 2]	0.4	[-0.4, 1]	208.2	[-70.78, 487.1]
yplus1	2***	[1, 3]	0.5	[-0.3, 1]	197.7	[-125.8, 521.3]
yplus2	1	[-1, 3]	0.3	[-1, 1]	82.3	[-328.9, 493.5]
yplus3	0.3	[-2, 3]	-1	[-2, 0.3]	92.84	[-458.6, 644.3]
yplus4	1	[-2, 5]	2*	[0.1, 3]	-24.79	[-931.1, 881.5]
yplus5	-6*	[-10, -0.2]	-1.0	[-5, 3]	-1075	[-3311.6, 1161.4]

	Antipsychotic Medication (n = 230,687)		Severe Pain (n = 217,284)		Pressure Ulcers (n = 278,188)	
yminus5	2	[-2, 5]	-0.1	[-5, 5]	0.3	[-1, 2]
yminus4	4	[-1, 8]	-2	[-5, 1]	-0.4	[-2, 1]
yminus3	-0.4	[-3, 2]	-4***	[-6, -2]	-0.4	[-2, 1]
yminus2	1	[-2, 5]	-2	[-5, 1]	0.03	[-2, 2]
yminus1	N/A	N/A	N/A	N/A	N/A	N/A
yplus0	0.4	[-2, 3]	-2*	[-5, -0.1]	0.3	[-0.1, 1]
yplus1	-0.1	[-3, 3]	-1	[-4, 2]	1	[-1, 2]
yplus2	3	[-0.02, 6]	-1	[-4, 2]	0.4	[-2, 2]
yplus3	-0.1	[-4, 3]	-1	[-4, 2]	0.4	[-1, 2]
yplus4	-2	[-7, 4]	-2	[-5, 2]	1	[-4, 5]
yplus5	16**	[4, 30]	7	[-6, 20]	-1	[-10, 7]

95% confidence intervals in brackets
* p<0.05, ** p<0.01, *** p<0.001

Linear regressions were used for estimation. All models included the following covariates: age (65-69, 70-74, 75-79, 80-84, 85+), race (white, black, other non-white race), sex, dual-eligibility for Medicare and Medicaid, indicators for 66 chronic and potentially disabling conditions used for risk adjustment (see eTable 2 for list of chronic conditions), activities of daily living (ADL) score at initial assessment (scale 1-28), and severe cognitive impairment (values greater than 3 on a 4-point Cognitive Function Scale). Nursing home characteristics included occupancy rate, an indicator for multi- facility chain affiliation, total number of beds, terciles of the distributions of the percentage of patients covered by Medicare and percentage covered by Medicaid. Other covariates included fixed-effects for quarter, year, nursing home, Hospital Referral Region (HRR), and HRR interacted with year.

Standard errors were adjusted for clustering at the level of the nursing home.