Evaluating trends in private equity ownership and impacts on health outcomes, costs, and quality: systematic review

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ABSTRACT

OBJECTIVE

To review the evidence on trends and impacts of private equity (PE) ownership of healthcare operators.

DESIGN

Systematic review.

DATA SOURCES

PubMed, Web of Science, Embase, Scopus, and SSRN.

ELIGIBILITY CRITERIA FOR STUDY SELECTION

Empirical research studies of any design that evaluated PE owned healthcare operators.

MAIN OUTCOME MEASURES

The main outcome measures were impact of PE ownership on health outcomes, costs to patients or payers, costs to operators, and quality. The secondary outcome measures were trends and prevalence of PE ownership of healthcare operators.

DATA SYNTHESIS

Studies were classified as finding either beneficial, harmful, mixed, or neutral impacts of PE ownership on main outcome measures. Results across studies were narratively synthesized and reported. Risk of bias was evaluated using ROBINS-I (Risk Of Bias In Non-randomised Studies of Interventions).

RESULTS

The electronic search identified 1778 studies, with 55 meeting the inclusion criteria. Studies spanned eight countries, with most (n=47) analyzing PE ownership of healthcare operators in the US. Nursing homes were the most commonly studied healthcare setting (n=17), followed by hospitals and dermatology settings (n=9 each); ophthalmology (n=7); multiple specialties or general physician groups (n=5); urology (n=4); gastroenterology and orthopedics (n=3 each); surgical centers, fertility, and obstetrics and gynecology (n=2 each); and anesthesia, hospice care, oral or maxillofacial surgery, otolaryngology, and plastics (n=1 each). Across the outcome measures, PE ownership was most consistently associated with increases in costs to patients or payers. Additionally, PE ownership was associated with mixed to harmful impacts on quality. These outcomes held in sensitivity analyses in which only studies with moderate risk of bias were included. Health outcomes showed both beneficial and harmful results, as did costs to operators, but the volume of studies for these outcomes was too low for conclusive interpretation. In some instances, PE ownership was associated with reduced nurse staffing levels or a shift towards lower nursing skill mix. No consistently beneficial impacts of PE ownership were identified.

CONCLUSIONS

Trends in PE ownership rapidly increased across almost all healthcare settings studied. Such ownership is often associated with harmful impacts on costs to patients or payers and mixed to harmful impacts on quality. Owing to risk of bias and frequent geographic focus on the US, conclusions might not be generalizable internationally.

SYSTEMATIC REVIEW REGISTRATION

PROSPERO CRD42022329857.

WHAT IS ALREADY KNOWN ON THIS TOPIC

Researchers have documented private equity (PE) ownership of healthcare operators

Despite much speculation, it is still unclear whether PE ownership is associated with improvements, exacerbations, or other changes in health outcomes, costs to patients or payers, costs to operators, and quality

WHAT THIS STUDY ADDS

The findings of this systematic review suggest that PE ownership of healthcare operators is increasing rapidly across settings

Such ownership may negatively impact costs to patients or payers, with generally mixed to harmful impacts on quality, warranting increased attention and possibly increased regulation

Introduction

Over the past decade, private equity (PE) firms have increasingly invested in, acquired, and consolidated healthcare facilities,[1] with global healthcare buyouts exceeding $200bn (£157bn; €184bn) since 2021 alone.[2] PE firms use capital from institutional investors and individuals of high net worth in combination with large amounts of debt to acquire other companies, and they generally seek to sell their holdings on a quick 3-5 year turnaround for substantial returns.[3] PE firms often enter fragmented markets through an "anchor investment," in which an initial "platform practice" is acquired and then used to acquire more practices in a region and to consolidate them.[4] One of the distinguishing features of PE investment is that the firms provide direct managerial oversight to acquired organizations, often making changes to increase valuation and future profit potential.[5]

The recent influx of PE ownership in the healthcare sector has prompted considerable speculation and debate among the medical community, pertaining to the possible impacts on healthcare delivery and the ethical dimensions of this form of investment structure.[6 7] Critics argue that PE ownership could jeopardize patient safety by prioritizing profits, overburdening healthcare companies with debt, impeding care delivery through ongoing management changes and sellouts, and over-emphasizing profitable service lines in place of less profitable ones.[1 8-10] Meanwhile,

proponents advocate that in addition to an infusion of capital, PE ownership may bring valuable managerial expertise, reduce operational inefficiencies, leverage economies of scale, and increase healthcare access by synergistically aligning profit incentives with high quality care provision.[11-14] These debates have spurred increased academic, medical, and regulatory attention to PE ownership in healthcare, such as by prompting the Medicare Payment Advisory Commission to compile a report for US Congress,[15] the American College of Physicians to publish a position statement,[6] and think tanks to compile policy responses.[16] Researchers have also identified the need for robust policy and legal frameworks to address the unique implications of PE ownership in healthcare.[17 18] Meanwhile, practicing physicians have debated how to respond when approached with an offer by PE investors, or if put into local market competition with them.[7 19 20]

Empirical research on the impacts of PE ownership on healthcare operators has slowly accumulated, drawing attention to both the accelerating magnitude of PE ownership across medical settings and the context sensitivity of its impacts on local market and regulatory conditions.[21 22] However, the relatively nascent body of literature on PE ownership in healthcare remains disjointed, with studies ranging across different medical settings and academic disciplines such as sociology, health services research, and economics. Although several overviews have been published about PE ownership in healthcare[23-25] as well as two research reviews that focused on the growth of PE ownership and its impacts on dermatology,[26 27] no systematic reviews have been published that comprehensively evaluated the impacts of PE ownership across healthcare settings globally. If PE ownership becomes increasingly prevalent within and across health systems, it is imperative to understand its influence on healthcare delivery and whether it differs from other institutional arrangements and management strategies. To combine the existing body of literature and synthesize individual study findings, we conducted a systematic review focused on the impacts of PE ownership on health outcomes, costs to patients or payers, costs to operators, and quality as primary measures, and the prevalence of PE ownership as a secondary measure. We present a narrative synthesis of the impacts of PE ownership on these outcomes, including critical appraisals of existing evidence.

Methods

This systematic review is reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement (see supplementary material 1).[28] The protocol for this review was developed in accordance with the PRISMA Protocol items (PRISMA-P)[29] and was prospectively registered with PROSPERO.

Eligibility criteria

Articles were eligible for inclusion if they contained original, empirical research on PE ownership of healthcare operators; addressed either the primary outcome measures (health outcomes, costs to patients or payers, costs to operators, and quality) or the secondary outcome measure (prevalence of PE ownership); contained data on years between 2000 and 2023 and were published within that timeframe; and were published in English. Studies of any design were eligible for inclusion—including quantitative, qualitative, or mixed methods approaches—as were studies involving any global geographic setting. Studies were excluded if they solely focused on non-operator healthcare organizations, such as laboratories or medical device companies, or if data on PE owned operators were not fully disaggregated from other ownership types, such as publicly traded companies.[30] We also excluded viewpoints and commentaries without empirical findings, and qualitative studies that only presented informant perspectives, as opposed to empirical documentation of PE related developments. For the purpose of this review, all forms of PE investment, including leveraged buyouts, minority stakes, and majority stakes, were classified as PE ownership, as is common in the literature. Different clinical environments, such as those grouped by medical specialty (eg, dermatology or urology) or operator type (eg, nursing homes or hospitals) are referred to as healthcare settings.

In the context of this review, we defined costs to patients or payers as measures relating to the amount charged, owed, or reimbursed by patients or payers. Costs to operators were defined as direct or indirect operating costs. Quality was defined as any measure included on an established, specialty specific evaluation instrument, or more general measures such as staffing per patient day or appointment availability. Health outcomes were defined as measures of any important health or disease state outside of routine care, such as mortality or hospital admission. For the purpose of this review, we classified hospital readmission from a previous care encounter as a quality metric.

Data sources

An electronic database search strategy was developed in collaboration with a medical research librarian. To obtain studies from a broad range of disciplines, we searched for those published between 2000 and 2023 on Embase, PubMed, Scopus, and Web of Science, as well as preprints published on SSRN, which is common practice in economics and other social sciences. We selected the year 2000 as a starting timepoint because global PE activity in healthcare began to increase noticeably only after the turn of the millennium.[31 32] We also believed that PE healthcare acquisitions before 2000 would be less relevant to present day acquisitions, nearly 25 years later. Two rounds of searches were conducted. The first search was performed on 9 June 2022, and the second search was done on 16 April 2023 to capture any additional studies that had been published since the first search. Supplementary material 2 provides the full search

strategy and list of search terms. All articles identified by our search strategy were retrieved and uploaded using Covidence systematic review software.[33]

Study selection

Two authors (AB and JDB) used Covidence systematic review software to independently screen titles and abstracts and remove duplicates. Studies that did not fit the inclusion criteria were excluded. Discrepancies were initially discussed collaboratively, and if consensus could not be reached, were resolved through a third author (ME); no disagreements occurred. AB and JDB retrieved and independently screened the full text of articles after title and abstract screening. Studies that did not match the inclusion criteria in the full text screening were excluded. Discrepancies were resolved through discussion between the same two authors until consensus was reached, with a third author (ME or GB) not needed to resolve disagreements. Two authors (AB and GB) independently extracted data on study characteristics using a pre-determined data extraction form, documenting for each study: authors, year published, study type, country evaluated, population evaluated, study period, comparison groups, whether primary measures were reported (health outcomes, costs to patients or payers, costs to operators, quality, or a combination of these factors, hereby referred to as impacts), whether secondary outcomes were measured (prevalence of PE ownership, hereby referred to as trends), time frame of data, and findings. For each category of health outcomes, costs to patients or payers, costs to operators, quality, or a combination of these factors, we also qualitatively documented whether the effects of PE ownership were found to be beneficial, harmful, mixed, or neutral. Any discrepancies were first discussed between the two authors (AB and GB) and escalated to a third author (JDB) if consensus could not be reached. Three authors (AB, GB, JDB) validated the final extraction results.

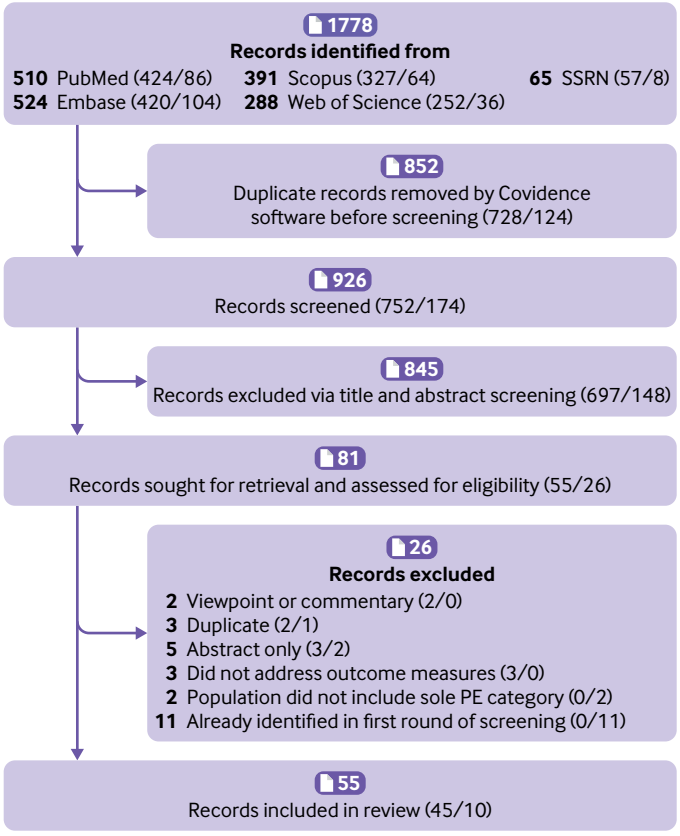

Fig 1 | Flow of studies through review. In each box, the numbers are from the searches on 9 June 2022 and 16 April 2023, respectively

Risk of bias within individual studies

Two authors (AB and GB) independently assessed risk of bias for each quantitative study using the Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I) tool.[34] The authors rated each of the seven domains for overall risk of bias as low, moderate, serious, or critical, with a third author (JDB) providing a final assessment for discrepancies in overall bias judgment. Generally, studies that were cross sectional and had limited control variables were rated as having serious or critical risk of bias due to uncontrolled confounding. Qualitative studies were assessed for quality and inclusion using the Joanna Briggs Institute Critical Appraisal Checklist for Qualitative Research.[35] Risk of bias was not assessed for studies that solely reported trends in PE ownership or market share with no findings related to the impacts of PE ownership.

Data synthesis

Studies that addressed main outcome measures were classified as reporting beneficial, harmful, mixed, or neutral impacts of PE ownership on health outcomes, costs, or quality, or a combination of these factors. Beneficial impacts consisted of improved health outcomes, reduced costs to patients or payers, reduced costs to operators, or improved quality at PE owned operators. Harmful impacts consisted of worse health outcomes, greater costs to patients or payers, greater costs to operators, or worse quality at PE owned operators. If a study found both beneficial and harmful impacts, the impact domain was classified as mixed, and if no differences were apparent, the impact domain was classified as neutral.

Two authors independently determined classifications using a holistic evaluation scheme. First, study results were extracted and each statistically significant finding ($P \leq 0.05$), effect size, and confidence interval (or standard error if not available) was recorded. Taking into account the study design, the authors' stated primary versus secondary outcome measures, and the authors' interpretations of their findings, we assigned beneficial, harmful, mixed, or neutral ratings to each domain within each study.

We narratively synthesized the relevant findings and looked for consistencies and divergences both within and across healthcare settings. To check the robustness of the full sample findings, we performed a sensitivity analysis including only studies with a moderate risk of bias. An additional sub analysis was performed on

Table 1 | Included studies with identified impacts of private equity ownership. Studies are in alphabetical order (continued in table 2 and table 3)

Reference	Country	Participants	Comparisons	Primary outcomes	Study period	Study type	Findings related to primary outcomes
Borsa and Bruch 2022[36]	USA	Fertility practices	Non-PE	Health outcomes, quality	2018	Cross sectional	No differences in fertility success rates or quality were identified
Bos and Harrington 2017*[37]	USA	Nursing homes	Non-PE (for profit)	Quality	2000-12	Case study, longitudinal, mixed methods	PE facilities had lower RN staffing hours per patient day pre-acquisition and post-acquisition compared with controls PE facilities had lower total nurse staffing (RN+LVN+CNA) hours per patient day pre-acquisition and post-acquisition compared with controls PE facilities had lower numbers of total deficiencies pre-acquisition, but comparable scores to the national average post-acquisition, indicating a worsening of quality
Bos et al 2020[38]	Netherlands	Nursing homes	Non-PE (for profit)	Quality	2014-17	Cross sectional, interviews, mixed methods	PE facilities had lower employee quality scores relative to controls (8.46 (0.44) *v* 8.91 (0.44), P<0.01) PE facilities had lower client rating scores relative to controls PE facilities had lower recommendation scores relative to controls (0.92 (0.07) *v* 0.97 (0.04), P<0.05)
Braun et al 2021[39]	USA	Dermatology practices	Non-PE	Costs to patients or payers	2012-17	Longitudinal	Prices paid for routine visits were significantly higher for PE dermatologists relative to controls 7 quarters after acquisition ($2.60 or 4%, P<0.05) and 9 quarters after and beyond ($3.20 or 5%, P<0.05)
Braun et al 2021[60]	USA	Nursing homes	Non-PE (for profit)	Health outcomes, costs to patients or payers, quality	2012-18	Longitudinal	PE nursing homes had a relative increase in ambulatory care sensitive emergency department visits relative to controls from pre-acquisition to post-acquisition (11.1%, or 1.7 pp (0.3 to 3.0 pp); P=0.02) PE nursing homes had a relative increase in ambulatory care sensitive emergency department hospital admissions relative to controls from pre-acquisition to post-acquisition (8.7%, or 1.0 pp (0.2 to 1.1 pp); P=0.003) PE nursing homes had a relative increase in total quarterly costs relative to controls from pre-acquisition to post-acquisition (3.9%, or $270.37 ($41.53 to $499.20); P=0.02) No statistically significant differences were found in use of antipsychotics, pressure ulcer incidence, or self-reported severe pain
Braun et al 2020[40]	USA	Nursing homes	Non-PE (for profit, non-profit, government)	Health outcomes, quality	2020	Cross sectional	PE homes reported more confirmed covid-19 cases per 1000 residents relative to government nursing homes (35.5 (1.8 to 69.2), P=0.03) For-profit, non-profit, and government nursing homes were more likely to report having at least a one week supply of N95 masks compared with PE homes (10.5% or 9.1 pp (1.8 to 16.3 pp.), P=0.006; 15.0% or 13.0 pp (5.5 to 20.6 pp), P<0.001; 17% or 14.8 pp (6.5 to 23.0 pp), P<0.001, respectively) For-profit, non-profit, and government nursing homes were more likely to have at least a one week supply of medical gowns than PE homes (24.3% or 21.3 pp (11.8 to 30.8 pp), P<0.001; 30.7% or 27.0 pp (17.7 to 36.2 pp), P<0.01; 29.2% or 25.7 pp (16.1 to 35.3 pp), P<0.001, respectively) Government nursing homes had a higher probability of having a nursing shortage than PE homes (6.9 pp (0.0 to 13.9 pp), P=0.049)
Broms et al 2023[61]	Sweden	Nursing homes	Non-PE (for profit, non-profit)	Quality	2012-19	Longitudinal	PE nursing homes had lower staffing density compared with private nursing homes (−2.034 (0.007), or approximately 2 staff per 100 residents, P<0.01) PE nursing homes had lower staff education compared with private nursing homes (−4.534 pp (0.007), P<0.01) PE nursing homes had lower staff density compared with non-profit nursing homes (−3.240 (0.000), or approximately 3 staff per 100 residents, P<0.001) PE nursing homes had higher care plan ratings compared with non-profit nursing homes (1.844 (0.035), P<0.05) PE nursing homes also reported lower nurse education and client satisfaction scores
Bruch et al 2023[62]	USA	Dermatology, ophthalmology, and gastroenterology physician practices	Non-PE	Quality	2014-19	Longitudinal	Clinicians at PE clinics had a higher relative probability of both entering and exiting the practice, relative to controls (15.74 pp (10.79 to 20.69), P<0.001; 6.00 pp (1.91 to 10.07), P=0.004, respectively)

(*Continued*)

Table 1 | Continued

Reference	Country	Participants	Comparisons	Primary outcomes	Study period	Study type	Findings related to primary outcomes
Bruch et al 2022[63]	USA	Ambulatory surgical centers	Non-PE	Health outcomes; costs to patients or payers	2009-17	Longitudinal	No statistically significant relative differences were found in the probability of an unplanned hospital visits between PE and non-PE centers No statistically significant relative differences were found in total costs per patient between PE and non-PE centers
Bruch et al 2021[41]	USA	Hospitals	Non-PE	Quality, costs to patients or payers	2018	Cross sectional	PE hospitals had lower patient experience scores relative to controls (−2.68 (−3.56 to −1.80), P<0.001) PE hospitals had fewer full time equivalent employees than non-PE hospitals, adjusted for occupied beds (−164.9 (−250.6 to −79.1), P<0.001) No differences in patient charges or charge-to-cost ratios were identified
Bruch et al 2020[42]	USA	Hospitals	Non-PE	Costs to patients or payers, quality	2002-18	Longitudinal	PE hospitals had an increase in total charge per inpatient day relative to controls from pre-acquisition to post-acquisition ($407 ($296 to $518), P<0.001) PE hospitals had an increase in emergency department charge-to-cost ratio relative to controls from pre-acquisition to post- acquisition (0.61 (0.48 to 0.73), P<0.001) PE hospitals had an increase in total charge-to-cost ratio relative to controls from pre-acquisition to post- acquisition (0.31 (0.26 to 0.37), P<0.001) PE hospitals had an increase in acute myocardial infarction quality scores relative to controls from pre-acquisition to post-acquisition (3.3 pp (1.6 to 5.0 pp), P=0.002) PE hospitals had an increase in pneumonia quality scores relative to controls from pre-acquisition to post-acquisition (2.9 pp (1.8 to 3.9 pp), P<0.001)

Standard errors are reported when studies did not provide confidence intervals.
$1.00 (£0.79; €0.92).
CNA=certified nursing assistant; LVN=licensed vocational nurse; PE=private equity; pp=percentage points; RN=registered nurse.
*Panel data with a high volume of coefficients are reported qualitatively.

studies in nursing homes to identify impacts within settings, as this was the most commonly investigated setting.

Statistical analysis

Owing to the differences in study designs, healthcare operators, comparators, outcomes assessed, and outcome measurements, no meta-analyses were performed.

Public and patient involvement

No patients or members of the public were involved in the design, development of outcome measures, or other aspects of the conduct of this study, as no funding was set aside for public or patient involvement. This review was, however, motivated in part by patients and members of the public who have expressed uncertainty about the impacts of PE ownership in healthcare.

Results

Overall, 1778 articles were identified from the two database searches, 852 of which Covidence automatically removed as duplicates. The titles and abstracts of the remaining 926 studies were screened, yielding 81 studies for full text review. During this stage, 26 further studies were excluded, leaving 55 studies in the final sample (fig 1). Of these studies, 32 evaluated the impacts of PE ownership on at least one category of health outcomes, costs to patients or payers, costs to operators, or quality, or a combination of these factors,[22 36-66] (table 1, table 2, and table 3) and 38 reported trends or prevalence of PE among healthcare operators (see supplementary material 3).[21 36 38-42 45 49 53 55 60 61 63-65 67-88] Fifteen studies in total reported findings for both impacts and trends.[36 38-42 45 49 53 55 60 61 63-65]

Risk of bias

Risk of bias was assessed for the 31 studies that quantitatively analyzed and reported findings for at least one of: health outcomes, costs to patients or payers, costs to operators, or quality (fig 2).

According to the ROBINS-I tool, overall risk of bias was rated as moderate in 19 studies,[22 39 42-45 47 48 50 51 53 56-58 60 62 63 65 66] serious in nine studies,[36 40 41 46 49 54 59 61 64] and critical in three studies.[37 38 55] No studies were rated as having low risk of bias. Confounding was the domain most frequently rated as serious or critical risk of bias and concerned 12 studies (see supplementary material 4). Although many studies used comprehensive and sophisticated statistical techniques to account for possible confounding and the non-random administration of the intervention and inclusion, other studies were less rigorous. Additionally, few studies provided detailed information on data missingness. Many studies used thorough identification strategies to document when healthcare operators obtained, lost, or already had PE ownership, and comprehensively reported subgroup analyses and effect estimates, including in supplemental materials.

Table 2 | Included studies with identified impacts of private equity ownership. Studies are in alphabetical order (continued from table 1)

Reference	Country	Participants	Comparisons	Primary outcomes	Study period	Study type	Findings related to primary outcomes
Cerullo et al 2022[43]	USA	Hospitals	Non-PE	Costs to operator, quality	2002-17	Longitudinal	PE hospitals were associated with a decrease in cost per adjusted discharge (−$431.6 ($−622.2 to $−241.0), P<0.001) PE hospitals were associated with a decrease in total staff FTEs per occupied bed (−0.50 (−0.71 to −0.30), P<0.001), as well as a decrease in total RN and LPN FTEs (−0.04 (−0.07 to −0.02), P<0.01), suggesting lower nurse staffing
Cerullo et al 2022*[44]	USA	Hospitals	Non-PE	Health outcomes, costs to patients or payers, quality	2001-18	Longitudinal	PE hospitals showed a relative decrease in acute myocardial infarction in-hospital mortality compared with controls (−1.14 pp (−1.86 to −0.42 pp), P=0.03) from pre-acquisition to post-acquisition PE hospitals showed a relative decrease in acute myocardial infarction 30 day mortality compared with controls (−1.41 pp (−2.26 to −0.56 pp), P=0.03) from pre-acquisition to post-acquisition No differences in 30 day payments, or 30 day readmissions for acute myocardial infarction, acute stroke, chronic obstructive pulmonary disease, congestive heart failure, or pneumonia were identified
Cerullo et al 2021[45]	USA	Hospitals	Non-PE	Quality	2004-18	Longitudinal	Relative to controls, PE hospitals were more likely to offer certain profitable services lines after PE acquisition: robotic surgery (6.2%, P<0.001), digital mammography (4.1%, P=0.02), adult interventional cardiac catheterization (3.8%, P=0.01), in-hospital hemodialysis (3.6%, P=0.01), free-standing or satellite emergency department (2.5%, P=0.03), birthing room or labor and delivery (2.3%, P=0.01) Relative to controls, PE hospitals were less likely to offer inpatient orthopedic surgery after acquisition (profitable service line) (−2.6%, P=0.03) Relative to controls, PE hospitals were less likely to offer outpatient psychiatric care after acquisition (unprofitable service line) (−4.0%, P=0.001) Relative to controls, PE hospitals were more likely to offer psychiatric emergency services after acquisition (unprofitable service line) (4.0%, P=0.01) Relative to controls, PE hospitals were less likely to offer ambulance services after acquisition (miscellaneous) (4.9%, P<0.001)
Creadore et al 2021[46]	USA	Dermatology clinics	Non-PE	Quality	2020	Cross sectional	Appointment availability for patients with Blue Cross Blue Shield was higher at PE clinics than at control clinics (98.5% (96% to 99%) *v* 94.6% (92% to 96%), P=0.03) Appointment availability for patients with Medicare was higher at PE clinics than at control clinics (97.5% (94% to 99%) *v* 92.8% (90% to 95%), P=0.02) PE clinics were more likely than controls to have appointments available with NPCs (80% (75% to 84%) *v* 63% (59% to 67%), P=0.001) PE clinics were more likely to have a next day appointment with any clinician relative to control clinics (30% (26% to 35%) *v* 21% (19% to 21%), P=0.001)
Gandhi et al 2020[22]	USA	Nursing homes	Non-PE	Quality	1993-2017	Longitudinal	From pre-2006 to post-2009, PE facilities showed both higher and lower levels of CNA, LPN, and total nursing expenditures, performing better under high scrutiny and reporting conditions and worse under low scrutiny and reporting conditions After the implementation of the Five-Star rating system in 2009, PE facilities had fewer health inspection deficiencies relative to controls (−5.501, P<0.05) After the implementation of the Five-Star rating system in 2009, PE facilities had greater long-stay quality scores relative to controls (2.777, P<0.01)
Gandhi et al 2020[47]	USA	Nursing homes	Non-PE; previously PE	Health outcomes, quality	2020	Cross sectional	PE was associated with an average decrease in the probability of confirmed covid-19 outbreaks in residents relative to controls (−7.1 pp (−11.3 to −2.9 pp), P<0.001) PE was associated with an average decrease in the probability of suspected covid-19 outbreaks in residents relative to controls (−13 pp (−17.8 to −8.3 pp), P<0.001) PE was associated with a decrease in the probability of confirmed covid-19 outbreaks in staff relative to controls (−5.4 pp (−9.8 to −1.1 pp), P=0.014) PE was associated with a decrease in the probability of suspected covid-19 outbreaks in staff relative to controls (−8.7 pp (−13.4 to −4.0 pp), P<0.001) PE was associated with a decrease in the likelihood of having a shortage of N95 masks (−6.4, P<0.01), surgical masks (−7.6 pp, P<0.01), protective eyewear (−4.8 pp, P<0.01), gowns (−7.0 pp, P<0.01), and gloves (−3.3 pp, P=0.02) relative to controls

(*Continued*)

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Table 2 | Continued

Reference	Country	Participants	Comparisons	Primary outcomes	Study period	Study type	Findings related to primary outcomes
Gupta et al 2021[†48]	USA	Nursing homes	Non-PE	Health outcomes, costs to patients or payers, costs to operators, quality	2000-17	Longitudinal	PE was associated with an increase in mortality during stay duration and 90 days after discharge (0.0169 (0.007), P<0.05) PE was associated with an increase in the log amount billed per patient stay (0.1777 (0.028), P<0.01) PE was associated with an increase in the log amount billed per patient stay and up to 90 days post-discharge (0.1054 (0.024), P<0.01) PE was associated with worse Five-Star overall quality scores (−0.082 (0.036), P<0.05) PE was associated with a lower level of all staffing per patient day (−0.048 (0.016), P<0.01) PE was associated with a lower level of CNA staffing per patient day (−0.066 (0.010), P<0.01) PE was associated with a lower level of LPN staffing per patient day (−0.019 (0.006), P<0.01) PE was associated with a greater level of RN staffing per patient day (0.037 (0.005), P<0.01) PE was associated with greater building lease costs for facilities (0.560 (0.061), P<0.01) PE was associated with worse quality scores pertaining to patient antipsychotic medication use, patient mobility scores, and deficiencies
Harrington et al 2012[49]	USA	Nursing homes	Non-PE (for profit, non-profit, government)	Quality	2003-08	Longitudinal	Relative to controls, PE homes showed an increase in total number of deficiencies in years 2006 and 2007 post-sale years relative to pre-sale years (0.197 (0.083), P<0.05; 0.205 (0.075), P<0.01, respectively) Relative to controls, PE homes showed an increase in number of severe deficiencies in 2006 and 2007 post-sale years relative to controls (0.450 (0.192), P<0.05; 0.393 (0.173), P<0.05, respectively)
Huang and Bowblis 2019[‡50]	USA	Nursing homes	Non-PE (for profit)	Quality	2005-10	Longitudinal	PE was associated with mixed impacts on multiple quality indicators, including catheter use, bowel/bladder incontinence, physical mobility, pressure ulcers, contractures, anti-anxiety medication use, and antidepressant medication use

$1.00 (£0.79; €0.92).
CNA=certified nursing assistant; FTE=full time equivalent; LVN=licensed vocational nurse; NPC=non-physician clinician.
*Mortality was categorized as a health outcome and readmission was categorized as a quality metric.
†Impacts are classified as negative, in alignment with the authors' reporting, as the increase in RN staffing was offset by larger decreases in CNAs and LPNs staffing.
‡Reported results are from the 2SRI model without fixed effects in the referenced manuscript (table 4, column 3).

Study characteristics

The included studies spanned eight countries, with most (n=47) evaluating PE ownership of healthcare operators solely in the US.[21 22 36 37 39 40-58 60 62 63 65 66 68 69 70 71 72 75-84 86-88] Other regions that were analyzed independently included Sweden (n=2),[59 61] the UK, Turkey, the Netherlands, Canada, and Germany (n=1 each).[38 64 67 73 85] One study compared developments across Canada, Norway, Sweden, the UK, and the US.[74] In total, studies assessed 16 different medical settings: nursing homes[22 37 38 40 47-50 56-61 64 67 74] were the most commonly studied settings (n=17) followed by hospital[41-45 52 53 55 73] and dermatology[39 46 62 77 78 83 84 88 65] settings (n=9 each); ophthalmology[62 65 72 81 82 86 88] (n=7); urology[54 66 80 88] (n=4); gastroenterology[62 65 88] and orthopedics[69 79 88] (n=3 each); surgical centers,[63 68] fertility,[36 71] and obstetrics and gynecology[71 88] (n=2 each); and anesthesia,[51] hospice care,[70] oral or maxillofacial surgery,[75] otolaryngology,[87] and plastics[76] (n=1 each). Five studies considered multiple specialties or general physician groups.[21 62 65 85 88] Among nursing home studies, 14 included nursing homes specifically[22 37 38 40 47-50 56-60 74] and three included either residential or long term care homes, which tend to provide more daily living and social support.[61 64 67]

Impacts of PE ownership

Among studies analyzing impacts, the greatest number concerned measures related to quality of care (n=27 total),[22 36-38 40-50 52-56 58-62 64 66] followed by costs to patients or payers (n=12 total),[39 41 42 44 48 51 53 55 60 65 66 89] health outcomes (n=8 total),[36 40 44 47 48 53 60 63] and costs to operators (n=5 total)[43 48 53 55 57] (fig 3). The nursing home setting was most commonly included (n=15) across impact studies, followed by hospitals (n=8); dermatology (n=4); ophthalmology, gastroenterology, urology, and multiple specialties or general physician groups (n=2 each); and surgical centers, fertility, and anesthesiology (n=1 each). Across all studies of health outcomes, costs to patients or payers, costs to operators, or quality, 22 used longitudinal designs,[22 37 39 42-45 48-51 53 55-58 60-63 65 66] nine were cross sectional,[36 38 40 41 46 47 54 59 64] and one was a qualitative case comparison.[52]

Health outcomes

Of the eight studies that included health outcomes, two found beneficial impacts[44 47] and three found harmful impacts,[40 48 60] and in three the findings were neutral.[36 53 63] Six of the studies had a moderate risk of bias[44 47 48 53 60 63] and two had a serious risk.[36 40] Because the volume of studies determining the impacts on health outcomes was low, and findings were mixed, no definitive conclusions could be drawn.

Cerullo and colleagues showed a relative decrease in in-hospital mortality due to acute myocardial infarction and in 30 day mortality in PE owned hospitals compared with non-PE, non-federally owned controls, although this finding was primarily driven by

Table 3 | Included studies with identified impacts of private equity ownership. Studies are in alphabetical order (continued from table 1 and table 2)

Reference	Country	Participants	Comparisons	Primary outcomes	Study period	Study type	Findings related to primary outcomes
La Forgia et al 2022[51]	USA	Outpatient anaesthesia facilities (hospitals, ASCs operated by physician management companies)	Non-PE (facilities operated by physician management companies)	Costs to patients or payers	2012-17	Longitudinal	Contracting with a PE physician management company was associated with increased allowed amounts relative to controls ($187.06 ($133.59 to $240.52) or 26%, P<0.001) Contracting with a PE physician management company was associated with increased allowed amounts by $97.18 ($97.18 ($35.38 to $158.97), P=0.002) more than a physician management company without PE
La France et al 2021[52]	USA	Hospital health systems	Non-PE (non-profit)	Quality	2010-19	Case comparison, qualitative review	Non-PE hospital system retained status as pioneer accountable care organization and increased quality scores during expansion; PE hospital system had a decline in quality scores during post-acquisition expansion
Liu 2021[53]	USA	Hospitals	Non-PE	Health outcomes, costs to patients or payers, costs to operator, quality	2013-19	Longitudinal	PE acquisition was associated with increased negotiated prices between a hospital and a private insurer (32%, P<0.01) PE acquisition was associated with an increase in health spending for all privately insured beneficiaries in local markets where PE acquisition occurred (11%, P<0.01), driven by higher PE bargaining with private insurers and a spillover effect to other local competitors Average cost per patient discharge significantly decreased starting 2 years after PE acquisition Hospital-wide 30 day readmission rates significantly decreased after PE acquisition Outpatient brain and sinus CT scan efficiency significantly increased after PE acquisition After PE acquisition, patient consumer scores significantly decreased for: rooms kept clean, doctor communication, nurse communication, explained medicines, staff helpful, overall rating, pain well controlled, would recommend to others, and patients understood care After PE acquisition, significant decreases were observed in certain service lines being offered: ambulatory surgical centers, computer assisted orthopedic surgery, certified trauma center, oncology services, robotic surgery No differences in 30 day mortality rates after acquisition were identified
Nie et al 2022[66]	USA	Urology practices	Non-PE	Costs to patients or payers, quality	2012-19	Longitudinal	PE urologists received greater inflation adjusted mean Medicare payments post-acquisition ($274 221 ($4289 to $544 153) or 11.0% relative change, P=0.054) while non-PE urologists' payments decreased (−$150 452 (-$16 924 to -$283 980) or −6.0% relative change, P<0.001) Of the 10 healthcare common procedure coding system codes with the largest pre-acquisition difference in mean payment between PE urologists and controls, 4 remained the same post-acquisition, and the other 6 were replaced with higher revenue generating codes ($785 *v* $233, on average) The magnitude of difference in payments and volume between PE and non-PE urologists doubled for CPT 99213 (established patient visit – 15 minutes) but was reduced by 40.3% for CPT 99214 (established patient visit – 25 minutes) as PE urologists simultaneously saw more patients post-acquisition (945.1 (616.7 to 1273.5) or 12.5% relative change, P<0.001), indicating shorter appointment times on average
Nie et al 2022[54]	USA	Urology practices	Non-PE	Quality	2021	Cross sectional	Appointment availability for patients with Medicaid was higher at controls relative to PE facilities (66.8% (60.4% to 73.2%) *v* 52.1% (45.0% to 59.2%); P=0.003) Commercially insured patient appointment availability was greater at PE facilities relative to controls (100% (100% to 100%) *v* 98.1% (96.2% to 99.9%), P=0.047) PE acquisition was independently associated with lower odds of appointment availability for patients with Medicaid (0.55 (0.37 to 0.83), P=0.004) PE practices had shorter mean wait times relative to controls (17.5 *v* 21.4 days, P=0.017)

(*Continued*)

Table 3 | Continued

Reference	Country	Participants	Comparisons	Primary outcomes	Study period	Study type	Findings related to primary outcomes
Offodile et al 2021[55]	USA	Hospitals	Non-PE (non-governmental)	Costs to patients or payers, costs to operator, quality	2003-17	Longitudinal	All staffing (FTE hours per 1000 patient days) was lower at PE hospitals relative to controls (20.07 *v* 24.7, P<0.001) Total operating expenses per discharge was lower at PE hospitals relative to controls ($10 018 *v* $11 690, P<0.001) Charge-to-cost ratio was greater at PE hospitals relative to controls (7.72 *v* 4.82, P<0.001)
Patwardhan et al 2022[64]	England	Nursing homes	Non-PE (non-profit, public)	Quality	2020	Cross sectional	PE homes were more likely to not meet regulator's requirements in overall quality ratings compared with controls (6.6 pp (2.9 to 10.2), P<0.01) PE homes were more likely to not meet regulator's requirements for multiple quality subdomains
Pradhan et al 2014*[56]	USA	Nursing homes	Non-PE (for-profit)	Quality	2000-07	Longitudinal	PE nursing homes had lower RN hours per patient day relative to controls (−29.2% (7.3), P<0.001) PE homes had higher LPN hours per patient day relative to controls (6.9% (3.2), P<0.05) PE homes had higher CNA hours per patient day relative to controls (30.4% (6.9), (P<0.001) CNA hours decreased with each year of PE ownership (−7.2% (0.014), P<0.001) PE homes had higher total deficiencies relative to controls (21.4% (8.7), P<0.05) PE homes had a lower odds of being reported for an actual harm citation relative to controls (0.53 (0.19), P<0.01) PE homes had worse scores for additional quality metrics including pressure sore/ulcer prevention restorative ambulation
Pradhan et al 2013[57]	USA	Nursing homes	Non-PE (For-profit)	Costs to operator	2000-07	Longitudinal	PE nursing homes reported 11% higher operating costs per patient day (P<0.001)
Singh et al 2022[65]	USA	Dermatology, ophthalmology, gastroenterology physician practices	Non-PE (independent)	Costs to patients or payers	2016-20	Longitudinal	Both average allowed amount per claim and average charges per claim increased for PE practices in each of the 8 quarters after acquisition PE acquired practices experienced a reduction in share of total spending on out-of-network services (-5.4%, (−9.5% to −1.0%); P=0.01)
Stevenson and Grabowski 2008†[58]	USA	Nursing homes	Non-PE (for profit)	Quality	1999-2007	Longitudinal	PE was associated with a decrease in RN staffing hours per resident day (−3.14, P<0.05) PE was associated with an increase in nurse aide staffing hours per resident day (2.24, P<0.05) PE was associated with mixed impacts on multiple other quality indicators, including measures on pressure ulcers, weight loss, and daily living
Winblad et al 2017[59]	Sweden	Nursing homes	Non-PE (public, private, private for profit, private non-profit)	Quality	2011	Cross sectional	PE nursing homes had fewer employees per resident than public nursing homes (−0.09 (0.02), P<001) PE homes had better quality indicator scores, including on measures related to care plans, medication review, pressure ulcer screenings, and malnutrition

$1.00 (£0.79; €0.92).
CNA=certified nursing assistant; FTE=full time equivalent; LPN=licensed practical nurse; PE=private equity; pp=percentage points; RN=registered nurse.
*Results reported as presented in table 3 of the referenced study. Discrepancies in effect sizes were observed in the body text, which stated that CNA hours per patient day compared with controls were 12% higher as opposed to 30.4% higher, and that pressure score prevention scores decreased by 5% each year, whereas the table indicated a non-time sensitive, statistically significant coefficient of −9.9%, and a non-significant yearly coefficient of 0.1%. However, the overall direction of the effects remains constant despite the possible discrepancies.
†Reported single post-term coefficients only, which reflect the panel data with a large volume of coefficients.

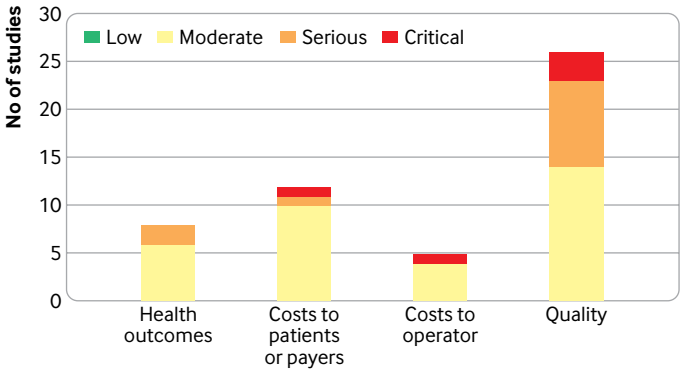

Fig 2 | Risk of bias across impact studies. A qualitative study[52] was excluded as it was evaluated using the Joanna Briggs Institute Critical Appraisal Checklist for Qualitative Research[35]

the largest hospital group acquisition in the dataset.[44] Gandhi and colleagues found a decrease in confirmed and suspected outbreaks of covid-19 in staff and residents in PE owned nursing homes compared with non-PE owned nursing homes.[47] Conversely, Braun and colleagues found that PE owned nursing homes reported more residents with covid-19 than government nursing homes—although the risk of bias for this study was serious.[40] Gupta and colleagues[48] found that before the covid-19 pandemic, PE acquisition was associated with an increase in mortality during patient stay duration plus 90 days at nursing homes, and Braun and colleagues[60] found higher rates of emergency department visits and hospital admissions in PE owned nursing homes. Lastly, Liu[53] found no difference in 30 day hospital mortality rates, Bruch and colleagues found no differences in unplanned hospital visits from surgical centers,[63] and Borsa and Bruch[36] found no differences in fertility outcomes, although the last study had a serious risk of bias.

Costs to patients or payers

Of all the impacts measured, costs to patients or payers showed the most consistent pattern across a total of 12 studies. No studies showed lowered costs to patients or payers (ie, a beneficial impact), whereas nine showed increased costs to patients or payers (ie, a harmful impact)[39 42 48 51 53 55 60 65 66] and three found no differences.[41 44 63] Risk of bias was moderate in 10 studies,[39 42 44 48 51 53 60 63 65 66] serious in one study,[41] and critical in one study.[55] When only studies with a moderate risk of bias were analyzed, eight showed harmful impacts on costs to patients or payers and two showed neutral findings. Although the volume of studies that found impacts on costs to patients or payers was not as high as those related to quality, the concordant findings of most of the studies indicated that PE ownership was generally associated with increased costs.

Bruch and colleagues found increased charges per inpatient day in PE owned hospital settings, as well as increased emergency department and total charge-to-cost ratios.[42] Liu found that PE acquisition was associated with an increase in negotiated prices between hospitals and private insurers, as well as a spillover effect in health spending to local markets.[53] Offodile and colleagues[55] found higher charge-to-cost ratios at PE owned hospitals, whereas Bruch and colleagues[41] found no differences in total charges or charge-to-cost ratios, although these studies had a critical and serious risk of bias, respectively. Similarly, Cerullo and colleagues found no differences in 30 day payments made between PE owned and non-PE owned acute care hospitals.[44]

Among nursing homes, Braun and colleagues[60] found a relative increase in total quarterly costs after PE ownership compared with other for profit homes, and Gupta and colleagues[48] found increased amounts billed in nursing homes during patient stays and the subsequent 90 days.

Among physicians and physician practices, LaForgia and colleagues found higher allowed amounts paid to anesthesiologists contracted with PE owned physician management companies compared with those contracted with non-PE owned physician management companies.[51] Nie and colleagues found that urologists in PE-owned practices received higher Medicare payments and payments per patient, possibly as a result of shifting to higher reimbursed procedures, despite urologists in non-PE owned practices receiving less compensation during the study period.[66] Similarly, Braun and colleague found marginal increases in prices paid to dermatologists after PE acquisition.[39] A study by Singh and colleagues found relative increases in multiple cost measures across dermatology, ophthalmology, and gastroenterology physician practices, which outweighed a marginal relative decrease in spending on out-of-network services.[65] But in another study by Bruch and colleagues, no relative differences were found in total costs for each encounter between PE owned and non-PE owned ambulatory surgical centers.[63]

These findings suggest a variety of possible mechanisms underlying increased costs to patients or payers, including directly through increased total charges, charge-to-cost ratios, and allowed amounts from payers, as well as indirectly through amassed market power and spillover effects. Because healthcare billing, insurance, and reimbursement practices vary between countries, we anticipate that this domain would most likely vary in national contexts outside the US.

Costs to operators

Five studies assessed costs to operators, with three finding reduced costs (beneficial impact) associated with PE acquisition[43 53 55] and two finding increased costs (harmful impact).[48 57] Risk of bias was moderate in four studies[43 48 53 57] and critical in one study.[55] As the volume of studies associated with costs to operators was the lowest among all outcomes, and the findings were mixed, no definitive conclusions could be drawn.

The three studies that identified beneficial impacts all pertained to hospital costs. Cerullo and colleagues[43] found an association between PE acquisition and

	Impacts			
	Health outcomes	Costs to patients or payers	Costs to operator	Quality
Borsa and Bruch 2022[36]	Neutral			Neutral
Bos and Harrington 2017[37]				Harmful
Bos et al 2020[38]				Harmful
Braun et al 2021[39]		Harmful		
Braun et al 2021[60]	Harmful	Harmful		Neutral
Braun et al 2020[40]	Harmful			Mixed
Broms et al 2023[61]				Harmful
Bruch et al 2023[62]				Harmful
Bruch et al 2022[63]	Neutral	Neutral		
Bruch et al 2021[41]		Neutral		Harmful
Bruch et al 2020[42]		Harmful		Beneficial
Cerullo et al 2022[43]			Beneficial	Harmful
Cerullo et al 2022[44]	Beneficial	Neutral		Neutral
Cerullo et al 2021[45]				Mixed
Creadore et al 2021[46]				Beneficial
Gandhi et al 2020[22]				Mixed
Gandhi et al 2020[47]	Beneficial			Beneficial
Gupta et al 2021[48]	Harmful	Harmful	Harmful	Harmful
Harrington et al 2012[49]				Harmful
Huang and Bowblis 2019[50]				Mixed
La Forgia et al 2022[51]		Harmful		
La France et al 2021[52]				Harmful
Liu 2021[53]	Neutral	Harmful	Beneficial	Mixed
Nie et al 2022[66]		Harmful		Harmful
Nie et al 2022[54]				Mixed
Offodile et al 2021[55]		Harmful	Beneficial	Harmful
Patwardhan et al 2022[64]				Harmful
Pradhan et al 2014[56]				Mixed
Pradhan et al 2013[57]			Harmful	
Singh et al 2022[65]		Harmful		
Stevenson and Grabowski 2008[58]				Mixed
Winblad et al 2017[59]				Mixed

Fig 3 | Graphical representation of impacts of private equity ownership on primary outcome measures

a decrease in cost per adjusted hospital discharge, Liu[53] found a decrease in the average cost per patient discharge starting two years after PE acquisition, and Offodile and colleagues[55] found lower total operating expenses at PE owned hospitals compared with non-PE owned hospitals, although this study had a critical risk of bias. In each of these three studies, beneficial impacts on costs to operator were accompanied by negative or mixed impacts on quality, and in the studies by Liu and by Offodile and colleagues, reduced operating costs were possibly achieved through reduced staffing per patient.

Among negative impacts, Pradhan and colleagues[57] found that PE owned nursing homes reported 11% higher operating costs per patient day, and Gupta and colleagues[48] found that PE owned nursing homes paid more in building lease costs.

Quality

Impacts on quality were most frequently measured in the literature. Of the 27 studies that assessed healthcare quality, 12 found harmful impacts,[37 38 41 43 48 49 52 55 61 62 64 66] three found beneficial impacts,[42 46 47] nine found mixed impacts,[22 40 45 50 53 54 56 58 59] and in three the results were neutral.[36 44 60] To summarize, 21 studies in total identified at least some form of harmful impact, whereas 12 identified some form of beneficial impact.

Although these findings are inconsistent, the greater prevalence of harmful impacts and studies finding solely harmful impacts suggest that PE ownership may have mixed effects on quality of care, and that there is more evidence to show that PE degrades it. However, the results were less conclusively harmful when only the 14 studies with moderate risk of bias and one qualitative case comparison were reviewed. In this sensitivity analysis two studies found beneficial impacts,[42 47] five found harmful impacts,[43 48 52 62 66] six found mixed impacts,[22 45 50 53 56 58] and two found neutral impacts.[44 60]

Across quality studies, a wide range of quality measures were analyzed, with a modest amount of overlap on some measures between studies. Of the 10 most frequent types of quality measures included, the most common related to staffing (n=12 studies, with 8 harmful impacts, 3 mixed, and 1 beneficial), followed by health intervention or outcome quality measures (n=9 studies, with 4 beneficial impacts, 2 harmful, 1 mixed, and 2 neutral) (see supplementary material 5).

For studies with beneficial results on quality, Bruch and colleagues found an increase in acute myocardial infarction and pneumonia quality scores in PE owned hospitals compared with matched non-PE owned hospitals.[42] Gandhi and colleagues found that PE was associated with a decreased likelihood of supply shortages during the start of the covid-19 pandemic.[47] Lastly, Creadore and colleagues found greater availability of appointments at PE owned clinics among both privately insured and Medicare insured patients, although this study had a serious risk of bias.[46]

Among studies that showed harmful impacts on quality, Bos and colleague found that PE owned nursing homes had lower employee quality and client recommendation scores compared with other for profit nursing homes, although this study had a critical risk of bias.[38] Broms and colleagues[61] found lower staffing density, education, and client ratings at PE owned nursing homes compared with various non-profit and private controls, and Patwardhan and colleagues[64] had similar findings, wherein PE owned nursing homes were less likely to meet regulatory quality requirements, although both studies also had a serious risk of bias. Harrington and colleagues[49] found increased deficiencies and severe deficiencies among PE owned nursing homes, and Bruch and colleagues[41] found that PE owned hospitals had lower patient experience scores compared with control hospitals, but both these studies had a serious risk of bias. Similarly, La France and colleagues found a decrease in the quality of a PE acquired hospital system, whereas quality scores increased during the same time for a non-PE owned academic hospital system undergoing similar expansion.[52] Offodile and colleagues found lower staffing per 1000 patient days at PE owned hospitals compared with non-PE owned hospitals, although this study had a critical risk of bias.[55] Bruch and colleagues found higher rates of clinician turnover at PE owned physician practices.[62] Lastly, Nie and colleagues found that PE urologists at PE owned practices had more patients on their schedule post-acquisition, and that these patient visits were generally shorter than pre-acquisition.[66]

Although the specific dimensions of quality varied across studies, the high prevalence of changes in quality—whether beneficial, harmful, or mixed—suggest that this domain is likely to be impacted by PE ownership. Moreover, quality effects were often observable in the years directly after an acquisition, suggesting that PE firms may make immediate changes to their acquired organizations. PE ownership was associated with almost exclusively negative impacts on patient satisfaction, daily functioning, and general quality scores[22 38 41 48 50 52 53 56 58 61 64] (see supplementary material 5). Among studies that found mixed impacts of PE ownership, there were often trade-offs within related quality measures, such as improvements in one domain of patient experience but not in another, increased staffing of lower skilled clinicians with reduced staffing of higher skilled clinicians, or increased availability of appointments for privately insured patients with reduced availability for patients receiving Medicaid.[22 45 54 56 58]

Nursing homes

As nursing homes received the most research attention among impact studies (n=15), we analyzed these settings independently. This greater research attention given to nursing homes mirrors a longstanding commercial interest in nursing homes by PE firms, as well as more pronounced public attention given to nursing homes in light of the covid-19 pandemic. The volume of studies that assessed health outcomes (n=4 total, 3 harmful, and 1 beneficial), costs to patients or payers (n=2 harmful), and costs to operators (n=2 harmful) was too small for conclusive interpretation. However, the findings of the 14 studies addressing quality roughly mirrored the proportions in the full sample, with six studies finding harmful impacts,[37 38 48 49 61 64] one study finding beneficial impacts,[47] six studies finding mixed impacts,[22 40 50 56 58 59] and one study finding neutral impacts.[60] In total, 12 studies identified some sort of harmful impact of PE ownership on nursing homes, and seven studies identified beneficial impacts. One of the most rigorous and least biased studies on nursing homes, by Gupta and colleagues,[48] found harmful impacts on health outcomes, patient costs, costs to operators, and quality. These results suggest that PE ownership often has mixed impacts on nursing homes, but that more evidence suggests a degradation rather than an improvement in quality.

Nurse staffing

The findings of five studies suggest that PE ownership is associated with reduced nursing levels or changes in nursing skill mix to reduce operator costs. Bos and Harrington found that PE owned nursing homes had lower registered nurses and total nurse staffing hours per patient day both before and after PE acquisition compared with other private nursing

homes, although this study had a critical risk of bias.[37] Cerullo and colleagues found an association between PE ownership and a decrease in total staff full time equivalents for each occupied hospital bed, as well as lower total registered nurse and licensed practical nurse full time equivalents, suggesting a decrease in nurse staffing.[43] Although Gupta and colleagues found that PE ownership of nursing homes was associated with marginally higher registered nurse staffing, it was eclipsed by a larger decrease in certified nursing assistant and licensed practical nurse staffing per patient day.[48] Conversely, Stevenson and Grabowski[58] found a decrease in nursing skill mix in PE owned nursing homes through a reduction in registered nurse hours and an increase in certified nursing assistants hours per patient day, and Pradhan and colleagues[56] found a similar trend with both licensed practical nurse and certified nursing assistant hours compared with registered nurse hours. In another study, however, Braun and colleagues found that nursing staff shortages were less likely in PE owned nursing homes than in government owned homes, although this study had a serious risk of bias.[40]

Trends in prevalence of PE ownership

Together, the studies evaluating trends in PE prevalence document a noticeable influx of ownership across many healthcare settings over the past 10-15 years, often increasing in yearly deal count over study duration.[21 65 68-72 75 76 81-84 86] PE acquisitions have been documented across the continental US, but PE ownership was particularly pronounced in the south,[21 42 53 55 69 71 72 81 87 89] northeast,[71 72 81 88 89] and, specifically, in Florida[39 53 81-84 88] and Texas.[39 53 60 82-84] Among studies evaluating trends in the prevalence of PE ownership, nursing homes were the most common setting (n=8), followed by dermatology (n=7); ophthalmology and hospital settings (n=6 each); multiple specialties or general physician groups (n=4); orthopedics (n=3); urology, obstetrics and gynecology, gastroenterology, fertility, and surgical centers (n=2 each); and plastics, otolaryngology, oral and maxillofacial surgery, and hospice agencies (n=1 each). Three studies addressed multiple specialties.

Certain studies identified particularly high market shares of PE owned healthcare operators. Borsa and Bruch estimated that as of 2018, 14.7% of fertility practices in the US were owned by PE firms.[36] Bos and colleagues found that in 2019, PE firms owned 20.5% of the for profit nursing homes in the Netherlands that had a contract with the regional long term care office.[38] Braun and colleagues found that although only 3.4% of hospice agencies in the US were owned by PE firms in 2011, the proportion had risen to 7.28% in 2019, and that 72% of these acquisitions involved previously not-for-profit agencies.[70] In a separate study, Braun and colleagues found that in 2017, one in 11 dermatologists practiced at a PE owned facility, and that in 21 hospital referral regions, dermatologists at PE owned facilities provided more than 50% of services, comprising 9.3% of all national US dermatologists by 2017.[39] Meanwhile, Nie and colleagues estimated that as of 2021, 7.2% of all private practice urologists in the US were employed by one of five PE owned platforms, and that more than 25% of all urologists practicing in New Jersey and Maryland were employed by a PE owned platform practice.[80] Singh and colleagues assessed multiple specialties and found acquisition by PE owned firms in physician practices to be 7.5% in dermatology, 7.4% in gastroenterology, 6.5% in urology, 5.1% in ophthalmology, and 4.7% in obstetrics and gynecology; and that PE affiliation rates among physicians were as high as 18.2% in Washington, DC, 17.5% in Arizona, 13.6% in New Jersey, 13.1% in Maryland, 12.6% in Connecticut, and 10.8% in Florida.[88]

Discussion

Based on data from 55 empirical studies, we found that PE ownership in the healthcare sector has markedly increased, that this trend has been accelerating across many healthcare settings and service types, and that this has important implications for patient or payer costs and healthcare quality. Although heterogeneity in study types, settings analyzed, and outcome measures included in this review was considerable, the most unequivocal evidence points to PE ownership being associated with an increase in healthcare costs to patients or payers, primarily by increased charges and negotiated higher rates with payers. Evidence across studies also suggests mixed impacts of PE ownership on healthcare quality, with greater evidence that PE ownership might degrade quality in some capacity rather than improve it. Findings pertaining to the impacts of PE ownership on health outcomes and costs to operators were less prevalent, suggesting the need for more research in these areas. Of all healthcare settings in the included studies, nursing homes were the most common. Similar to the overall results, the results of studies on nursing homes related to quality were mixed, with a slightly higher prevalence of harmful impacts. One of the main impacts on quality associated with PE ownership was a decrease in nurse staffing or a shift to lower nursing skill mix, which could be pursued as a means of keeping operating costs low. Additionally, although the studies identified by this review did not comprehensively address provider skill mix, some evidence suggests that PE owned operators may shift staffing or first line service provision away from physicians and towards less expensive non-physician clinicians.[46 62]

Proponents of PE in healthcare have argued that PE firms use their managerial expertise to implement operational and financial changes and improve the acquired company's value after an acquisition. While the findings of this review suggest that PE firms do produce organizational changes, we found evidence that these changes are often reflected in greater costs to patients and payers. The fact that no consistently positive effects of PE in healthcare were identified also provides an evidentiary basis to remain cautious about claims that PE ownership is a self-evident benefit to healthcare provision.

Comparison with other studies

Few academic studies have systematically evaluated PE in healthcare. Our findings are aligned with two recent reviews of PE activity as it relates to dermatology,[26 27] reporting substantial growth, market penetration, and operational changes in association with PE ownership. Our findings are also more broadly aligned with existing research on the financialization of local and global healthcare systems,[90-95] including a shift towards increasingly complex corporate structures and modes of governance driven in part by PE ownership.[18 96-98]

Studies documenting trends in PE ownership and prevalence show that an increasing portion of healthcare operators are being acquired and consolidated in the US, particularly in fragmented markets located in the northeast and southern US. Our findings pertaining to patient costs and quality support claims that PE owned practices scale-up charges, billing, and profitable service lines to generate more revenue, as well as claims about PE ownership's capacity to change service quality. These results emphasize the importance of context specificity in PE research, such as local market competition, medical setting, and regulatory environment.

Strengths and limitations of this review

This study fills a gap in the current literature on PE ownership in healthcare by integrating a heterogenous body of empirical research and incorporating studies from across medical settings, academic disciplines, and methodological approaches. By grouping different outcome measures under broader categories of health outcomes, costs to patients or payers, costs to operators, and quality, this study was able to present emergent patterns related to PE ownership that other more granular studies have been unable to synthesize.

Despite this study's strengths, it does have several limitations. We did not differentiate between different subtypes of PE investment and ownership, such as minority or majority stakes, and we classified all forms of PE affiliation as the same intervention. Additionally, we did not look at the impacts of PE ownership on profitability, debt, risk of bankruptcy, or productivity, which are important measures and mechanisms that influence healthcare delivery and organizational stability. Although we addressed certain dimensions of access to care, such as the availability of appointments, we were unable to capture larger possible impacts of PE on access to care.

While grouping diverse outcome measures under our four main impact categories enabled our synthesis, it also removed a level of specificity present in each of the individual studies. Additionally, although ROBINS–I is useful for evaluating risk of bias in a variety of study types, it is not as suited for certain quasi-experimental research designs, such as difference-in-differences or instrumental variable approaches.[99]

Additionally, although our search strategy was broad and yielded a high number of results, because of the wide range of disciplines that may contain research on PE ownership in healthcare, it is possible we did not capture some relevant studies.

Lastly, because most of the studies included in this review occurred in the US, the impacts identified may not be as generalizable to all global settings. For example, the impacts on patient and payer costs may be attenuated in countries with universal healthcare or alternative reimbursement models, and the impacts on quality are likely modified by local regulatory policies, surveillance practices, and reporting requirements. Because fewer studies analyzed PE ownership in healthcare in non-US settings, more rigorous comparative analysis was not possible, and therefore care is needed when interpreting this review's findings and applying it to non-US contexts.

Methodological limitations of included studies

The non-random nature of PE ownership imposed several challenges on the studies included in this review, such as needing to account for non-parallel trends and heterogenous treatment effects in difference-in-differences studies. Moreover, several studies did not appropriately control for confounding variables, influencing the risk of bias scores. In addition to the wide array of outcome measures, individual studies also included a variety of comparison groups, including other for profit practices, government practices, not-for-profit practices, and chains. Despite the importance of all of these comparators, it remains unclear what the appropriate control group should be in studies of PE ownership in healthcare, or whether there is even a standard approach that would be suitable across study contexts.

Recommendations for policy and future research

As PE ownership continues to grow in the healthcare sector, it becomes increasingly important to identify impacts on quality, patient and payer costs, operator costs, and health outcomes. Because of the complex corporate structures and financial arrangements associated with PE ownership, and a lack of regulatory surveillance and reporting about PE owned healthcare operators, it is exceedingly difficult for the average patient or consumer to identify when a provider or practice is owned by a PE firm. Even providers or other stakeholders who do not see themselves as impacted by PE ownership should take note of this increasing trend, as healthcare settings are increasingly acquired and consolidated by PE firms, or, if not, are put into competition with those with PE ownership.[20 22] A variety of other financialized institutions and practices are growing in healthcare and working with PE firms, including ownership of properties by real estate investment trusts, which warrants future research and synthesis.[52 67 74 79 89 100]

Conclusions

The results of this study confirm the need for increased rigorous research on PE ownership in healthcare, particularly its impacts on health outcomes and system costs and in other non-US settings, such as

Europe.[101] Much of the empirical research included in this review captured only a short time horizon before and after PE ownership. However, the full effects of PE on countries' health systems may not be visible in the short term and may not be captured in current types of available data. The findings from this review should be complemented by other analyses of PE ownership, including case studies, journalistic reports, and qualitative investigations.

This said, the current body of evidence is robust enough to confirm that PE ownership is a consequential and increasingly prominent element in healthcare, warranting surveillance, reporting, and possibly increased regulation.

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The lead author (AB) affirms that the manuscript is an honest, accurate, and transparent account of the study reported; no important aspects of the study have been omitted. Dissemination to participants and related patient and public communities: It is anticipated to disseminate the results of this research to wider community via press release and social media platforms.

Dissemination to participants and related patient and public communities: Findings from the current work will be disseminated through open access publication at *The BMJ*; targeted outreach to non-research stakeholders in PE, finance, and policymaking; social media posts; and potential press releases via colleagues in journalism and science communication.

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Supplementary information: PRISMA checklist and supplementary material, tables, and figures