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Financial Performance of English NHS Trusts and Variation in Clinical Outcomes: A Longitudinal Observational Study

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Financial Performance of English NHS Trusts and Variation in Clinical Outcomes: A Longitudinal Observational Study

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ABSTRACT

Objectives

To examine the association between financial performance as measured by operating margin (surplus/deficit as a proportion of turnover) and clinical outcomes in English NHS trusts.

Setting

Longitudinal, observational study in 149 acute NHS trusts in England between 2011 and 2016.

Participants

Our analysis focused on the outcomes at individual NHS Trust-level (composed of one or more acute hospitals).

Primary and secondary outcomes

Outcome measures included readmissions, inpatient satisfaction score and the following process measures: emergency department (A&E) waiting time targets, cancer referral and treatment targets, and delayed transfers of care.

Results

There was a progressive increase in the proportion of trusts in financial deficit: 22% in 2011, 27% in 2012, 28% in 2013, 51% in 2014, 68% in 2015 and 91% in 2016. In linear regression analyses, there was no significant association between operating margin and clinical outcomes (readmission rate or inpatient satisfaction score). There was, however, a significant association between operating margin and process measures (delayed transfers of care, A&E breaches and cancer waiting time targets). Between the best and worst financially performing Trusts, there was an approximately 2-fold increase in A&E breaches and delayed transfers of care overall although this variation decreased over the six years. Despite significant differences between the best and worst performing trusts on cancer targets, the magnitude of difference was much smaller (1·16 and 1·15-fold), although the variation slowly rose during the six years.

Conclusions

Operating margins in English NHS trusts progressively worsened during 2011-16, and this change was associated with poorer performance on several process measures but not with hospital readmissions or inpatient satisfaction. Significant variation exists between the best and worst financially performing Trusts. Further research is needed to examine the causal nature of relationships between financial performance, process measures and outcomes.

STRENGTHS AND LIMITATIONS

- To our knowledge, one of the first empirical exploratory analyses of the relationship between funding and outcomes in the English NHS
- Operating margin may not be the ideal measure of an organisation's financial position
- The proportion of activity at each Trust which is elective, acute or specialised was not taken into account nor was the percentage of activity subject to a national tariff
- There may be additional unmeasured confounders that have impacted the results
- This observational study is limited to demonstrating associations rather than causal links

INTRODUCTION

The combination of higher demand due to ageing, growing populations, with more chronic illness and disability, in addition to rising treatment and technology costs, is driving increased health spending in high-income countries.¹ The National Health Service (NHS) in England is introducing policies to address these demands, attempting to contain costs while improving health outcomes. The NHS Five Year Forward View, published in October 2014, set out a strategic vision for sustaining a high-quality, comprehensive health system in England.² Specifically, it identified a £22 billion funding gap by 2020/21, based on the current funding trajectory of the NHS, to be met by ambitious efficiency savings of 2-3% annually (given a long-term track-record of 1% each year).

The call for increased efficiency comes in an austere climate, in which individual NHS Trusts are progressively challenged to achieve financial control,^{3,4} while responding to high demand, especially in winter months, reported widely in the British media.⁵ NHS Improvement, the body responsible for overseeing Trust performance, reported an overall third quarter deficit of £886 million for the 2016-17 financial year, £300 million higher than the planned target.⁶ Higher demand for services, with rising emergency attendances and admissions, and delayed transfers of care (DTOCs), have been cited as key reasons for increasing deficit.⁷ While control of Trust financial deficits is important for sustainability of the NHS, there are concerns on the adverse impact of worsening financial performance on clinical outcomes and processes,⁸ but few studies which have explored this relationship.

We investigated the relationship between operating margin (surplus/deficit as a proportion of turnover) at English NHS Trusts during 2011-16, with outcomes and process measures. We selected performance measures that are commonly used for benchmarking performance of NHS Trusts and that are plausibly related to quality, namely, hospital readmissions, inpatient satisfaction scores, emergency department waiting time targets, cancer referral and treatment targets, and delayed transfers of care. Lastly, we investigated the variation in outcome and process measures between the financially best and worst performing Trusts, both overall and over time.

METHODS

Data sources and extraction

NHS Hospitals in England are categorised into financially and operationally distinct legal entities known as Trusts, which deliver services on behalf of the NHS. Trusts may be located at multiple sites and can be responsible for one or more hospitals. Well-performing Trusts are able to gain Foundation status, which allows a degree of financial and operational autonomy from the Department of Health. Data was sought for acute NHS Trusts in the 6-year period encompassing the financial years from April 2010 to March 2016.

We obtained financial data for Trusts from the gov.uk open data portal.⁹ Where information was lacking for specific Trusts, we sought the original data from the published accounts available on individual Trust websites or from NHS 'The Quarter' reports.¹⁰

Data on four financial metrics were extracted and examined: first, the retained surplus/deficit for the financial year; second, the turnover for the Trust (calculated as "Revenue from patient care activities" and "Other operating revenue"); third, trust spend on agency staff, and fourth, spend on consultancy. The precise table IDs and sub-codes for extraction are detailed in the online Supplementary Appendix. Only the first two metrics are measures of financial performance. The second two reflect Trust spending choices and we included these as exploratory variables given the public and media interest in rising agency and consultancy spend.

Bed availability for the quarter preceding the end of each financial year was obtained from publicly available NHS England data¹¹ with occupancy rate calculated as the percentage of beds (as a proportion of total available) occupied on average during that quarter. Teaching status of the trusts was defined dichotomously on the basis of membership of The Association of UK University Hospitals.¹² For each NHS Trust, the postcode of the Trust was extracted and used as a proxy for location to calculate the region of the country in which the trust hospitals were located.

1 This postcode data were matched to the 2015 Indices of Multiple Deprivation (IMD) score.¹³ The Office
2 for National Statistics uses UK census data to generate the IMD score which encompasses census
3 information from the following domains: income, employment, crime, living environment, health
4 deprivation and disability, education and skills/training, barriers to housing and services.
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10 Using publicly available NHS England datasets, we obtained data on hospital activity in the form of
11 number of annual admissions per Trust and annual outpatient attendances.¹⁴ Data on last-minute
12 elective operation cancellations (for non-clinical reasons) and the number of such patients not being
13 treated within 28 days of such a cancellation were also extracted from publicly available NHS England
14 datasets.¹⁴
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23 **Outcome measures**

24 The outcomes we measured consisted of two clinical measures and three process measures that are
25 commonly used for benchmarking NHS Trusts and have plausible mechanisms for a relation to quality.
26 We openly acknowledge that there are several other outcomes and process measures which may also
27 relate to quality and could have been chosen. Our selection was based on a combination of logistical
28 constraints (i.e. what data was publicly available) and an effort to include measures which are commonly
29 used for benchmarking trusts and thereby also reported in the mainstream media.
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38 The clinical measures were (i) the proportion of discharges readmitted as an emergency within 7 days of
39 discharge and (ii) annual overall patient satisfaction for each trust using data from the National Adult
40 Inpatient Survey compiled by the Care Quality Commission.¹⁵ Data on readmissions was only available
41 for the years 2014-16. The three process measures were: (i) Accident and Emergency (A&E) 4-hour
42 waiting time breaches (ii) delayed transfers of care from an acute Trust, and (iii) cancer waiting time
43 targets.
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52 The first process measure, Accident and Emergency (A&E) 4-hour waiting time breaches, was defined
53 as the percentage of patient attendances in type 1 departments (major A&E) who waited greater than
54 four hours from arrival to admission, transfer or discharge.
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3 The second process measure, a delayed transfer of care from an acute Trust, was said to occur when a
4 patient was ready to depart from acute care but was still occupying a bed. These data were extracted as
5 'total number of bed days attributed to delayed transfers of care' and standardised to number of beds
6 available in the Trust. Delayed transfer of care data were only available for the latter eight months of the
7 2011 financial year. To ensure comparability with other years, a 1.5x multiplier was applied for each trust
8 in this financial year (see online Supplementary Appendix for further details). No other missing data in
9 the study was imputed.
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18 For the third process measure, cancer waiting time targets, we assessed two specific targets (a) the
19 proportion of patients who received a first consultant appointment within two weeks of urgent referral for
20 suspected cancer by their General Practitioner (GP) and (b) the proportion of patients who commenced
21 a first treatment for cancer within 62 days of being urgently referred by their GP.
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28 **Unit of analysis**

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30 Our analysis focused on the outcomes at individual NHS Trust-level (composed of one or more acute
31 hospitals).
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36 **Statistical analysis**

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38 Our financial metric of interest was the annual Trust operating margin. Similarly to prior literature,^{16,17} we
39 defined operating margin as the retained surplus (or deficit) for the Trust in a financial year divided by the
40 turnover (turnover being calculated as "Revenue from patient care activities" and "Other operating
41 revenue"). This value was winsorised to set all outliers beyond the 2.5th and 97.5th percentiles to the
42 values at these percentiles. We first calculated summary statistics of the operating surplus/deficit and
43 metrics of trust characteristics, breaking the sample into 4 groups of deciles by Trust margin.
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52 As a second step, we compared the variation in process and outcome measures between the financially
53 best and worst performing trusts as categorised by operating margin decile (highest versus lowest).
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56 Third, we performed multiple linear regression with our outcomes as the dependent variable and the
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1 following independent variables: operating margin, number of beds available and year. Each Trust in
2 each year was treated as a separate observation with standard errors clustered by Trust to account for
3 the non-independence of Trust-level data.
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8 Fourth, we compared outcomes and process measures between 'struggling' and 'non-struggling' Trusts.
9 For this purpose, a struggling Trust was defined as either: (i) in financial or quality special measures as
10 of December 2016 or (ii) a Foundation Trust subject to enforcement actions by Monitor as of September
11 2016. Fifth, we investigated the relationships between delayed transfers of care, cancelled elective
12 operations, agency spend, A&E breaches and operating margin by assessing correlation between these
13 variables over an early period (2011-12) and a late period (2015-16).
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22 We performed sensitivity analyses to assess the impact of (i) adjustment for missing 2011 delayed
23 transfer of care data and (ii) inclusion of Trusts that had changed in composition during the study period.
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28 All reported p -values are two sided with the statistical significance threshold set to a p -value of less than
29 0.05. Given the hypothesis generating nature of this study, no corrections were made for multiple
30 comparisons. Approximately 1 in every 20 comparisons could be expected to achieve statistical
31 significance by chance alone. All analyses were performed using STATA statistical software version 12.1
32 (College Station, TX). This study had no external funding source.
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40 **Patient involvement**

41 Patients were not involved in any aspect of the study design, conduct or in the development of the
42 research question or outcome measures. This study was a retrospective longitudinal observational study
43 of publicly available Trust-level data and therefore there was no active patient recruitment for data
44 collection or requirement for ethical approval.
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RESULTS

Over the 6-year period of study, encompassing the financial years from April 2010 to March 2016, there were changes in the composition to 31 of 149 Trusts. These are detailed in the online Supplementary Appendix and took the form of creation of a new Trust, dissolution of an existing Trust, acquisitions of a hospital or entire Trust to another Trust and mergers between Trusts. 13 Trusts (9%) transitioned to Foundation Status during the 6-year study period. Of the remaining 136 Trusts, 63 (42%) were non Foundation Trusts and 73 (49%) were Foundation Trusts.

There was a progressive increase in the proportion of Trusts in deficit over the 6-year study period: 22% in 2011, 27% in 2012, 28% in 2013, 51% in 2014, 68% in 2015 and 91% in 2016. The distribution of average operating surplus/deficit over the study period is displayed in Figure 1. Operating surplus/deficit varied widely across Trusts ranging from -£250 million to £181 million over the six years. Median operating surplus/deficit over the study period was -£3.8 million (IQR -£8.7 million to -£0.7 million, range -£63.1 million to £32.6 million). Median operating margin over the study period was -1.1% (IQR -2.7% to -0.2%, range -42.5% to 4.6%). Median operating margin was higher in teaching Trusts compared to non-Teaching Trusts (-0.5% versus -1.4%, $p=0.002$) and lowest in the Midlands compared to other regions (-2.3% in the Midlands, -1.2% in London, -0.8% in the South, -1.0% in the North; $p=0.028$).

During the 6-year study period, there was a nationwide decline in overnight general and acute beds from 110,568 to 103,422 (6.5% reduction) with a concomitant increase in day only beds from 11,572 to 12,207 (5.5% increase).

Trust metrics are shown in Table 1 stratified by decile of operating margin. Between the best and worst financially performing Trusts, there was an approximately 1.75-fold and 2-fold increase in agency and consultancy spend respectively as a proportion of turnover. The best financially performing Trusts also had a 1.5-fold higher annual number of outpatient attendances. In contrast, the annual number of admissions, bed occupancy rates and local deprivation scores were broadly similar between the best and worst performing Trusts. The proportion of Trusts with teaching status increased throughout deciles

1 of operating margin. Trends in the variation of operating margin over time with clinical outcomes and
2 process measures are displayed in figures 2 and 3 respectively.
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6 Clinical outcomes and process measures, stratified by decile of operating margin, are shown in table 2.
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8 Between the best and worst financially performing Trusts, there was an approximately 2-fold increase in
9 A&E breach rates and delayed transfers of care. In contrast, despite significant differences between the
10 best and worst performing trusts on cancer targets, the magnitude of difference was much smaller (both
11 approximately 1·15-fold).
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18 Trends in the variation between the best and worst financially performing Trusts over time for both
19 clinical outcomes and process measures are shown in table 3. There was no appreciable variation in
20 readmission rate or inpatient satisfaction score with the latter increasing over time at a slightly faster rate
21 in the worst financially performing Trusts.
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28 Performance on process measures in both the best and worst financially performing Trusts deteriorated
29 over time (table 3). However, variation between the best and worst groups narrowed for A&E breaches,
30 returned to baseline for delayed transfers of care after an initial rise, and rose slowly for both cancer
31 target breaches. The variation in agency spend as a proportion of turnover between the best and worst
32 financially performing trusts increased substantially between 2011 (best 2·7% and worst 3·9%,
33 difference 1·2%) and 2016 (best 4·5% and worst 9·1%, difference 4·6%) (see online Supplementary
34 Appendix for further details).
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44 In our linear regression analyses, there was no significant association between operating margin and
45 clinical outcomes (readmission rate or inpatient satisfaction score; table 4). There was, however, a
46 significant association between operating margin and process measures (delayed transfers of care, A&E
47 breaches and cancer waiting time targets; table 4). Trusts defined as struggling (i.e. in special measures
48 or subject to enforcement action) were associated with worse performance on all process measures but
49 not with readmission rate or inpatient satisfaction scores (table 5).
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1 The associations between delayed transfers of care, elective surgery cancellations, agency spend, A&E
2 breaches and operating margins are displayed in a correlation matrix for the early years (2011 and 2012;
3 figure 4) and the later years (2015 and 2016; figure 5) of the six year study period (same scale applied to
4 figure 4) and the later years (2015 and 2016; figure 5) of the six year study period (same scale applied to
5 both figures 4 and 5). There was weak positive correlation between all factors except operating margin
6 for which there was weak negative correlation with the other measures. These associations were
7 maintained in the later years though with a greater spread among trusts.
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14 Sensitivity analyses are reported in the online Supplementary Appendix. There was no change to the
15 results with and without adjustment for missing 2011 delayed transfer of care data. There was no change
16 to the results when excluding Trusts that had changed in composition over the study period.
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DISCUSSION

Principal findings

Our study has a number of important findings. First, in the period 2011-16, there was a substantial increase in the proportion of NHS Trusts with negative operating margins. Second, the overall variation between the best and worst financially performing Trusts was considerably larger for A&E breach rates and delayed transfers of care than for cancer targets. Third, the variation over time between the best and worst financially performing trusts was static for clinical outcomes and mixed for process measures (decreased over the six years for A&E breaches, was static for delayed transfers of care while increasing slightly for cancer targets). Fourth, there was a significant association between worsened operating margin and deteriorating process measures (four-hour A&E targets, cancer waiting time targets and delayed transfers of care), but not between operating margin and either readmission rates or inpatient satisfaction scores.

Comparison with other studies

The extant literature on the association between financial performance and outcomes comes primarily from the United States (US) and is mixed in pronouncement. Volpp and colleagues assessed the impact of a budget act reducing Medicare reimbursements on processes of care for acute myocardial infarction (MI).¹⁸ They found that while the budget act added moderate financial strain to organisations, there was no appreciable worsening of care with respect to MI processes of care or mortality in 236,506 patients from 208 hospitals. An analysis by Bazzoli and colleagues in 2008 concluded that while there may be an association between some measures of financial performance and adverse events, it was much weaker than previously reported by Encinosa and Bernard who found a concerning association between frequency of patient safety alerts and operating margin.^{16,17} Further, a study by Ly and colleagues in over 3,000 US hospitals found that low hospital margins were associated with worse processes of care and higher readmissions, although not with higher mortality.¹⁹

Placing our findings in the context of earlier studies requires extreme caution given the differences between the US and UK health systems. Specifically, Ly et al. excluded public hospitals (which comprise

1 the vast majority of English hospitals) from their analysis. However, these prior studies do highlight the
2 difficulty in disentangling the relationship between financial performance and outcomes. Meanwhile, a
3 large European cohort study revealed that attempts to save money by cutting nurse to patient ratios may
4 adversely affect patient outcomes.²⁰ An increase in a nurses' workload by one patient increased the
5 likelihood of a 30-day inpatient death by 7% (odds ratio 1.07, 95% CI 1.03 to 1.11).²⁰
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10 11 12 **Study limitations**

13 Our findings must be borne in light of several study limitations. First, while we had access to a
14 considerable volume of data, the granularity of data was limited. For example, our unit of analysis was at
15 the Trust level, giving a sample size of approximately 149 compared to equivalent US studies that have
16 analysed over 3000 hospitals.¹⁹ Lack of 'high-frequency' data also prevented us performing interrupted
17 time-series and time-lag analyses.
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26 Second, it may be that operating margin is not the ideal measure of an organisation's financial position.
27 A Trust's deficit may be exaggerated if it realises that a deficit is unavoidable and careful accounting
28 allows for a larger than necessary deficit in one year to ensure a small surplus in the following year (as
29 opposed to two years of deficit); potential gamification. Organisations including NHS Improvement and
30 the Department of Health typically use breakeven performance figures instead of operating
31 surplus/deficits. We chose not to use such figures as the data were not easily available at Trust level for
32 much of the period under investigation.
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42 Third, we utilised only a small selection of existing clinical outcomes and process. This decision was
43 driven by two factors. Logistically, there is limited public access to many clinical outcomes. While there is
44 access to many process measures, we opted for a small selection that is commonly used for
45 benchmarking trusts (i.e. often quoted in media reports and receive major public scrutiny) so as to avoid
46 the issues of multiple comparisons. It is entirely possible that other process measures may well display
47 differing relationships with respect to operating margins.
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1 Fourth, we did not take into account the proportion of activity at each Trust which is elective, acute or
2 specialised nor did we assess the percentage of activity subject to a national tariff. Work from the Health
3 Foundation in 2016 suggests a link between financial performance and the proportion of Trust income
4 arising from activities subject to the national tariff.²¹ Although there is likely to be correlation between
5 teaching hospital status (which we did assess) and the share of activity subject to a specialised services
6 tariff, this is nonetheless a crude proxy.
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14 Fifth, there may be additional unmeasured confounders that have impacted on our results. For example,
15 surrounding Primary Care systems may impact on the efficiency with which the acute Trusts function.
16 We adjusted for hospital size in the form of number of beds as well as using operating margin as a more
17 standardised measure of financial performance than gross surplus or deficit (as turnover showed wide
18 variation between trusts). However, as with any observational research, we cannot fully discount the
19 impact of confounding on our results. For example, financial underperformance may be a signal of
20 general underperformance in a Trust where clinical and other functions that might be suboptimal affect
21 outcomes. Sixth, we are limited to demonstrating associations rather than causal links.
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32 **Conclusions and policy implications**

34 Notwithstanding limitations, our findings have important ramifications for clinical leads, managers and
35 policy makers. The relationship between financial performance and clinical outcomes is far more
36 complex and associated with myriad other factors which will vary among Trusts. Trusts with financial
37 deficits may be spending more than they can afford and one could therefore argue that higher quality
38 should be expected for this extra financial outlay. Conversely, the existence of such deficit might instead
39 indicate reduced efficiency and challenged management. Alternatively, financial penalties due to poor
40 clinical performance or financial management could exacerbate deficits. Attempts to redress this balance
41 may inadvertently lead to reflex spending cuts and poorer quality care. The role of clinical leads,
42 management and leadership within a Trust is likely to be a key contributor to how financial deficits impact
43 quality of care.
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1 There are a number of specific points to consider also. First, there is substantial variation between
2 Trusts, which in some cases is worsening. Between the best and worst financially performing Trusts,
3 there are up-to 2-fold differences in agency spend, delayed transfers of care, A&E breaches and cancer
4 waiting times. This is notable and needs to be explicitly tackled with greater efficacy. While national
5 regulators such as the Care Quality Commission (CQC) and NHS Improvement do seek to support
6 challenged Trusts, the effectiveness of this has not necessarily translated into improved performance
7 metrics.
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16 Second, the lack of significant association between operating margin and either readmissions or
17 inpatient satisfaction may suggest that clinical outcomes are more resilient to financial pressures than
18 process measures, or that the driver for such clinical metrics is not predominantly financial-based. Third,
19 the recent narrowing of variation between the best and worst performing Trusts on the measures of A&E
20 targets and delayed transfers of care, may be a cause for concern, suggesting that now even the best
21 financially performing Trusts are struggling to manage demand. This indicates that a more system-wide
22 approach to demand-management and improving Trust performance may be required to address the
23 identified deteriorations, given the entire Trust cohort is now showing signs of deterioration. Stated
24 plainly, it seems that even if best practice is adopted from the most well managed Trusts, demands on
25 secondary and tertiary care may not be adequately addressed.
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38 Finally, our inability to demonstrate causal links on the available macro level public data re-emphasises
39 the need for higher quality interventional studies such as cluster randomised trials specifically assessing
40 policy impacts before implementation en masse. Furthermore, studies assessing the micro level
41 spending decisions by Trusts when confronted by financial pressures may also lend more insight into the
42 causal pathway and suggest appropriate targets for intervention.
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50 **Summary**

51 Notwithstanding limitations, our results demonstrate that operating margins at English NHS Trusts have
52 progressively worsened over 2011-16, and that this change correlates with poorer Trust performance on
53 a range of widely benchmarked process measures, but not significantly with readmissions or inpatient
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1 satisfaction. The variation between the best and worst financially performing Trusts was considerably
2 larger for A&E breach rates and delayed transfers of care than for cancer targets but showed differing
3 patterns of variation over time. The causal nature of relationships between financial performance,
4 process measures and outcomes remains difficult to disentangle.
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RESEARCH IN CONTEXT

Evidence before this study

We searched the scientific literature to identify original research articles assessing the macro-level association between financial performance and outcomes in the NHS and how such outcomes vary between the best and worst financially performing Trusts. We searched PubMed for manuscripts published in any language up to and including August 15th 2017, using the following search terms: ("NHS"[Ti] OR "National health service"[Ti] OR ("English"[Ti] AND "Hospital"[Tiab])) AND ("Variation"[Tiab] or "Outcome"[Tiab]). 550 records were retrieved but none were deemed includable.

Added value of this study

Most of the extant literature comes from the United States and direct comparison is fraught with difficulty. Our study is the largest analysis to date of the association between financial performance, as measured by operating margin, and outcomes at English NHS Trusts. Operating margins in English NHS trusts progressively worsened during 2011-16, and this change was associated with poorer performance on several process measures but not with hospital readmissions or inpatient satisfaction. Significant variation exists between the best and worst financially performing Trusts.

Implications of all the available evidence

The causal nature of relationships between financial performance, process measures and outcomes remains problematic to entangle but specific findings from our study merit further consideration. The lack of significant association between operating margin and either readmissions or inpatient satisfaction may suggest that clinical outcomes are more resilient to financial pressures than process measures, or that the driver for such clinical metrics is not predominantly financial-based. The recent narrowing of variation between the best and worst performing Trusts on the measures of A&E targets and delayed transfers of care, may be a cause for concern, suggesting that now even the best financially performing Trusts are struggling to manage demand.

CONTRIBUTORSHIP

MN and MM conceived the study. RR and RA had critical input into study direction and interpretation. MN and GK extracted and sorted data for the study. MN performed the analysis and wrote the first draft of the manuscript. All authors (MN, GK, RR, RA, MM) contributed to critical revision of the manuscript for important intellectual content and approved the final version. MN and MM are the guarantors.

ACKNOWLEDGEMENTS

Nil.

DECLARATION OF INTERESTS

All authors have completed the ICMJE uniform disclosure at [ww.icmje.org/coi_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf). Mahiben Maruthappu serves as NHS England's Innovation Adviser. All authors declare no support from any organisation for the submitted work, no financial relationships with any organisations that might have an interest in the submitted work in the previous three years and no other relationships or activities that could appear to have influenced the submitted work.

FUNDING

No specific funding for this study.

SPONSOR

No sponsor for this study.

DATA SHARING

Raw data and analysis available on request from authors.

TRANSPARENCY STATEMENT

The study guarantors (MN and MM) affirm that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

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ETHICS

No ethical approval required as retrospective longitudinal observational study of publicly available Trust-level data.

For peer review only

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FIGURE LEGENDS

Figure 1. Distribution of average operating surplus/deficit over the 2011-16 period.

Figure 2. Trends in operating margin and clinical outcomes over time.

Figure 3. Trends in operating margin and process measures over time. Abbreviations: A&E, Accident & Emergency.

Figure 4. 2011-12 correlation between delayed transfers of care, elective operation cancellations, agency spend, A&E breaches and operating margin. Elective surgery cancellations are last-minute elective operation cancellations (for non-clinical reasons) standardised in this figure to number of available beds at the Trust (as a proxy for hospital capacity). Agency spend is displayed as a proportion of turnover. Operating margin is as defined in study methods. Abbreviations: A&E, Accident & Emergency; DTOC, delayed transfer of care.

Figure 5. 2015-16 correlation between delayed transfers of care, elective operation cancellations, agency spend, A&E breaches and operating margin. Elective surgery cancellations are last-minute elective operation cancellations (for non-clinical reasons) standardised in this figure to number of available beds at the Trust (as a proxy for hospital capacity). Agency spend is displayed as a proportion of turnover. Operating margin is as defined in study methods. Abbreviations: A&E, Accident & Emergency; DTOC, delayed transfer of care.

TABLE LEGENDS

Table 1. Trust metrics by decile of operating margin.

Table 2. Outcomes and process measures by decile of operating margin. Values are median (IQR).

Abbreviations: A&E, Accident & Emergency.

Table 3. Variation in outcomes and process measures over time by financial performance. 'Best 10%' refers to Trusts with operating margins in the top 10% of the sample. 'Worst 10%' refers to Trusts with operating margins in the bottom 10% of the sample.

Table 4. Association of operating margin with outcomes and process measures. Abbreviations: A&E, Accident & Emergency; CI, confidence interval.

Table 5. Outcomes and process measures in trusts struggling (i.e. in special measures or subject to enforcement action) versus those that are not. Values are median (IQR).

Table 1. Trust metrics by decile of operating margin.

	Operating margin			
	Bottom 10%	11-50%	51-89%	Top 10%
Operating surplus / deficit (£ millions, median (range))	-30.9 (-61.1 to -12.4)	-6.3 (-63.1 to -1.2)	-1.5 (-13.8 to 6.8)	5.4 (1.3 to 32.6)
Agency spend as proportion of turnover (%)	6.9 (2.0)	4.8 (2.4)	3.8 (2.0)	3.9 (1.2)
Consultancy spend as proportion of turnover (%)	0.96 (0.54)	0.44 (0.35)	0.45 (0.74)	0.46 (0.29)
Annual admissions, mean (SD)	26,978 (9,698)	29,006 (13,326)	36,411 (21,300)	30,445 (12,455)
Annual outpatient attendances, mean (SD)	271,508 (109,938)	295,223 (142,784)	374,266 (210,861)	407,595 (209,956)
Bed availability, mean (SD)	716 (267)	718 (321)	822 (387)	740 (226)
Bed occupancy (%)	90.1	88.3	87.2	88.1
Deprivation score, mean (SD)	23.4 (11.8)	19.2 (13.2)	23.3 (14.6)	23.5 (11.9)
Teaching trust (%)	6.7	17.0	33.3	35.7
Region (%)				
London	20	17	17	21
South	20	17	38	7
Midlands	40	36	15	29
North	20	31	30	43

Table 2. Outcomes/process measures by decile of operating margin.

	Operating margin				p-value
	Bottom 10%	11-50%	51-89%	Top 10%	
Readmission rate (%)	3·6 (3·4 to 3·9)	3·6 (3·1 to 3·9)	3·7 (3·2 to 4·0)	3·3 (3·0 to 3·8)	0·137
Inpatient satisfaction score (out of 10)	8·0 (7·8 to 8·2)	8·0 (7·8 to 8·2)	7·9 (7·7 to 8·1)	7·9 (7·7 to 8·2)	<0·001
4 hour A&E target breach rate (%)	10·2 (6·7 to 15·1)	6·7 (4·9 to 10·7)	5·3 (4·2 to 7·3)	5·3 (3·9 to 6·7)	<0·001
Delayed transfer of care days per hospital bed	11·1 (6·0 to 17·1)	7·4 (4·5 to 10·9)	6·5 (3·7 to 11·0)	5·7 (2·6 to 8·1)	<0·001
Cancer two week wait target adherence (%)	94·9 (93·2 to 96·2)	95·5 (94·2 to 96·7)	95·4 (94·4 to 96·7)	95·6 (95·0 to 96·5)	0·009
Cancer 62 days to first treatment target adherence (%)	86·2 (81·9 to 88·2)	86·6 (83·6 to 89·1)	87·6 (85·6 to 89·6)	88·0 (86·3 to 89·9)	<0·001

Table 3. Variation in outcomes and process measures over time by financial performance.

Readmissions (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	-	-	-	3.6	3.7	3.8
Middle 80%	-	-	-	3.4	3.6	3.6
Best 10%	-	-	-	3.4	3.5	3.6
Ratio of worst to best	-	-	-	1.1	1.0	1.1
Difference (best and worst)	-	-	-	0.2	0.1	0.2
Inpatient satisfaction survey (score out of 10)						
	2011	2012	2013	2014	2015	2016
Worst 10%	7.5	7.7	7.9	7.9	8.0	8.0
Middle 80%	7.7	7.8	7.9	8.0	8.1	8.1
Best 10%	7.8	7.8	7.9	8.0	8.1	8.1
Ratio of worst to best	1.0	1.0	1.0	1.0	1.0	1.0
Difference (best and worst)	0.3	0.1	0.0	0.1	0.1	0.1
Accident & Emergency breach rate (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	8.2	6.4	7.8	7.8	11.9	13.6
Middle 80%	5.2	4.9	6.0	6.3	9.3	12.0
Best 10%	4.2	4.5	5.5	5.9	7.5	10.4
Ratio of worst to best	2.0	1.4	1.4	1.3	1.6	1.3
Difference (best and worst)	4.0	1.9	2.3	1.9	4.4	3.2
Delayed transfers of care days						
	2011	2012	2013	2014	2015	2016
Worst 10%	5,077	6,657	7,248	6,972	7,813	8,284
Middle 80%	4,851	5,082	5,558	6,046	7,311	8,044
Best 10%	3,850	3,722	3,884	3,932	5,712	6,477
Ratio of worst to best	1.3	1.8	1.9	1.8	1.4	1.3
Difference (best and worst)	1,227	2,935	3,364	3,040	2,101	1,807
Cancer two week wait target breach rate (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	4.2	4.2	4.6	4.8	6.2	5.9
Middle 80%	4.3	3.9	4.3	4.4	5.7	5.5
Best 10%	4.6	4.1	4.0	4.6	5.9	5.2
Ratio of worst to best	0.9	1.0	1.2	1.0	1.1	1.1
Difference (best and worst)	-0.4	0.1	0.6	0.2	0.3	0.7
Cancer 62 days to first treatment breach rate (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	11.9	11.7	12.2	13.7	16.6	18.3
Middle 80%	12.1	12.0	12.2	13.4	15.6	16.2
Best 10%	11.9	11.7	10.0	11.7	13.5	15.2
Ratio of worst to best	1.0	1.0	1.2	1.2	1.2	1.2
Difference (best and worst)	0.0	0.0	2.2	2.0	3.1	3.1

Table 4. Impact of operating margin on outcomes and process measures.

Outcome	n	Trust clusters	Coefficient	95% CI	p-value
Readmission rate (%)	387	135	-0.012	-0.029 to 0.005	0.164
Inpatient satisfaction score (out of 10)	825	148	0.80	-0.06 to 1.67	0.067
A&E 4 hour breach rate (%)	835	148	-0.24	-0.33 to -0.15	<0.001
Delayed transfers of care days per hospital bed	837	148	-25.1	-39.1 to -11.0	0.001
2 week wait cancer target adherence (%)	833	148	0.05	0.00 to 0.09	0.031
62 day cancer treatment target adherence (%)	833	148	0.12	0.03 to 0.21	0.009

Table 5. Outcomes/process measures in trusts struggling (i.e. in special measures or subject to enforcement action) versus those that are not.

	Struggling trust	Non-struggling trust	p-value
Readmission rate (%)	3.6 (3.1 to 3.9)	3.7 (3.1 to 3.9)	0.285
Inpatient satisfaction score (out of 10)	7.9 (7.8 to 8.1)	7.9 (7.8 to 8.1)	0.378
A&E 4 hour target breach rate (%)	6.8 (5.2 to 10.2)	5.5 (4.2 to 8.3)	<0.001
Delayed transfer of care days per hospital bed	8.2 (4.5 to 11.9)	6.4 (4.0 to 10.4)	0.005
Cancer two week wait target adherence (%)	95.1 (94.0 to 96.4)	95.5 (94.4 to 96.8)	0.002
Cancer 62 days to first treatment target adherence (%)	86.6 (83.7 to 88.9)	87.4 (84.8 to 89.6)	0.002

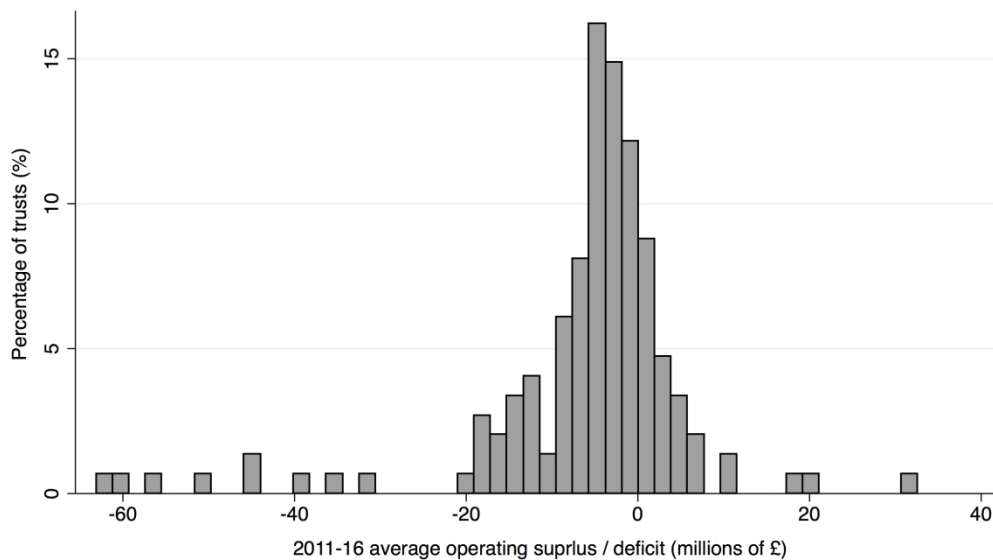


Figure 1. Distribution of average operating surplus/deficit over the 2011-16 period.

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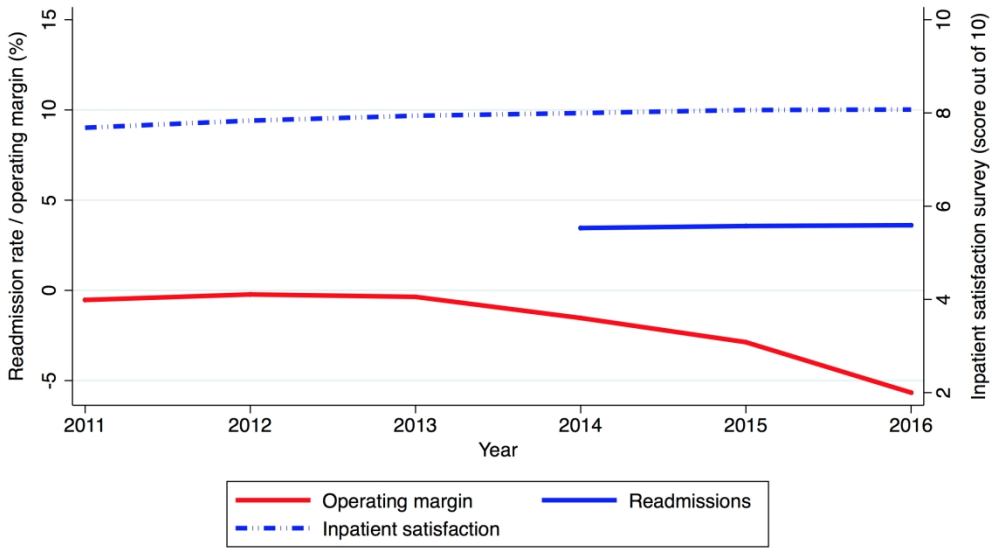


Figure 2. Trends in operating margin and clinical outcomes over time.

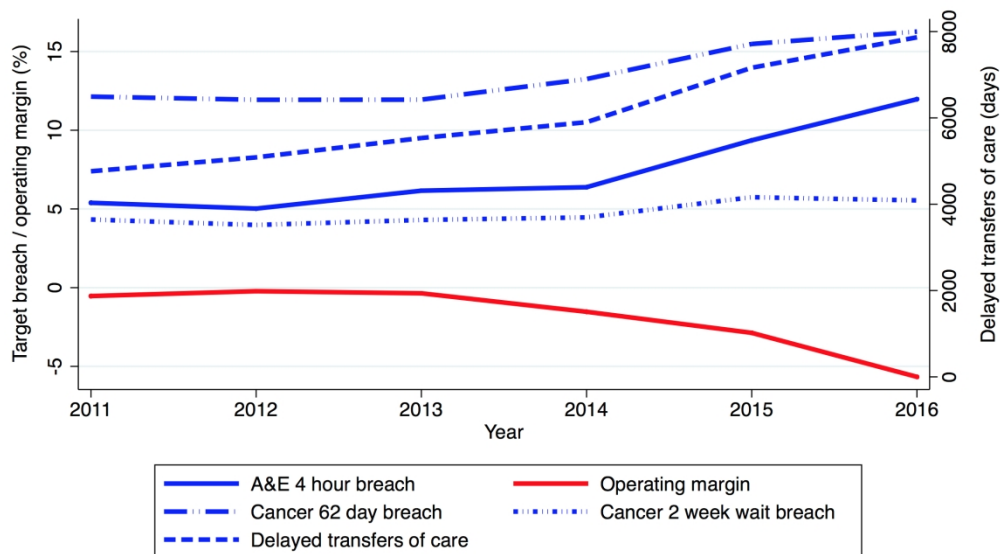


Figure 3. Trends in operating margin and process measures over time. Abbreviations: A&E, Accident & Emergency.

2011-12

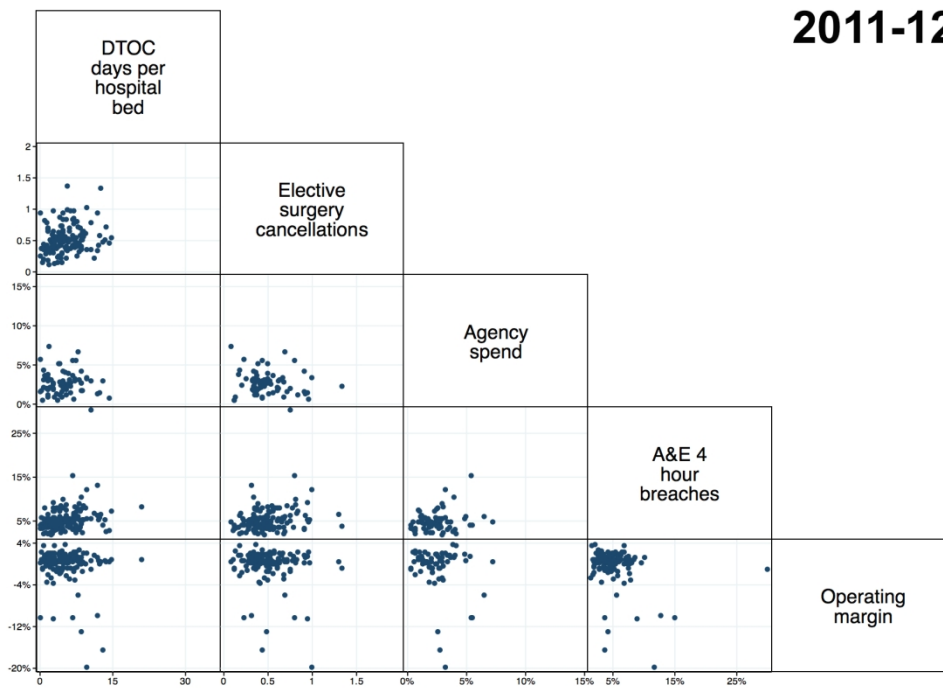


Figure 4. 2011-12 correlation between delayed transfers of care, elective operation cancellations, agency spend, A&E breaches and operating margin. Elective surgery cancellations are last-minute elective operation cancellations (for non-clinical reasons) standardised in this figure to number of available beds at the Trust (as a proxy for hospital capacity). Agency spend is displayed as a proportion of turnover. Operating margin is as defined in study methods. Abbreviations: A&E, Accident & Emergency; DTOC, delayed transfer of care.

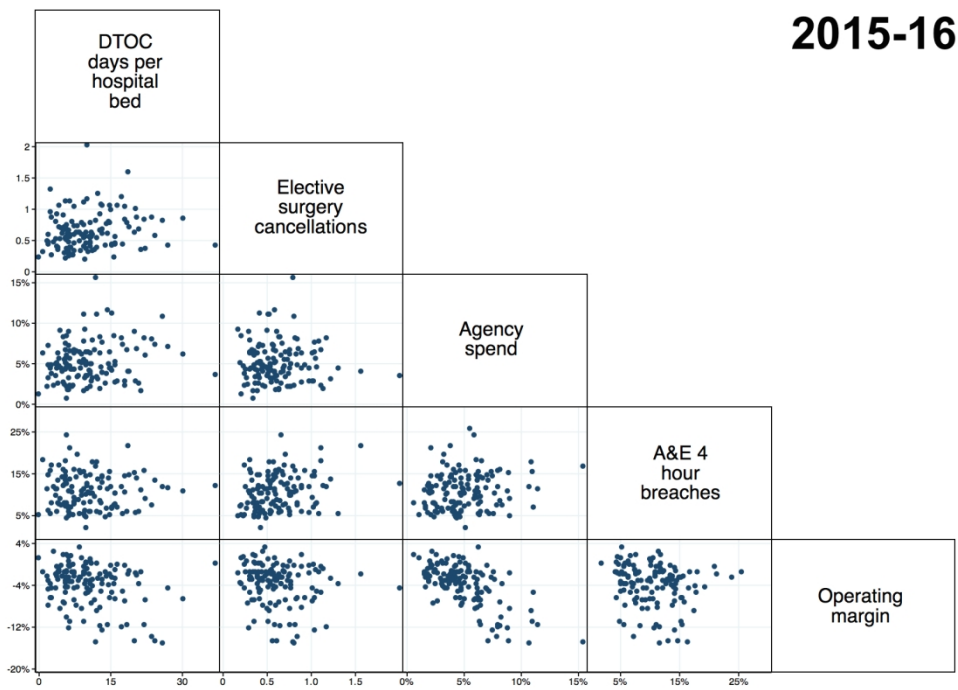


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Financial Performance of English NHS Trusts and Clinical Outcomes: A Longitudinal Observational Study

ONLINE SUPPLEMENTAL DATA

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Supplement version: 2.1

FINANCIAL DATA EXTRACTION

Where financial data was extracted from consolidated end of year accounts files via the gov.uk open data portal, the following fields were extracted:

For foundation trusts:

Turnover --> Table ID 1, Subcode 100
Surplus/Deficit --> Table ID 1, Subcode 160
Consultancy --> 07A and 07I, subcode 280
Agency spend --> 1415TRU06_EXP_P13, maincode 01, subcode 180

For non-Foundation trusts:

Turnover --> Table ID CNE, Subcode 120 and 130
Surplus/Deficit --> Table ID CNE, Subcode 390
Consultancy --> 08C, subcode 125 (**only available for 2014-16**)
Agency spend --> 1415TRU09_EMP_P13, maincode 04, subcode 100 (**only available for 2015-16**)

1 DELAYED TRANSFERS OF CARE IN FINANCIAL YEAR ENDING 2011

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4 Delayed transfer of care data were only available at Trust level for the latter eight months of the
5 2011 financial year. To ensure comparability with other years, a 1.5x multiplier was applied for
6 each trust in this financial year with a sensitivity analysis to examine any impact of this change.
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11 The total numbers of delayed transfers for all hospitals were available as an aggregate total
12 (data obtained from King's Fund Quarterly Monitoring Report for 2010-11).
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16 The ratio of aggregate delayed transfer of care days for the first 4 months (April 2010 to July
17 2010) to the last 8 months (August 2010 to March 2011) was 0.492; suggesting that a 1.5x
18 multiplier appeared reasonable.
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Year	Month	Number of DTOCs	4-monthly total
2010	Apr	113900	-
2010	May	112442	-
2010	Jun	115336	-
2010	Jul	109918	451596
-	-	-	-
2010	Aug	115855	-
2010	Sep	113246	-
2010	Oct	113091	-
2010	Nov	116466	458658
-	-	-	-
2010	Dec	114346	-
2011	Jan	112386	-
2011	Feb	123130	-
2011	Mar	109362	459224

CHANGES TO TRUST COMPOSITION

The 168 Trusts listed below include specialist Trusts (e.g. Great Ormond Street Hospital for Children NHS Foundation Trust) that were excluded prior to analysis. Changes in composition to the Trusts (creation of a new Trust, dissolution of an existing Trust, acquisitions of a hospital or entire Trust to another Trust and mergers between Trusts) are detailed at the end of the table.

Trust	Trust identifier	Change in composition	Transitioned to Foundation status	Foundation Trust transition date
Aintree University Hospital NHS Foundation Trust	REM			
Airedale NHS Foundation Trust	RCF		Yes	01/06/2010
Alder Hey Children's NHS Foundation Trust	RBS			
Ashford and St Peter's Hospitals NHS Foundation Trust	RTK		Yes	01/12/2010
Barking, Havering and Redbridge University Hospitals NHS Trust	RF4			
Barnet and Chase Farm Hospitals NHS Trust	RVL	Yes (1)		
Barnsley Hospital NHS Foundation Trust	RFF			
Barts and the London NHS Trust	RNJ	Yes (2)		
Barts Health NHS Trust	R1H	Yes (3)		
Basildon and Thurrock University Hospitals NHS Foundation Trust	RDD			
Bedford Hospital NHS Trust	RC1			
Birmingham Children's Hospital NHS Foundation Trust	RQ3			
Birmingham Women's NHS Foundation Trust	RLU			
Blackpool Teaching Hospitals NHS Foundation Trust	RXL			
Bolton NHS Foundation Trust	RMC			
Bradford Teaching Hospitals NHS Foundation Trust	RAE			
Brighton and Sussex University Hospitals NHS Trust	RXH			
Buckinghamshire Healthcare NHS Trust	RXQ			

1	Burton Hospitals NHS Foundation Trust	RJF			
2	Calderdale and Huddersfield NHS Foundation Trust	RWY			
3	Cambridge University Hospitals NHS Foundation Trust	RGT			
4	Central Manchester University Hospitals NHS Foundation Trust	RW3	Yes (4)		
5	Chelsea and Westminster Hospital NHS Foundation Trust	RQM	Yes (5)		
6	Chesterfield Royal Hospital NHS Foundation Trust	RFS			
7	City Hospitals Sunderland NHS Foundation Trust	RLN			
8	Colchester Hospital University NHS Foundation Trust	RDE			
9	Countess Of Chester Hospital NHS Foundation Trust	RJR			
10	County Durham and Darlington NHS Foundation Trust	RXP			
11	Croydon Health Services NHS Trust	RJ6			
12	Dartford and Gravesham NHS Trust	RN7			
13	Derby Teaching Hospitals NHS Foundation Trust	RTG			
14	Doncaster and Bassetlaw Hospitals NHS Foundation Trust	RP5			
15	Dorset County Hospital NHS Foundation Trust	RBD			
16	Ealing Hospital NHS Trust	RC3	Yes (6)		
17	East and North Hertfordshire NHS Trust	RWH			
18	East Cheshire NHS Trust	RJN			
19	East Kent Hospitals University NHS Foundation Trust	RVV			
20	East Lancashire Hospitals NHS Trust	RXR			
21	East Sussex Healthcare NHS Trust	RXC			
22	Epsom and St Helier University Hospitals NHS Trust	RVR			
23	Frimley Health NHS Foundation Trust	RDU	Yes (7)		
24	Gateshead Health NHS Foundation Trust	RR7			
25	George Eliot Hospital NHS Trust	RLT			
26	Gloucestershire Hospitals NHS Foundation Trust	RTE			
27	Great Ormond Street Hospital for Children NHS Foundation Trust	RP4		Yes	01/03/2012
28	Great Western Hospitals NHS Foundation Trust	RN3			
29	Guy's and St Thomas' NHS Foundation Trust	RJ1			
30	Hampshire Hospitals NHS Foundation Trust	RN5	Yes (8)		

1	Harrogate and District NHS Foundation Trust	RCD			
2	Heart Of England NHS Foundation Trust	RR1			
3	Heatherwood and Wexham Park Hospitals NHS Foundation Trust	RD7	Yes (9)		
4	Hinchingbrooke Health Care NHS Trust	RQQ			
5	Homerton University Hospital NHS Foundation Trust	RQX			
6	Hull and East Yorkshire Hospitals NHS Trust	RWA			
7	Imperial College Healthcare NHS Trust	RYJ			
8	Ipswich Hospital NHS Trust	RGQ			
9	Isle Of Wight NHS Trust	R1F	Yes (10)		
10	James Paget University Hospitals NHS Foundation Trust	RGP			
11	Kettering General Hospital NHS Foundation Trust	RNQ			
12	King's College Hospital NHS Foundation Trust	RJZ	Yes (11)		
13	Kingston Hospital NHS Foundation Trust	RAX		Yes	01/05/2013
14	Lancashire Teaching Hospitals NHS Foundation Trust	RXN			
15	Leeds Teaching Hospitals NHS Trust	RR8			
16	Lewisham and Greenwich NHS Trust	RJ2	Yes (12)		
17	Liverpool Heart and Chest NHS Foundation Trust	RBQ			
18	Liverpool Women's NHS Foundation Trust	REP			
19	London North West Healthcare NHS Trust	R1K	Yes (13)		
20	Luton and Dunstable University Hospital NHS Foundation Trust	RC9			
21	Maidstone and Tunbridge Wells NHS Trust	RWF			
22	Medway NHS Foundation Trust	RPA			
23	Mid Cheshire Hospitals NHS Foundation Trust	RBT			
24	Mid Essex Hospital Services NHS Trust	RQ8			
25	Mid Staffordshire NHS Foundation Trust	RJD	Yes (14)		
26	Mid Yorkshire Hospitals NHS Trust	RXF			
27	Milton Keynes University Hospital NHS Foundation Trust	RD8			
28	Moorfields Eye Hospital NHS Foundation Trust	RP6			
29	Newham University Hospital NHS Trust	RNH	Yes (15)		
30	Norfolk and Norwich University Hospitals NHS Foundation Trust	RM1			

1	North Bristol NHS Trust	RVJ			
2	North Cumbria University Hospitals NHS Trust	RNL			
3	North Middlesex University Hospital NHS Trust	RAP			
4	North Tees and Hartlepool NHS Foundation Trust	RVW			
5	North West London Hospitals NHS Trust	RV8	Yes (16)		
6	Northampton General Hospital NHS Trust	RNS			
7	Northern Devon Healthcare NHS Trust	RBZ			
8	Northern Lincolnshire and Goole NHS Foundation Trust	RJL			
9	Northumbria Healthcare NHS Foundation Trust	RTF			
10	Nottingham University Hospitals NHS Trust	RX1			
11	Oxford University Hospitals NHS Foundation Trust	RTH	Yes (17)	Yes	01/10/2015
12	Papworth Hospital NHS Foundation Trust	RGM			
13	Pennine Acute Hospitals NHS Trust	RW6			
14	Peterborough and Stamford Hospitals NHS Foundation Trust	RGN			
15	Plymouth Hospitals NHS Trust	RK9			
16	Poole Hospital NHS Foundation Trust	RD3			
17	Portsmouth Hospitals NHS Trust	RHU			
18	Queen Victoria Hospital NHS Foundation Trust	RPC			
19	Robert Jones and Agnes Hunt Orthopaedic and District Hospital NHS Foundation Trust	RL1		Yes	01/08/2011
20	Royal Berkshire NHS Foundation Trust	RHW			
21	Royal Brompton and Harefield NHS Foundation Trust	RT3			
22	Royal Cornwall Hospitals NHS Trust	REF			
23	Royal Devon and Exeter NHS Foundation Trust	RH8			
24	Royal Free London NHS Foundation Trust	RAL	Yes (18)	Yes	01/04/2012
25	Royal Liverpool and Broadgreen University Hospitals NHS Trust	RQ6			
26	Royal National Hospital For Rheumatic Diseases NHS Foundation Trust	RBB	Yes (19)		
27	Royal National Orthopaedic Hospital NHS Trust	RAN			
28	Royal Surrey County NHS Foundation Trust	RA2			
29	Royal United Hospitals Bath NHS Foundation Trust	RD1	Yes (20)	Yes	01/11/2014
30	Salford Royal NHS Foundation Trust	RM3			

1	Salisbury NHS Foundation Trust	RNZ			
2	Sandwell and West Birmingham Hospitals NHS Trust	RXK			
3	Scarborough and North East Yorkshire Healthcare NHS Trust	RCC	Yes (21)		
4	Sheffield Children's NHS Foundation Trust	RCU			
5	Sheffield Teaching Hospitals NHS Foundation Trust	RHQ			
6	Sherwood Forest Hospitals NHS Foundation Trust	RK5			
7	Shrewsbury and Telford Hospital NHS Trust	RXW			
8	South London NHS Healthcare Trust	RYQ	Yes (22)		
9	South Tees Hospitals NHS Foundation Trust	RTR			
10	South Tyneside NHS Foundation Trust	RE9			
11	South Warwickshire NHS Foundation Trust	RJC			
12	Southend University Hospital NHS Foundation Trust	RAJ			
13	Southport and Ormskirk Hospital NHS Trust	RVY			
14	St George's University Hospitals NHS Foundation Trust	RJ7		Yes	01/02/2015
15	St Helens and Knowsley Hospitals NHS Trust	RBN			
16	Stockport NHS Foundation Trust	RWJ			
17	Surrey and Sussex Healthcare NHS Trust	RTP			
18	Tameside Hospital NHS Foundation Trust	RMP			
19	Taunton and Somerset NHS Foundation Trust	RBA			
20	The Christie NHS Foundation Trust	RBV			
21	The Clatterbridge Cancer Centre NHS Foundation Trust	REN			
22	The Dudley Group NHS Foundation Trust	RNA			
23	The Hillingdon Hospitals NHS Foundation Trust	RAS		Yes	01/04/2011
24	The Newcastle Upon Tyne Hospitals NHS Foundation Trust	RTD			
25	The Princess Alexandra Hospital NHS Trust	RQW			
26	The Queen Elizabeth Hospital, King's Lynn. NHS Foundation Trust	RCX		Yes	01/02/2011
27	The Rotherham NHS Foundation Trust	RFR			
28	The Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust	RDZ			
29	The Royal Marsden NHS Foundation Trust	RPY			
30	The Royal Orthopaedic Hospital NHS Foundation Trust	RRJ			

1	The Royal Wolverhampton NHS Trust	RL4	Yes (23)		
2	The Walton Centre NHS Foundation Trust	RET			
3	The Whittington Hospital NHS Trust	RKE			
4	Torbay and South Devon NHS Foundation Trust	RA9	Yes (24)		
5	Trafford Healthcare NHS Trust	RM4	Yes (25)		
6	United Lincolnshire Hospitals NHS Trust	RWD			
7	University College London Hospitals NHS Foundation Trust	RRV			
8	University Hospital Of South Manchester NHS Foundation Trust	RM2			
9	University Hospital Southampton NHS Foundation Trust	RHM		Yes	01/10/2011
10	University Hospitals Birmingham NHS Foundation Trust	RRK			
11	University Hospitals Bristol NHS Foundation Trust	RA7			
12	University Hospitals Coventry and Warwickshire NHS Trust	RKB			
13	University Hospitals Of Leicester NHS Trust	RWE			
14	University Hospitals Of Morecambe Bay NHS Foundation Trust	RTX		Yes	01/10/2010
15	University Hospitals of North Midlands NHS Trust	RJE	Yes (26)		
16	Walsall Healthcare NHS Trust	RBK			
17	Warrington and Halton Hospitals NHS Foundation Trust	RWW			
18	West Hertfordshire Hospitals NHS Trust	RWG			
19	West Middlesex University Hospital NHS Trust	RFW	Yes (27)		
20	West Suffolk NHS Foundation Trust	RGR		Yes	01/12/2011
21	Western Sussex Hospitals NHS Foundation Trust	RYR		Yes	01/07/2013
22	Weston Area Health NHS Trust	RA3			
23	Whipps Cross University Hospital NHS Trust	RGC	Yes (28)		
24	Winchester and Eastleigh Healthcare Trust	RN1	Yes (29)		
25	Wirral University Teaching Hospital NHS Foundation Trust	RBL			
26	Worcestershire Acute Hospitals NHS Trust	RWP			
27	Wrightington, Wigan and Leigh NHS Foundation Trust	RRF			
28	Wye Valley NHS Trust	RLQ	Yes (30)		
29	Yeovil District Hospital NHS Foundation Trust	RA4			
30	York Teaching Hospital NHS Foundation Trust	RCB	Yes (31)		

1. Acquired by Royal Free London NHS FT in 2014
2. Merged with Newham University Hospital NHS Trust and Whipps Cross University Hospital NHS Trust to form Barts Health NHS Trust in 2012
3. Formed from the merger of Barts and the London NHS Trust, Whipps Cross University Hospital NHS Trust and Newham University Hospital NHS Trust in 2012
4. Acquired Trafford Healthcare NHS Trust in Apr 2012
5. Acquired West Middlesex University Hospital NHS Trust in Sep 2015
6. Merged with North West London Hospitals NHS Trust to form London North West Healthcare NHS Trust in 2014
7. Formed by merger of Heatherwood and Wexham Park Hospitals NHS FT and Frimley Park Hospital NHS FT on 1 October 2014
8. Formed by acquisition of Winchester and Eastleigh Healthcare Trust by Basingstoke and North Hampshire NHS FT in Jan 2012
9. Merged with Frimley Park Hospital NHS FT to form Frimley Health NHS FT on 1 October 2014
10. Created in Apr 2012 by a provider split from Isle of Wight NHS PCT (5QT)
11. Acquired Princess Royal University Hospital from South London NHS Healthcare Trust's dissolution in Oct 2013
12. Formed on 1 Oct 2013 by merger of merger of Lewisham Healthcare NHS Trust and Queen Elizabeth Hospital (previously part of South London NHS Healthcare Trust)
13. Formed by merger of Ealing Hospital NHS Trust and North West London Hospitals NHS Trust in 2014
14. Mid Staffordshire NHS FT which ran Stafford hospital dissolved In Nov 2014. Stafford hospital renamed to County Hospital and acquired by newly named University Hospitals of North Midlands NHS Trust
15. Merged with Barts and the London NHS Trust and Whipps Cross University Hospital NHS Trust to form Barts Health NHS Trust in 2012
16. Merged with Ealing Hospital NHS Trust to form London North West Healthcare NHS Trust in 2014
17. Formed from Oxford Radcliffe Hospitals NHS Trust by acquisition of Nuffield Orthopaedic Acute Centre NHS Trust in 2011
18. Acquired Barnet and Chase Farm Hospitals NHS Trust in 2014
19. Acquired by Royal United Hospital Bath NHS FT on 1 Feb 2015
20. Acquired Royal National Hospital For Rheumatic Diseases NHS FT on 1 Feb 2015
21. Acquired by York Teaching Hospital NHS Foundation Trust in Jul 2013
22. Dissolved in Oct 2013

- 1 23. Acquired Cannock Chase Hospital when Mid Staffordshire NHS FT dissolved In Nov 2014
- 2 24. Created on 1 Oct 2015 from South Devon Healthcare NHS Foundation Trust merging with Torbay and Southern Devon Health and Care NHS Trust
- 3 (community and social care services)
- 4
- 5 25. Acquired by Central Manchester University Hospitals NHS FT in Apr 2012
- 6
- 7 26. Formed from University Hospital Of North Staffordshire NHS Trust taking over Stafford Hospital (now named County Hospital) on 1 Nov 2014. Mid
- 8 Staffordshire NHS FT which ran Stafford hospital dissolved In Nov 2014
- 9
- 10 27. Acquired by Chelsea and Westminster Hospital NHS FT in Sep 2015
- 11
- 12 28. Merged with Newham University Hospital NHS Trust and Barts and the London NHS Trust to form Barts Health NHS Trust in 2012
- 13
- 14 29. Acquired by Basingstoke and North Hampshire NHS FT to form Hampshire Hospitals NHS FT in Jan 2012
- 15
- 16 30. Formed from Hereford Hospitals NHS Trust on 1 April 2011 following Herefordshire's health and adult social care providers joining to form an
- 17 integrated provider of acute, community and social care in England
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- 19 31. Acquired Scarborough and North East Yorkshire Healthcare NHS Trust in Jul 2013
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SENSITIVITY ANALYSES AND ADDITIONAL TABLES

Table A. Assessment of the impact of not adjusting for missing 2011 delayed transfer of care data. Abbreviations: CI, confidence interval.

Delayed transfers of care days per hospital bed	n	Trust clusters	Coefficient	95% CI	p-value
Without adjustment for missing 2011 data	837	148	-21.9	-35.5 to -8.4	0.002
With adjustment for missing 2011 data	837	148	-25.1	-39.1 to -11.0	0.001

Table B. Association of operating margin with outcomes and process measures. Adjusted regression analyses as per table 3 in the manuscript excluding Trusts that had changed in composition between 2011 and 2016. Abbreviations: A&E, Accident & Emergency; SHMI, Summary Hospital-level Mortality Indicator.

Outcome	n	Trust clusters	Coefficient	95% CI	p-value
Readmission rate (%)	344	119	-0.01	-0.03 to 0.01	0.403
Inpatient satisfaction score (out of 10)	706	119	0.66	-0.23 to 1.55	0.142
A&E 4 hour breach rate (%)	710	119	-0.20	-0.30 to -0.11	<0.001
Delayed transfers of care days per hospital bed	711	119	-29.5	-44.1 to -14.8	<0.001
2 week wait cancer target adherence (%)	710	119	0.05	0.00 to 0.10	0.042
62 day cancer treatment target adherence (%)	710	119	0.12	0.02 to 0.23	0.018

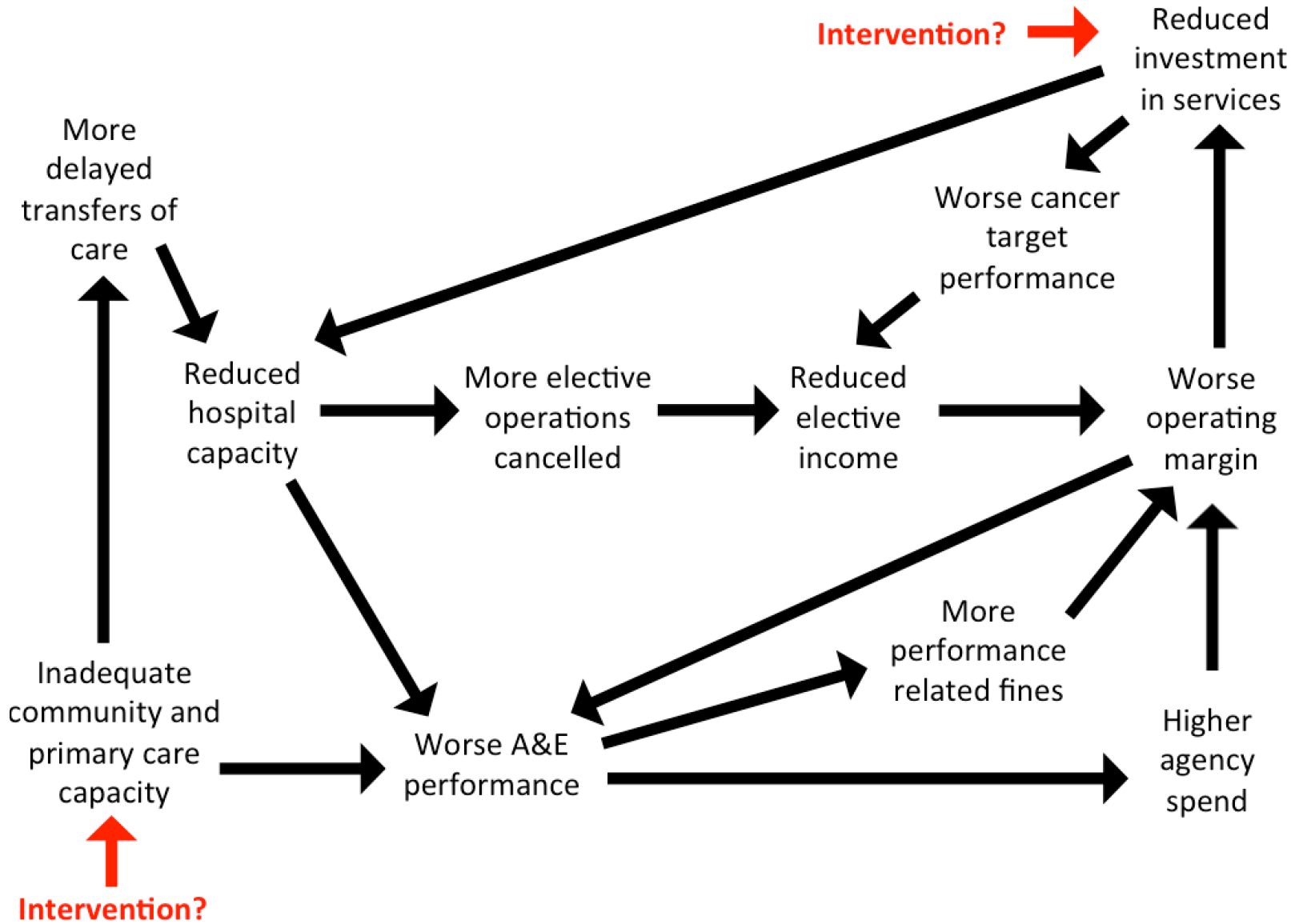
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Table C. Association of operating margin with outcomes and process measures (summary model for 2011-13). Operating margin and outcomes were averaged over the 3 years from 2011-13 to form the inputs to the summary model. Readmission rate is not included as data was not available for 2011-13. Abbreviations: A&E, Accident & Emergency; CI, confidence interval.

Agency spend as a proportion of turnover (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	3.9	3.9	4.6	6.0	8.5	9.1
Middle 80%	2.4	2.3	2.6	3.0	4.6	5.1
Best 10%	2.7	2.9	3.4	3.8	4.0	4.5
Ratio of worst to best	1.4	1.3	1.4	1.6	2.1	2.0
Difference (best and worst)	1.2	1.0	1.2	2.2	4.5	4.6

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1 PUTATIVE INTERPLAY OF FACTORS AFFECTING TRUST FINANCE AND PERFORMANCE



STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract PAGE 1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found PAGE 2
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported PAGE 4
Objectives	3	State specific objectives, including any pre-specified hypotheses PAGE 4
Methods		
Study design	4	Present key elements of study design early in the paper PAGES 5-7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection PAGES 5-7 (IN SO FAR AS APPLICABLE TO THIS STUDY)
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up PAGE 5 (NO PARTICIPANTS, DESCRIBED FOR CENTRES)
		(b) For matched studies, give matching criteria and number of exposed and unexposed NOT APPLICABLE
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable PAGES 5-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group PAGES 5-7
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at PAGE 5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding PAGES 7-8
		(b) Describe any methods used to examine subgroups and interactions PAGE 7
		(c) Explain how missing data were addressed PAGES 6-7
		(d) If applicable, explain how loss to follow-up was addressed NOT APPLICABLE
		(e) Describe any sensitivity analyses PAGE 8

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Results		
Participants	13*	<p>(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed</p> <p>NOT APPLICABLE</p> <p>(b) Give reasons for non-participation at each stage</p> <p>NOT APPLICABLE BUT DETAILS GIVEN IN ONLINE APPENDIX REGARDING CHANGE IN COMPOSITION OF TRUSTS</p> <p>(c) Consider use of a flow diagram</p> <p>NOT APPLICABLE</p>
Descriptive data	14*	<p>(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders</p> <p>NOT APPLICABLE BUT DETAILS FOR TRUSTS GIVEN ON PAGES 9 & 24</p> <p>(b) Indicate number of participants with missing data for each variable of interest</p> <p>NOT APPLICABLE BUT DETAILS FOR TRUSTS GIVEN ON PAGE 5 IN METHODS SECTION</p> <p>(c) Summarise follow-up time (eg, average and total amount)</p> <p>NOT APPLICABLE AS FOLLOW-UP TIME IS STUDY-PERIOD</p>
Outcome data	15*	<p>Report numbers of outcome events or summary measures over time</p> <p>NOT APPLICABLE IN THE FORMAT OF NUMBER OF OUTCOME EVENTS</p>
Main results	16	<p>(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included</p> <p>PAGES 9-11</p> <p>(b) Report category boundaries when continuous variables were categorized</p> <p>PAGES 9-11</p> <p>(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period</p> <p>NOT APPLICABLE</p>
Other analyses	17	<p>Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses</p> <p>PAGE 11 AND ONLINE APPENDIX</p>
Discussion		
Key results	18	<p>Summarise key results with reference to study objectives</p> <p>PAGE 11</p>
Limitations	19	<p>Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias</p> <p>PAGES 13-14</p>
Interpretation	20	<p>Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence</p> <p>PAGES 14-16</p>
Generalisability	21	<p>Discuss the generalisability (external validity) of the study results</p> <p>PAGES 14-16</p>
Other information		
Funding	22	<p>Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based</p>

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

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Financial Performance of English NHS Trusts and Variation in Clinical Outcomes: A Longitudinal Observational Study

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Financial Performance of English NHS Trusts and Variation in Clinical Outcomes: A Longitudinal Observational Study

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ABSTRACT

Objectives

To examine the association between financial performance as measured by operating margin (surplus/deficit as a proportion of turnover) and clinical outcomes in English NHS trusts.

Setting

Longitudinal, observational study in 149 acute NHS trusts in England between the financial years 2011 and 2016.

Participants

Our analysis focused on the outcomes at individual NHS Trust-level (composed of one or more acute hospitals).

Primary and secondary outcomes

Outcome measures included readmissions, inpatient satisfaction score and the following process measures: emergency department (A&E) waiting time targets, cancer referral and treatment targets, and delayed transfers of care.

Results

There was a progressive increase in the proportion of trusts in financial deficit: 22% in 2011, 27% in 2012, 28% in 2013, 51% in 2014, 68% in 2015 and 91% in 2016. In linear regression analyses, there was no significant association between operating margin and clinical outcomes (readmission rate or inpatient satisfaction score). There was, however, a significant association between operating margin and process measures (delayed transfers of care, A&E breaches and cancer waiting time targets). Between the best and worst financially performing Trusts, there was an approximately 2-fold increase in A&E breaches and delayed transfers of care overall although this variation decreased over the six years. Despite significant differences between the best and worst performing trusts on cancer targets, the magnitude of difference was much smaller (1·16 and 1·15-fold), although the variation slowly rose during the six years.

Conclusions

Operating margins in English NHS trusts progressively worsened during 2011-16, and this change was associated with poorer performance on several process measures but not with hospital readmissions or inpatient satisfaction. Significant variation exists between the best and worst financially performing Trusts. Further research is needed to examine the causal nature of relationships between financial performance, process measures and outcomes.

STRENGTHS AND LIMITATIONS

- To our knowledge, one of the first empirical exploratory analyses of the relationship between funding and outcomes in the English NHS
- Operating margin may not be the ideal measure of an organisation's financial position
- The proportion of activity at each Trust which is elective, acute or specialised was not taken into account nor was the percentage of activity subject to a national tariff
- There may be additional unmeasured confounders that have impacted the results
- This observational study is limited to demonstrating associations rather than causal links

INTRODUCTION

The combination of higher demand due to ageing, growing populations, with more chronic illness and disability, in addition to rising treatment and technology costs, is driving increased health spending in high-income countries.¹ The National Health Service (NHS) in England is introducing policies to address these demands, attempting to contain costs while improving health outcomes. The NHS Five Year Forward View, published in October 2014, set out a strategic vision for sustaining a high-quality, comprehensive health system in England.² Specifically, it identified a £22 billion funding gap by 2020/21, based on the current funding trajectory of the NHS, to be met by ambitious efficiency savings of 2-3% annually (given a long-term track-record of 1% each year).

The call for increased efficiency comes in an austere climate, in which individual NHS Trusts are progressively challenged to achieve financial control,^{3,4} while responding to high demand, especially in winter months, reported widely in the British media.⁵ NHS Improvement, the body responsible for overseeing Trust performance, reported an overall third quarter deficit of £886 million for the 2016-17 financial year, £300 million higher than the planned target.⁶ Higher demand for services, with rising emergency attendances and admissions, and delayed transfers of care (DTOCs), have been cited as key reasons for increasing deficit.⁷ While control of Trust financial deficits is important for sustainability of the NHS, there are concerns on the adverse impact of worsening financial performance on clinical outcomes and processes,⁸ but few studies which have explored this relationship.

We investigated the relationship between operating margin (surplus/deficit as a proportion of turnover) at English NHS Trusts during 2011-16, with outcomes and process measures. We selected performance measures that are commonly used for benchmarking performance of NHS Trusts and that could plausibly be related to quality, namely, hospital readmissions, inpatient satisfaction scores, emergency department waiting time targets, cancer referral and treatment targets, and delayed transfers of care.⁹ Lastly, we investigated the variation in outcome and process measures between the financially best and worst performing Trusts, both overall and over time.

METHODS

Data sources and extraction

NHS Hospitals in England are categorised into financially and operationally distinct legal entities known as Trusts, which deliver services on behalf of the NHS. Trusts may be located at multiple sites and can be responsible for one or more hospitals. Well-performing Trusts are able to gain Foundation status, which allows a degree of financial and operational autonomy from the Department of Health. Data was sought for acute NHS Trusts in the 6-year period encompassing the financial years from April 2010 to March 2016.

We obtained financial data for Trusts from the gov.uk open data portal.¹⁰ Where information was lacking for specific Trusts, we sought the original data from the published accounts available on individual Trust websites or from NHS 'The Quarter' reports.¹¹

Data on four financial metrics were extracted and examined: first, the retained surplus/deficit for the financial year; second, the turnover for the Trust (calculated as "Revenue from patient care activities" and "Other operating revenue"); third, trust spend on agency staff, and fourth, spend on consultancy. The precise table IDs and sub-codes for extraction are detailed in the online Supplementary Appendix. Only the first two metrics are measures of financial performance. The second two reflect Trust spending choices and we included these as exploratory variables given the public and media interest in rising agency and consultancy spend.

Bed availability for the quarter preceding the end of each financial year was obtained from publicly available NHS England data¹² with occupancy rate calculated as the percentage of beds (as a proportion of total available) occupied on average during that quarter. Teaching status of the trusts was defined dichotomously on the basis of membership of The Association of UK University Hospitals.¹³ For each NHS Trust, the postcode of the Trust was extracted and used as a proxy for location to calculate the region of the country in which the trust hospitals were located.

1 This postcode data were matched to the 2015 Indices of Multiple Deprivation (IMD) score.¹⁴ The Office
2 for National Statistics uses UK census data to generate the IMD score which encompasses census
3 information from the following domains: income, employment, crime, living environment, health
4 deprivation and disability, education and skills/training, barriers to housing and services.
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10 Using publicly available NHS England datasets, we obtained data on hospital activity in the form of
11 number of annual admissions per Trust and annual outpatient attendances.¹⁵ Data on last-minute
12 elective operation cancellations (for non-clinical reasons) and the number of such patients not being
13 treated within 28 days of such a cancellation were also extracted from publicly available NHS England
14 datasets.¹⁵
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20 **Outcome measures**

21 The outcomes we measured consisted of two clinical measures and three process measures that are
22 commonly used for benchmarking NHS Trusts and have plausible mechanisms for a relation to quality.
23 We openly acknowledge that there are several other outcomes and process measures which may also
24 relate to quality and could have been chosen. Our selection was based on a combination of logistical
25 constraints (i.e. what data was publicly available) and an effort to include measures which are commonly
26 used for benchmarking trusts and thereby also reported in the mainstream media.⁹
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38 The clinical measures were (i) the proportion of discharges readmitted as an emergency within 7 days of
39 discharge and (ii) annual overall patient satisfaction for each trust using data from the National Adult
40 Inpatient Survey compiled by the Care Quality Commission.¹⁶ Data on readmissions was only available
41 for the years 2014-16. The three process measures were: (i) Accident and Emergency (A&E) 4-hour
42 waiting time breaches (ii) delayed transfers of care from an acute Trust, and (iii) cancer waiting time
43 targets.
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51 The first process measure, Accident and Emergency (A&E) 4-hour waiting time breaches, was defined
52 as the percentage of patient attendances in type 1 departments (major A&E) who waited greater than
53 four hours from arrival to admission, transfer or discharge.
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3 The second process measure, a delayed transfer of care from an acute Trust, was said to occur when a
4 patient was ready to depart from acute care but was still occupying a bed. These data were extracted as
5 'total number of bed days attributed to delayed transfers of care' and standardised to number of beds
6 available in the Trust. Delayed transfer of care data were only available for the latter eight months of the
7 2011 financial year. To ensure comparability with other years, a 1.5x multiplier was applied for each trust
8 in this financial year (see online Supplementary Appendix for further details). No other missing data in
9 the study was imputed.
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18 For the third process measure, cancer waiting time targets, we assessed two specific targets (a) the
19 proportion of patients who received a first consultant appointment within two weeks of urgent referral for
20 suspected cancer by their General Practitioner (GP) and (b) the proportion of patients who commenced
21 a first treatment for cancer within 62 days of being urgently referred by their GP.
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28 **Unit of analysis**

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30 Our analysis focused on the outcomes at individual NHS Trust-level (composed of one or more acute
31 hospitals).
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36 **Statistical analysis**

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38 Our financial metric of interest was the annual Trust operating margin. Similarly to prior literature,¹⁷⁻¹⁹ we
39 defined operating margin as the retained surplus (or deficit) for the Trust in a financial year divided by the
40 turnover (turnover being calculated as "Revenue from patient care activities" and "Other operating
41 revenue"). This value was winsorised to set all outliers beyond the 2.5th and 97.5th percentiles to the
42 values at these percentiles. We first calculated summary statistics of the operating surplus/deficit and
43 metrics of trust characteristics, breaking the sample into 4 groups of deciles by Trust margin.
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52 As a second step, we compared the variation in process and outcome measures between the financially
53 best and worst performing trusts as categorised by operating margin decile (highest versus lowest).
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56 Third, we performed multiple linear regression with our outcomes as the dependent variable and the
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1 following independent variables: operating margin, number of beds available and year. Each Trust in
2 each year was treated as a separate observation with standard errors clustered by Trust to account for
3 the non-independence of Trust-level data.
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8 Fourth, we compared outcomes and process measures between 'struggling' and 'non-struggling' Trusts.
9 For this purpose, a struggling Trust was defined as either: (i) in financial or quality special measures as
10 of December 2016 or (ii) a Foundation Trust subject to enforcement actions by Monitor as of September
11 2016. Fifth, we investigated the relationships between delayed transfers of care, cancelled elective
12 operations, agency spend, A&E breaches and operating margin by assessing correlation between these
13 variables over an early period (2011-12) and a late period (2015-16).
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22 We performed sensitivity analyses to assess the impact of (i) adjustment for missing 2011 delayed
23 transfer of care data and (ii) inclusion of Trusts that had changed in composition during the study period.
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28 All reported p -values are two sided with the statistical significance threshold set to a p -value of less than
29 0.05. Given the hypothesis generating nature of this study, no corrections were made for multiple
30 comparisons. Approximately 1 in every 20 comparisons could be expected to achieve statistical
31 significance by chance alone. All analyses were performed using STATA statistical software version 12.1
32 (College Station, TX). This study had no external funding source.
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40 **Patient involvement**

41 Patients were not involved in any aspect of the study design, conduct or in the development of the
42 research question or outcome measures. This study was a retrospective longitudinal observational study
43 of publicly available Trust-level data and therefore there was no active patient recruitment for data
44 collection or requirement for ethical approval.
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RESULTS

Over the 6-year period of study, encompassing the financial years from April 2010 to March 2016, there were changes in the composition to 31 of 149 Trusts. These are detailed in the online Supplementary Appendix and took the form of creation of a new Trust, dissolution of an existing Trust, acquisitions of a hospital or entire Trust to another Trust and mergers between Trusts. 13 Trusts (9%) transitioned to Foundation Status during the 6-year study period. Of the remaining 136 Trusts, 63 (42%) were non Foundation Trusts and 73 (49%) were Foundation Trusts.

There was a progressive increase in the proportion of Trusts in deficit over the 6-year study period: 22% in 2011, 27% in 2012, 28% in 2013, 51% in 2014, 68% in 2015 and 91% in 2016. The distribution of average operating surplus/deficit over the study period is displayed in Figure 1. Operating surplus/deficit varied widely across Trusts ranging from -£250 million to £181 million over the six years. Median operating surplus/deficit over the study period was -£3.8 million (IQR -£8.7 million to -£0.7 million, range -£63.1 million to £32.6 million). Median operating margin over the study period was -1.1% (IQR -2.7% to -0.2%, range -42.5% to 4.6%). Median operating margin was higher in teaching Trusts compared to non-Teaching Trusts (-0.5% versus -1.4%, $p=0.002$) and lowest in the Midlands compared to other regions (-2.3% in the Midlands, -1.2% in London, -0.8% in the South, -1.0% in the North; $p=0.028$).

During the 6-year study period, there was a nationwide decline in overnight general and acute beds from 110,568 to 103,422 (6.5% reduction) with a concomitant increase in day only beds from 11,572 to 12,207 (5.5% increase).

Trust metrics are shown in Table 1 stratified by decile of operating margin. Between the best and worst financially performing Trusts, there was an approximately 1.75-fold and 2-fold increase in agency and consultancy spend respectively as a proportion of turnover. The best financially performing Trusts also had a 1.5-fold higher annual number of outpatient attendances. In contrast, the annual number of admissions, bed occupancy rates and local deprivation scores were broadly similar between the best and worst performing Trusts. The proportion of Trusts with teaching status increased throughout deciles

1 of operating margin. Trends in the variation of operating margin over time with clinical outcomes and
2 process measures are displayed in figures 2 and 3 respectively.
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6 Clinical outcomes and process measures, stratified by decile of operating margin, are shown in table 2.
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8 Between the best and worst financially performing Trusts, there was an approximately 2-fold increase in
9 A&E breach rates and delayed transfers of care. In contrast, despite significant differences between the
10 best and worst performing trusts on cancer targets, the magnitude of difference was much smaller (both
11 approximately 1·15-fold).
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18 Trends in the variation between the best and worst financially performing Trusts over time for both
19 clinical outcomes and process measures are shown in table 3. There was no appreciable variation in
20 readmission rate or inpatient satisfaction score with the latter increasing over time at a slightly faster rate
21 in the worst financially performing Trusts.
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28 Performance on process measures in both the best and worst financially performing Trusts deteriorated
29 over time (table 3). However, variation between the best and worst groups narrowed for A&E breaches,
30 returned to baseline for delayed transfers of care after an initial rise, and rose slowly for both cancer
31 target breaches. The variation in agency spend as a proportion of turnover between the best and worst
32 financially performing trusts increased substantially between 2011 (best 2·7% and worst 3·9%,
33 difference 1·2%) and 2016 (best 4·5% and worst 9·1%, difference 4·6%) (see online Supplementary
34 Appendix for further details).
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44 In our linear regression analyses, there was no significant association between operating margin and
45 clinical outcomes (readmission rate or inpatient satisfaction score; table 4). There was, however, a
46 significant association between operating margin and process measures (delayed transfers of care, A&E
47 breaches and cancer waiting time targets; table 4). Trusts defined as struggling (i.e. in special measures
48 or subject to enforcement action) were associated with worse performance on all process measures but
49 not with readmission rate or inpatient satisfaction scores (table 5).
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1 The associations between delayed transfers of care, elective surgery cancellations, agency spend, A&E
2 breaches and operating margins are displayed in a correlation matrix for the early years (2011 and 2012;
3 figure 4) and the later years (2015 and 2016; figure 5) of the six year study period (same scale applied to
4 figure 4) and the later years (2015 and 2016; figure 5) of the six year study period (same scale applied to
5 both figures 4 and 5). There was weak positive correlation between all factors except operating margin
6 for which there was weak negative correlation with the other measures. These associations were
7 maintained in the later years though with a greater spread among trusts.
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14 Sensitivity analyses are reported in the online Supplementary Appendix. There was no change to the
15 results with and without adjustment for missing 2011 delayed transfer of care data. There was no change
16 to the results when excluding Trusts that had changed in composition over the study period.
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DISCUSSION

Principal findings

Our study has a number of important findings. First, in the period 2011-16, there was a substantial increase in the proportion of NHS Trusts with negative operating margins. Second, the overall variation between the best and worst financially performing Trusts was considerably larger for A&E breach rates and delayed transfers of care than for cancer targets. Third, the variation over time between the best and worst financially performing trusts was static for clinical outcomes and mixed for process measures (decreased over the six years for A&E breaches, was static for delayed transfers of care while increasing slightly for cancer targets). Fourth, there was a significant association between worsened operating margin and deteriorating process measures (four-hour A&E targets, cancer waiting time targets and delayed transfers of care), but not between operating margin and either readmission rates or inpatient satisfaction scores.

Comparison with other studies

The extant literature on the association between financial performance and outcomes comes primarily from the United States (US) and is mixed in pronouncement. Volpp and colleagues assessed the impact of a budget act reducing Medicare reimbursements on processes of care for acute myocardial infarction (MI).²⁰ They found that while the budget act added moderate financial strain to organisations, there was no appreciable worsening of care with respect to MI processes of care or mortality in 236,506 patients from 208 hospitals. An analysis by Bazzoli and colleagues in 2008 concluded that while there may be an association between some measures of financial performance and adverse events, it was much weaker than previously reported by Encinosa and Bernard who found a concerning association between frequency of patient safety alerts and operating margin.^{17,18} Further, a study by Ly and colleagues in over 3,000 US hospitals found that low hospital margins were associated with worse processes of care and higher readmissions, although not with higher mortality.²¹

Placing our findings in the context of earlier studies requires extreme caution given the differences between the US and UK health systems. Specifically, Ly et al. excluded public hospitals (which comprise

1 the vast majority of English hospitals) from their analysis. However, these prior studies do highlight the
2 difficulty in disentangling the relationship between financial performance and outcomes. Meanwhile, a
3 large European cohort study revealed that attempts to save money by cutting nurse to patient ratios may
4 adversely affect patient outcomes.²² An increase in a nurses' workload by one patient increased the
5 likelihood of a 30-day inpatient death by 7% (odds ratio 1·07, 95% CI 1·03 to 1·11).²²
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10 11 12 **Study limitations**

13 Our findings must be borne in light of several study limitations. First, while we had access to a
14 considerable volume of data, the granularity of data was limited. For example, our unit of analysis was at
15 the Trust level, giving a sample size of approximately 149 compared to equivalent US studies that have
16 analysed over 3000 hospitals.²¹ Lack of 'high-frequency' data also prevented us performing interrupted
17 time-series and time-lag analyses.
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26 Second, it may be that operating margin is not the ideal measure of an organisation's financial position.
27 A Trust's deficit may be exaggerated if it realises that a deficit is unavoidable and careful accounting
28 allows for a larger than necessary deficit in one year to ensure a small surplus in the following year (as
29 opposed to two years of deficit); potential gamification. Organisations including NHS Improvement and
30 the Department of Health typically use breakeven performance figures instead of operating
31 surplus/deficits. We chose not to use such figures as the data were not easily available at Trust level for
32 much of the period under investigation.
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42 Third, we utilised only a small selection of existing clinical outcomes and process. This decision was
43 driven by two factors. Logistically, there is limited public access to many clinical outcomes. While there is
44 access to many process measures, we opted for a small selection that is commonly used for
45 benchmarking trusts (i.e. often quoted in media reports and receive major public scrutiny) so as to avoid
46 the issues of multiple comparisons. It is entirely possible that other process measures may well display
47 differing relationships with respect to operating margins.
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1 Fourth, we did not take into account the proportion of activity at each Trust which is elective, acute or
2 specialised nor did we assess the percentage of activity subject to a national tariff. Work from the Health
3 Foundation in 2016 suggests a link between financial performance and the proportion of Trust income
4 arising from activities subject to the national tariff.²³ Reimbursement prices for specialist activity tend to
5 be higher than average treatment costs. Furthermore, best practice tariffs tend to reward more efficient
6 treatment delivery such as an increased proportion of day cases. Although there is likely to be correlation
7 between teaching hospital status (which we did assess) and the share of activity subject to a specialised
8 services tariff, this is nonetheless a crude proxy.
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18 Fifth, there may be additional unmeasured confounders that have impacted on our results. For example,
19 surrounding Primary Care systems may impact on the efficiency with which the acute Trusts function. Or
20 alternatively, competition from independent sector treatment centres (ISTCs) may lead to a loss of
21 revenue and market share for some Trusts, who may then need to invest more of their operating funds in
22 attracting patients, especially given an increasing emphasis on patient choice and the freedom for
23 patients to select hospitals by publicly reported outcomes. We adjusted for hospital size in the form of
24 number of beds as well as using operating margin as a more standardised measure of financial
25 performance than gross surplus or deficit (as turnover showed wide variation between trusts). Trusts that
26 treat greater volumes of patients may benefit from economies of scale. However, as with any
27 observational research, we cannot fully discount the impact of confounding on our results. For example,
28 financial underperformance may be a signal of general underperformance in a Trust where clinical and
29 other functions that might be suboptimal affect outcomes. Sixth, we are limited to demonstrating
30 associations rather than causal links.
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46 **Conclusions and policy implications**

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48 Notwithstanding limitations, our findings have important ramifications for clinical leads, managers and
49 policy makers. The relationship between financial performance and clinical outcomes is far more
50 complex and associated with myriad other factors which will vary among Trusts. Trusts with financial
51 deficits may be spending more than they can afford (for example, on extra nursing staff) and one could
52 therefore argue that higher quality should be expected for this extra financial outlay. Conversely, the
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1 existence of such deficit might instead indicate reduced efficiency and challenged management.

2 Alternatively, financial penalties due to poor clinical performance or financial management could
3 exacerbate deficits. For example, marginal rate payment reductions for emergency admissions, penalties
4 for readmissions and withholding payment for cases resulting in never events. Attempts to redress this
5 balance may inadvertently lead to reflex spending cuts and poorer quality care. The role of clinical leads,
6 management and leadership within a Trust is likely to be a key contributor to how financial deficits impact
7 quality of care. For example, cutting down on management personnel to save costs may result in worse
8 productivity if clinicians have to allocate more time to administrative activities and away from revenue
9 producing clinical activities.
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20 There are a number of specific points to consider also. First, there is substantial variation between
21 Trusts, which in some cases is worsening. Between the best and worst financially performing Trusts,
22 there are up-to 2-fold differences in agency spend, delayed transfers of care, A&E breaches and cancer
23 waiting times. This is notable and needs to be explicitly tackled with greater efficacy. While national
24 regulators such as the Care Quality Commission (CQC) and NHS Improvement do seek to support
25 challenged Trusts, the effectiveness of this has not necessarily translated into improved performance
26 metrics.
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36 Second, the lack of significant association between operating margin and either readmissions or
37 inpatient satisfaction may suggest that clinical outcomes are more resilient to financial pressures than
38 process measures, or that the driver for such clinical metrics is not predominantly financial-based. Third,
39 the recent narrowing of variation between the best and worst performing Trusts on the measures of A&E
40 targets and delayed transfers of care, may be a cause for concern, suggesting that now even the best
41 financially performing Trusts are struggling to manage demand. This indicates that a more system-wide
42 approach to demand-management and improving Trust performance may be required to address the
43 identified deteriorations, given the entire Trust cohort is now showing signs of deterioration. Stated
44 plainly, it seems that even if best practice is adopted from the most well managed Trusts, demands on
45 secondary and tertiary care may not be adequately addressed.
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1 Finally, our inability to demonstrate causal links on the available macro level public data re-emphasises
2 the need for higher quality interventional studies such as cluster randomised trials specifically assessing
3 policy impacts before implementation en masse. Furthermore, studies assessing the micro level
4 spending decisions by Trusts when confronted by financial pressures may also lend more insight into the
5 causal pathway and suggest appropriate targets for intervention.
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10 11 12 **Summary**

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14 Notwithstanding limitations, our results demonstrate that operating margins at English NHS Trusts have
15 progressively worsened over 2011-16, and that this change correlates with poorer Trust performance on
16 a range of widely benchmarked process measures, but not significantly with readmissions or inpatient
17 satisfaction. The variation between the best and worst financially performing Trusts was considerably
18 larger for A&E breach rates and delayed transfers of care than for cancer targets but showed differing
19 patterns of variation over time. The causal nature of relationships between financial performance,
20 process measures and outcomes remains difficult to disentangle.
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RESEARCH IN CONTEXT

Evidence before this study

We searched the scientific literature to identify original research articles assessing the macro-level association between financial performance and outcomes in the NHS and how such outcomes vary between the best and worst financially performing Trusts. We searched PubMed for manuscripts published in any language up to and including August 15th 2017, using the following search terms: ("NHS"[Ti] OR "National health service"[Ti] OR ("English"[Ti] AND "Hospital"[Tiab])) AND ("Variation"[Tiab] or "Outcome"[Tiab]). 550 records were retrieved but none were deemed includable.

Added value of this study

Most of the extant literature comes from the United States and direct comparison is fraught with difficulty. Our study is the largest analysis to date of the association between financial performance, as measured by operating margin, and outcomes at English NHS Trusts. Operating margins in English NHS trusts progressively worsened during 2011-16, and this change was associated with poorer performance on several process measures but not with hospital readmissions or inpatient satisfaction. Significant variation exists between the best and worst financially performing Trusts.

Implications of all the available evidence

The causal nature of relationships between financial performance, process measures and outcomes remains problematic to entangle but specific findings from our study merit further consideration. The lack of significant association between operating margin and either readmissions or inpatient satisfaction may suggest that clinical outcomes are more resilient to financial pressures than process measures, or that the driver for such clinical metrics is not predominantly financial-based. The recent narrowing of variation between the best and worst performing Trusts on the measures of A&E targets and delayed transfers of care, may be a cause for concern, suggesting that now even the best financially performing Trusts are struggling to manage demand.

CONTRIBUTORSHIP

MN and MM conceived the study. RR and RA had critical input into study direction and interpretation. MN and GK extracted and sorted data for the study. MN performed the analysis and wrote the first draft of the manuscript. All authors (MN, GK, RR, RA, MM) contributed to critical revision of the manuscript for important intellectual content and approved the final version. MN and MM are the guarantors.

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DECLARATION OF INTERESTS

All authors have completed the ICMJE uniform disclosure at www.icmje.org/coi_disclosure.pdf. Mahiben Maruthappu serves as NHS England's Innovation Adviser and is an investor and employee of Cera Care which is a domiciliary care provider. All authors declare no support from any organisation for the submitted work, no financial relationships with any organisations that might have an interest in the submitted work in the previous three years and no other relationships or activities that could appear to have influenced the submitted work.

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DATA SHARING

Raw data and analysis available on request from authors.

TRANSPARENCY STATEMENT

1 The study guarantors (MN and MM) affirm that the manuscript is an honest, accurate, and transparent
2 account of the study being reported; that no important aspects of the study have been omitted; and that
3 any discrepancies from the study as planned have been explained.
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8 **ETHICS**

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10 No ethical approval required as retrospective longitudinal observational study of publicly available Trust-
11 level data.
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FIGURE LEGENDS

Figure 1. Distribution of average operating surplus/deficit over the 2011-16 period.

Figure 2. Trends in operating margin and clinical outcomes over time.

Figure 3. Trends in operating margin and process measures over time. Abbreviations: A&E, Accident & Emergency.

Figure 4. 2011-12 correlation between delayed transfers of care, elective operation cancellations, agency spend, A&E breaches and operating margin. Elective surgery cancellations are last-minute elective operation cancellations (for non-clinical reasons) standardised in this figure to number of available beds at the Trust (as a proxy for hospital capacity). Agency spend is displayed as a proportion of turnover. Operating margin is as defined in study methods. Abbreviations: A&E, Accident & Emergency; DTOC, delayed transfer of care.

Figure 5. 2015-16 correlation between delayed transfers of care, elective operation cancellations, agency spend, A&E breaches and operating margin. Elective surgery cancellations are last-minute elective operation cancellations (for non-clinical reasons) standardised in this figure to number of available beds at the Trust (as a proxy for hospital capacity). Agency spend is displayed as a proportion of turnover. Operating margin is as defined in study methods. Abbreviations: A&E, Accident & Emergency; DTOC, delayed transfer of care.

TABLE LEGENDS

Table 1. Trust metrics by decile of Trust operating margin. Higher deprivation score indicates more deprivation.

Table 2. Outcomes and process measures by decile of Trust operating margin. Values are median (IQR). P-value refers to a one-way analysis of variance (ANOVA) test. Abbreviations: A&E, Accident & Emergency.

Table 3. Variation in outcomes and process measures over time by Trust financial performance. 'Best 10%' refers to Trusts with operating margins in the top 10% of the sample. 'Worst 10%' refers to Trusts with operating margins in the bottom 10% of the sample.

Table 4. Association of operating margin with outcomes and process measures. These estimates are derived from a linear regression with outcome/process measure as the dependent variable and the following independent variables: operating margin, number of beds available and year. Each Trust in each year was treated as a separate observation with standard errors clustered by Trust to account for the non-independence of Trust-level data. Abbreviations: A&E, Accident & Emergency; CI, confidence interval.

Table 5. Outcomes and process measures in trusts struggling (i.e. in special measures or subject to enforcement action) versus those that are not. Values are median (IQR). P-value refers to a Kruskal-Wallis equality-of-populations rank test.

Table 1. Trust metrics by decile of Trust operating margin.

	Operating margin			
	Bottom 10%	11-50%	51-89%	Top 10%
Operating surplus / deficit (£ millions, median (range))	-30.9 (-61.1 to -12.4)	-6.3 (-63.1 to -1.2)	-1.5 (-13.8 to 6.8)	5.4 (1.3 to 32.6)
Agency spend as proportion of turnover (%)	6.9 (2.0)	4.8 (2.4)	3.8 (2.0)	3.9 (1.2)
Consultancy spend as proportion of turnover (%)	0.96 (0.54)	0.44 (0.35)	0.45 (0.74)	0.46 (0.29)
Annual admissions, mean (SD)	26,978 (9,698)	29,006 (13,326)	36,411 (21,300)	30,445 (12,455)
Annual outpatient attendances, mean (SD)	271,508 (109,938)	295,223 (142,784)	374,266 (210,861)	407,595 (209,956)
Bed availability, mean (SD)	716 (267)	718 (321)	822 (387)	740 (226)
Bed occupancy (%)	90.1	88.3	87.2	88.1
Deprivation score, mean (SD)	23.4 (11.8)	19.2 (13.2)	23.3 (14.6)	23.5 (11.9)
Teaching trust (%)	6.7	17.0	33.3	35.7
Region (%)				
London	20	17	17	21
South	20	17	38	7
Midlands	40	36	15	29
North	20	31	30	43

Table 2. Outcomes/process measures by decile of Trust operating margin.

	Operating margin				p-value
	Bottom 10%	11-50%	51-89%	Top 10%	
Readmission rate (%)	3.6 (3.4 to 3.9)	3.6 (3.1 to 3.9)	3.7 (3.2 to 4.0)	3.3 (3.0 to 3.8)	0.137
Inpatient satisfaction score (out of 10)	8.0 (7.8 to 8.2)	8.0 (7.8 to 8.2)	7.9 (7.7 to 8.1)	7.9 (7.7 to 8.2)	<0.001
4 hour A&E target breach rate (%)	10.2 (6.7 to 15.1)	6.7 (4.9 to 10.7)	5.3 (4.2 to 7.3)	5.3 (3.9 to 6.7)	<0.001
Delayed transfer of care days per hospital bed	11.1 (6.0 to 17.1)	7.4 (4.5 to 10.9)	6.5 (3.7 to 11.0)	5.7 (2.6 to 8.1)	<0.001
Cancer two week wait target adherence (%)	94.9 (93.2 to 96.2)	95.5 (94.2 to 96.7)	95.4 (94.4 to 96.7)	95.6 (95.0 to 96.5)	0.009
Cancer 62 days to first treatment target adherence (%)	86.2 (81.9 to 88.2)	86.6 (83.6 to 89.1)	87.6 (85.6 to 89.6)	88.0 (86.3 to 89.9)	<0.001

Table 3. Variation in outcomes and process measures over time by Trust financial performance.

Readmissions (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	-	-	-	3.6	3.7	3.8
Middle 80%	-	-	-	3.4	3.6	3.6
Best 10%	-	-	-	3.4	3.5	3.6
Ratio of worst to best	-	-	-	1.1	1.0	1.1
Difference (best and worst)	-	-	-	0.2	0.1	0.2
Inpatient satisfaction survey (score out of 10)						
	2011	2012	2013	2014	2015	2016
Worst 10%	7.5	7.7	7.9	7.9	8.0	8.0
Middle 80%	7.7	7.8	7.9	8.0	8.1	8.1
Best 10%	7.8	7.8	7.9	8.0	8.1	8.1
Ratio of worst to best	1.0	1.0	1.0	1.0	1.0	1.0
Difference (best and worst)	0.3	0.1	0.0	0.1	0.1	0.1
Accident & Emergency breach rate (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	8.2	6.4	7.8	7.8	11.9	13.6
Middle 80%	5.2	4.9	6.0	6.3	9.3	12.0
Best 10%	4.2	4.5	5.5	5.9	7.5	10.4
Ratio of worst to best	2.0	1.4	1.4	1.3	1.6	1.3
Difference (best and worst)	4.0	1.9	2.3	1.9	4.4	3.2
Delayed transfers of care days						
	2011	2012	2013	2014	2015	2016
Worst 10%	5,077	6,657	7,248	6,972	7,813	8,284
Middle 80%	4,851	5,082	5,558	6,046	7,311	8,044
Best 10%	3,850	3,722	3,884	3,932	5,712	6,477
Ratio of worst to best	1.3	1.8	1.9	1.8	1.4	1.3
Difference (best and worst)	1,227	2,935	3,364	3,040	2,101	1,807
Cancer two week wait target breach rate (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	4.2	4.2	4.6	4.8	6.2	5.9
Middle 80%	4.3	3.9	4.3	4.4	5.7	5.5
Best 10%	4.6	4.1	4.0	4.6	5.9	5.2
Ratio of worst to best	0.9	1.0	1.2	1.0	1.1	1.1
Difference (best and worst)	-0.4	0.1	0.6	0.2	0.3	0.7
Cancer 62 days to first treatment breach rate (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	11.9	11.7	12.2	13.7	16.6	18.3
Middle 80%	12.1	12.0	12.2	13.4	15.6	16.2
Best 10%	11.9	11.7	10.0	11.7	13.5	15.2
Ratio of worst to best	1.0	1.0	1.2	1.2	1.2	1.2
Difference (best and worst)	0.0	0.0	2.2	2.0	3.1	3.1

Table 4. Association of operating margin on outcomes and process measures.

Outcome	n	Trust clusters	Coefficient	95% CI	p-value
Readmission rate (%)	387	135	-0.012	-0.029 to 0.005	0.164
Inpatient satisfaction score (out of 10)	825	148	0.80	-0.06 to 1.67	0.067
A&E 4 hour breach rate (%)	835	148	-0.24	-0.33 to -0.15	<0.001
Delayed transfers of care days per hospital bed	837	148	-25.1	-39.1 to -11.0	0.001
2 week wait cancer target adherence (%)	833	148	0.05	0.00 to 0.09	0.031
62 day cancer treatment target adherence (%)	833	148	0.12	0.03 to 0.21	0.009

Table 5. Outcomes and process measures in trusts struggling (i.e. in special measures or subject to enforcement action) versus those that are not.

	Struggling trust	Non-struggling trust	p-value
Readmission rate (%)	3.6 (3.1 to 3.9)	3.7 (3.1 to 3.9)	0.285
Inpatient satisfaction score (out of 10)	7.9 (7.8 to 8.1)	7.9 (7.8 to 8.1)	0.378
A&E 4 hour target breach rate (%)	6.8 (5.2 to 10.2)	5.5 (4.2 to 8.3)	<0.001
Delayed transfer of care days per hospital bed	8.2 (4.5 to 11.9)	6.4 (4.0 to 10.4)	0.005
Cancer two week wait target adherence (%)	95.1 (94.0 to 96.4)	95.5 (94.4 to 96.8)	0.002
Cancer 62 days to first treatment target adherence (%)	86.6 (83.7 to 88.9)	87.4 (84.8 to 89.6)	0.002

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For peer review only

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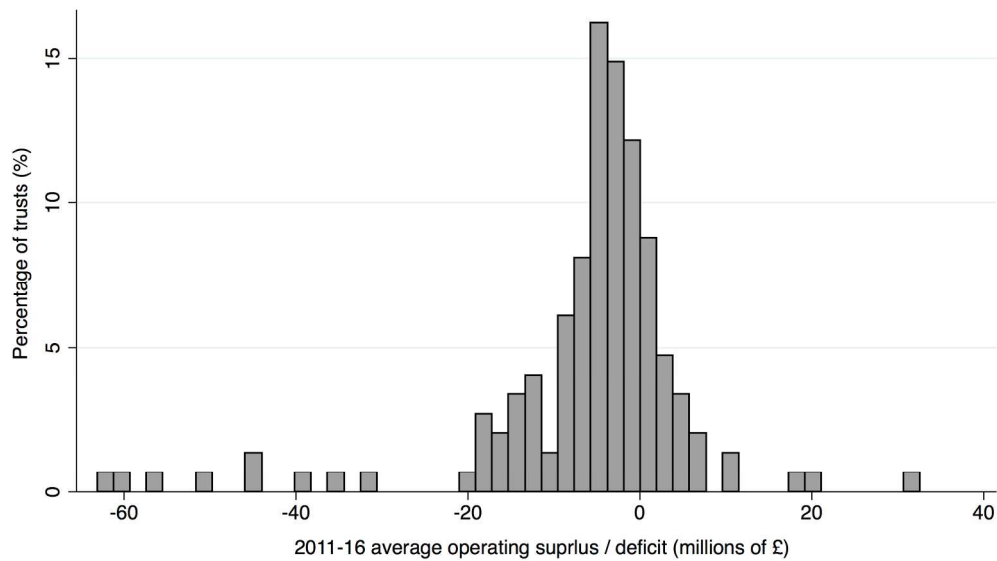


Figure 1. Distribution of average operating surplus/deficit over the 2011-16 period.

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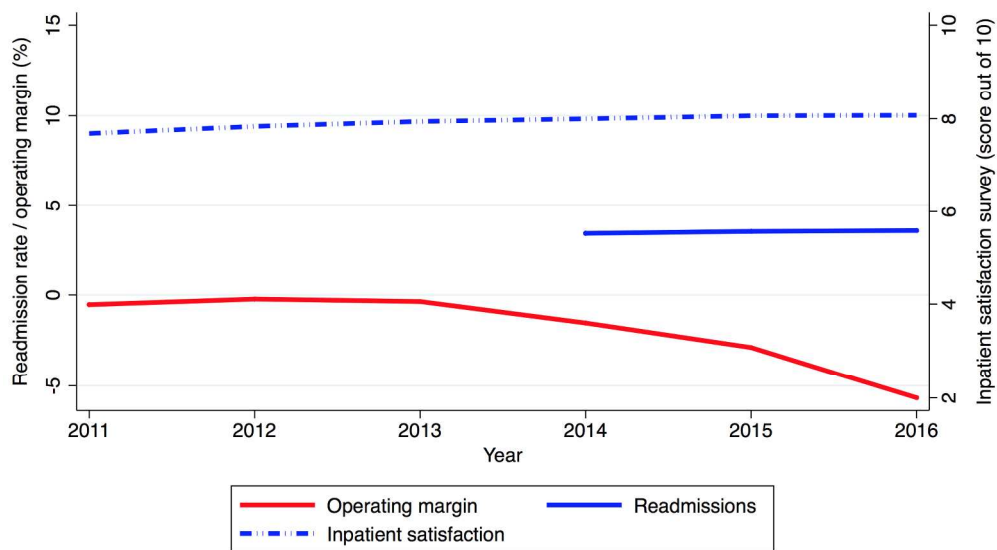


Figure 2. Trends in operating margin and clinical outcomes over time.

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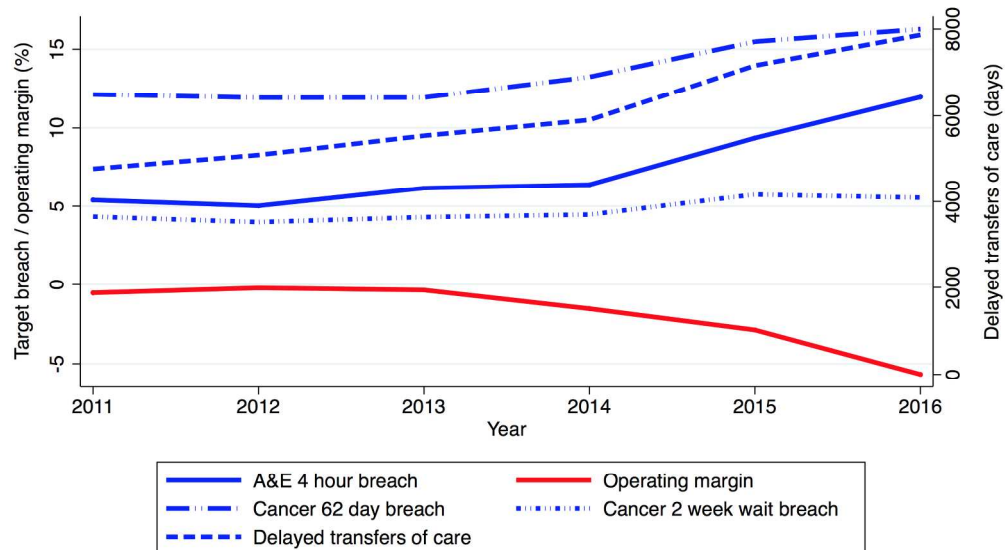


Figure 3. Trends in operating margin and process measures over time. Abbreviations: A&E, Accident & Emergency.

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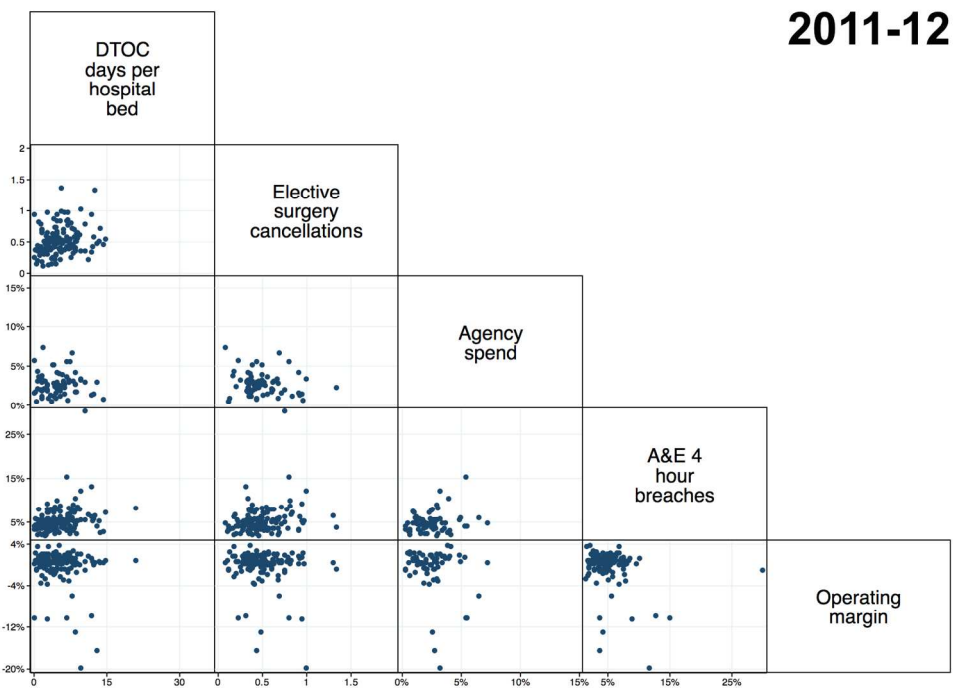


Figure 4. 2011-12 correlation between delayed transfers of care, elective operation cancellations, agency spend, A&E breaches and operating margin. Elective surgery cancellations are last-minute elective operation cancellations (for non-clinical reasons) standardised in this figure to number of available beds at the Trust (as a proxy for hospital capacity). Agency spend is displayed as a proportion of turnover. Operating margin is as defined in study methods. Abbreviations: A&E, Accident & Emergency; DTOC, delayed transfer of care.

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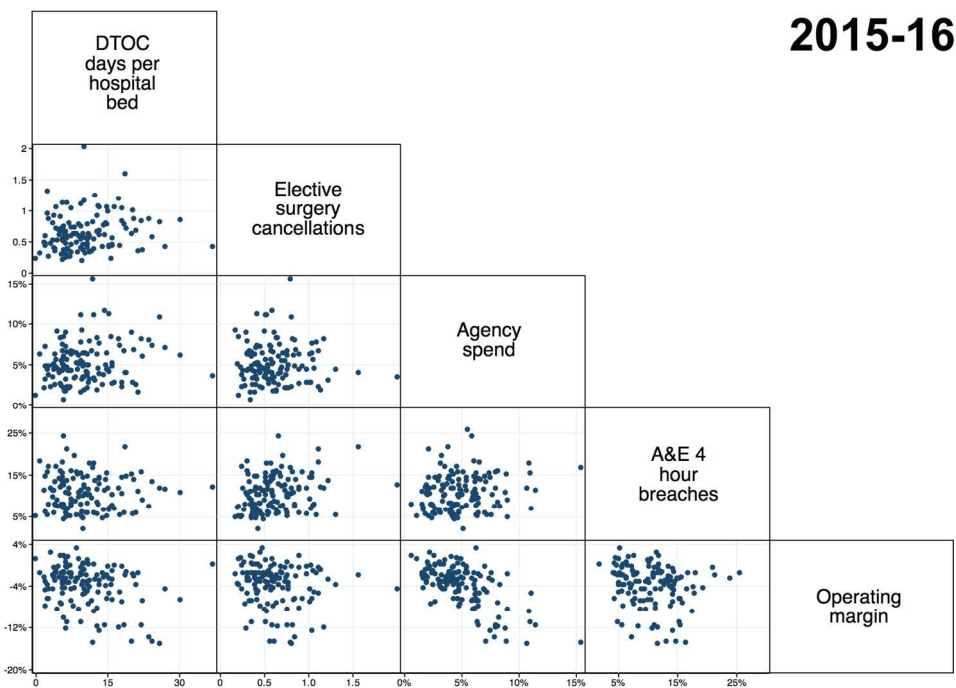


Figure 5. 2015-16 correlation between delayed transfers of care, elective operation cancellations, agency spend, A&E breaches and operating margin. Elective surgery cancellations are last-minute elective operation cancellations (for non-clinical reasons) standardised in this figure to number of available beds at the Trust (as a proxy for hospital capacity). Agency spend is displayed as a proportion of turnover. Operating margin is as defined in study methods. Abbreviations: A&E, Accident & Emergency; DTOC, delayed transfer of care.

Financial Performance of English NHS Trusts and Clinical Outcomes: A Longitudinal Observational Study

ONLINE SUPPLEMENTAL DATA

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Supplement version: 2.1

FINANCIAL DATA EXTRACTION

Where financial data was extracted from consolidated end of year accounts files via the gov.uk open data portal, the following fields were extracted:

For foundation trusts:

Turnover --> Table ID 1, Subcode 100
Surplus/Deficit --> Table ID 1, Subcode 160
Consultancy --> 07A and 07I, subcode 280
Agency spend --> 1415TRU06_EXP_P13, maincode 01, subcode 180

For non-Foundation trusts:

Turnover --> Table ID CNE, Subcode 120 and 130
Surplus/Deficit --> Table ID CNE, Subcode 390
Consultancy --> 08C, subcode 125 (*only available for 2014-16*)
Agency spend --> 1415TRU09_EMP_P13, maincode 04, subcode 100 (*only available for 2015-16*)

1 DELAYED TRANSFERS OF CARE IN FINANCIAL YEAR ENDING 2011

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4 Delayed transfer of care data were only available at Trust level for the latter eight months of the
5 2011 financial year. To ensure comparability with other years, a 1.5x multiplier was applied for
6 each trust in this financial year with a sensitivity analysis to examine any impact of this change.
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11 The total numbers of delayed transfers for all hospitals were available as an aggregate total
12 (data obtained from King's Fund Quarterly Monitoring Report for 2010-11).
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16 The ratio of aggregate delayed transfer of care days for the first 4 months (April 2010 to July
17 2010) to the last 8 months (August 2010 to March 2011) was 0.492; suggesting that a 1.5x
18 multiplier appeared reasonable.
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Year	Month	Number of DTOCs	4-monthly total
2010	Apr	113900	-
2010	May	112442	-
2010	Jun	115336	-
2010	Jul	109918	451596
-	-	-	-
2010	Aug	115855	-
2010	Sep	113246	-
2010	Oct	113091	-
2010	Nov	116466	458658
-	-	-	-
2010	Dec	114346	-
2011	Jan	112386	-
2011	Feb	123130	-
2011	Mar	109362	459224

CHANGES TO TRUST COMPOSITION

The 168 Trusts listed below include specialist Trusts (e.g. Great Ormond Street Hospital for Children NHS Foundation Trust) that were excluded prior to analysis. Changes in composition to the Trusts (creation of a new Trust, dissolution of an existing Trust, acquisitions of a hospital or entire Trust to another Trust and mergers between Trusts) are detailed at the end of the table.

Trust	Trust identifier	Change in composition	Transitioned to Foundation status	Foundation Trust transition date
Aintree University Hospital NHS Foundation Trust	REM			
Airedale NHS Foundation Trust	RCF		Yes	01/06/2010
Alder Hey Children's NHS Foundation Trust	RBS			
Ashford and St Peter's Hospitals NHS Foundation Trust	RTK		Yes	01/12/2010
Barking, Havering and Redbridge University Hospitals NHS Trust	RF4			
Barnet and Chase Farm Hospitals NHS Trust	RVL	Yes (1)		
Barnsley Hospital NHS Foundation Trust	RFF			
Barts and the London NHS Trust	RNJ	Yes (2)		
Barts Health NHS Trust	R1H	Yes (3)		
Basildon and Thurrock University Hospitals NHS Foundation Trust	RDD			
Bedford Hospital NHS Trust	RC1			
Birmingham Children's Hospital NHS Foundation Trust	RQ3			
Birmingham Women's NHS Foundation Trust	RLU			
Blackpool Teaching Hospitals NHS Foundation Trust	RXL			
Bolton NHS Foundation Trust	RMC			
Bradford Teaching Hospitals NHS Foundation Trust	RAE			
Brighton and Sussex University Hospitals NHS Trust	RXH			
Buckinghamshire Healthcare NHS Trust	RXQ			

1	Burton Hospitals NHS Foundation Trust	RJF			
2	Calderdale and Huddersfield NHS Foundation Trust	RWY			
3	Cambridge University Hospitals NHS Foundation Trust	RGT			
4	Central Manchester University Hospitals NHS Foundation Trust	RW3	Yes (4)		
5	Chelsea and Westminster Hospital NHS Foundation Trust	RQM	Yes (5)		
6	Chesterfield Royal Hospital NHS Foundation Trust	RFS			
7	City Hospitals Sunderland NHS Foundation Trust	RLN			
8	Colchester Hospital University NHS Foundation Trust	RDE			
9	Countess Of Chester Hospital NHS Foundation Trust	RJR			
10	County Durham and Darlington NHS Foundation Trust	RXP			
11	Croydon Health Services NHS Trust	RJ6			
12	Dartford and Gravesham NHS Trust	RN7			
13	Derby Teaching Hospitals NHS Foundation Trust	RTG			
14	Doncaster and Bassetlaw Hospitals NHS Foundation Trust	RP5			
15	Dorset County Hospital NHS Foundation Trust	RBD			
16	Ealing Hospital NHS Trust	RC3	Yes (6)		
17	East and North Hertfordshire NHS Trust	RWH			
18	East Cheshire NHS Trust	RJN			
19	East Kent Hospitals University NHS Foundation Trust	RVV			
20	East Lancashire Hospitals NHS Trust	RXR			
21	East Sussex Healthcare NHS Trust	RXC			
22	Epsom and St Helier University Hospitals NHS Trust	RVR			
23	Frimley Health NHS Foundation Trust	RDU	Yes (7)		
24	Gateshead Health NHS Foundation Trust	RR7			
25	George Eliot Hospital NHS Trust	RLT			
26	Gloucestershire Hospitals NHS Foundation Trust	RTE			
27	Great Ormond Street Hospital for Children NHS Foundation Trust	RP4		Yes	01/03/2012
28	Great Western Hospitals NHS Foundation Trust	RN3			
29	Guy's and St Thomas' NHS Foundation Trust	RJ1			
30	Hampshire Hospitals NHS Foundation Trust	RN5	Yes (8)		

1	Harrogate and District NHS Foundation Trust	RCD			
2	Heart Of England NHS Foundation Trust	RR1			
3	Heatherwood and Wexham Park Hospitals NHS Foundation Trust	RD7	Yes (9)		
4	Hinchingbrooke Health Care NHS Trust	RQQ			
5	Homerton University Hospital NHS Foundation Trust	RQX			
6	Hull and East Yorkshire Hospitals NHS Trust	RWA			
7	Imperial College Healthcare NHS Trust	RYJ			
8	Ipswich Hospital NHS Trust	RGQ			
9	Isle Of Wight NHS Trust	R1F	Yes (10)		
10	James Paget University Hospitals NHS Foundation Trust	RGP			
11	Kettering General Hospital NHS Foundation Trust	RNQ			
12	King's College Hospital NHS Foundation Trust	RJZ	Yes (11)		
13	Kingston Hospital NHS Foundation Trust	RAX		Yes	01/05/2013
14	Lancashire Teaching Hospitals NHS Foundation Trust	RXN			
15	Leeds Teaching Hospitals NHS Trust	RR8			
16	Lewisham and Greenwich NHS Trust	RJ2	Yes (12)		
17	Liverpool Heart and Chest NHS Foundation Trust	RBQ			
18	Liverpool Women's NHS Foundation Trust	REP			
19	London North West Healthcare NHS Trust	R1K	Yes (13)		
20	Luton and Dunstable University Hospital NHS Foundation Trust	RC9			
21	Maidstone and Tunbridge Wells NHS Trust	RWF			
22	Medway NHS Foundation Trust	RPA			
23	Mid Cheshire Hospitals NHS Foundation Trust	RBT			
24	Mid Essex Hospital Services NHS Trust	RQ8			
25	Mid Staffordshire NHS Foundation Trust	RJD	Yes (14)		
26	Mid Yorkshire Hospitals NHS Trust	RXF			
27	Milton Keynes University Hospital NHS Foundation Trust	RD8			
28	Moorfields Eye Hospital NHS Foundation Trust	RP6			
29	Newham University Hospital NHS Trust	RNH	Yes (15)		
30	Norfolk and Norwich University Hospitals NHS Foundation Trust	RM1			

1	North Bristol NHS Trust	RVJ			
2	North Cumbria University Hospitals NHS Trust	RNL			
3	North Middlesex University Hospital NHS Trust	RAP			
4	North Tees and Hartlepool NHS Foundation Trust	RVW			
5	North West London Hospitals NHS Trust	RV8	Yes (16)		
6	Northampton General Hospital NHS Trust	RNS			
7	Northern Devon Healthcare NHS Trust	RBZ			
8	Northern Lincolnshire and Goole NHS Foundation Trust	RJL			
9	Northumbria Healthcare NHS Foundation Trust	RTF			
10	Nottingham University Hospitals NHS Trust	RX1			
11	Oxford University Hospitals NHS Foundation Trust	RTH	Yes (17)	Yes	01/10/2015
12	Papworth Hospital NHS Foundation Trust	RGM			
13	Pennine Acute Hospitals NHS Trust	RW6			
14	Peterborough and Stamford Hospitals NHS Foundation Trust	RGN			
15	Plymouth Hospitals NHS Trust	RK9			
16	Poole Hospital NHS Foundation Trust	RD3			
17	Portsmouth Hospitals NHS Trust	RHU			
18	Queen Victoria Hospital NHS Foundation Trust	RPC			
19	Robert Jones and Agnes Hunt Orthopaedic and District Hospital NHS Foundation Trust	RL1		Yes	01/08/2011
20	Royal Berkshire NHS Foundation Trust	RHW			
21	Royal Brompton and Harefield NHS Foundation Trust	RT3			
22	Royal Cornwall Hospitals NHS Trust	REF			
23	Royal Devon and Exeter NHS Foundation Trust	RH8			
24	Royal Free London NHS Foundation Trust	RAL	Yes (18)	Yes	01/04/2012
25	Royal Liverpool and Broadgreen University Hospitals NHS Trust	RQ6			
26	Royal National Hospital For Rheumatic Diseases NHS Foundation Trust	RBB	Yes (19)		
27	Royal National Orthopaedic Hospital NHS Trust	RAN			
28	Royal Surrey County NHS Foundation Trust	RA2			
29	Royal United Hospitals Bath NHS Foundation Trust	RD1	Yes (20)	Yes	01/11/2014
30	Salford Royal NHS Foundation Trust	RM3			

1	Salisbury NHS Foundation Trust	RNZ			
2	Sandwell and West Birmingham Hospitals NHS Trust	RXK			
3	Scarborough and North East Yorkshire Healthcare NHS Trust	RCC	Yes (21)		
4	Sheffield Children's NHS Foundation Trust	RCU			
5	Sheffield Teaching Hospitals NHS Foundation Trust	RHQ			
6	Sherwood Forest Hospitals NHS Foundation Trust	RK5			
7	Shrewsbury and Telford Hospital NHS Trust	RXW			
8	South London NHS Healthcare Trust	RYQ	Yes (22)		
9	South Tees Hospitals NHS Foundation Trust	RTR			
10	South Tyneside NHS Foundation Trust	RE9			
11	South Warwickshire NHS Foundation Trust	RJC			
12	Southend University Hospital NHS Foundation Trust	RAJ			
13	Southport and Ormskirk Hospital NHS Trust	RVY			
14	St George's University Hospitals NHS Foundation Trust	RJ7		Yes	01/02/2015
15	St Helens and Knowsley Hospitals NHS Trust	RBN			
16	Stockport NHS Foundation Trust	RWJ			
17	Surrey and Sussex Healthcare NHS Trust	RTP			
18	Tameside Hospital NHS Foundation Trust	RMP			
19	Taunton and Somerset NHS Foundation Trust	RBA			
20	The Christie NHS Foundation Trust	RBV			
21	The Clatterbridge Cancer Centre NHS Foundation Trust	REN			
22	The Dudley Group NHS Foundation Trust	RNA			
23	The Hillingdon Hospitals NHS Foundation Trust	RAS		Yes	01/04/2011
24	The Newcastle Upon Tyne Hospitals NHS Foundation Trust	RTD			
25	The Princess Alexandra Hospital NHS Trust	RQW			
26	The Queen Elizabeth Hospital, King's Lynn. NHS Foundation Trust	RCX		Yes	01/02/2011
27	The Rotherham NHS Foundation Trust	RFR			
28	The Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust	RDZ			
29	The Royal Marsden NHS Foundation Trust	RPY			
30	The Royal Orthopaedic Hospital NHS Foundation Trust	RRJ			

1	The Royal Wolverhampton NHS Trust	RL4	Yes (23)		
2	The Walton Centre NHS Foundation Trust	RET			
3	The Whittington Hospital NHS Trust	RKE			
4	Torbay and South Devon NHS Foundation Trust	RA9	Yes (24)		
5	Trafford Healthcare NHS Trust	RM4	Yes (25)		
6	United Lincolnshire Hospitals NHS Trust	RWD			
7	University College London Hospitals NHS Foundation Trust	RRV			
8	University Hospital Of South Manchester NHS Foundation Trust	RM2			
9	University Hospital Southampton NHS Foundation Trust	RHM		Yes	01/10/2011
10	University Hospitals Birmingham NHS Foundation Trust	RRK			
11	University Hospitals Bristol NHS Foundation Trust	RA7			
12	University Hospitals Coventry and Warwickshire NHS Trust	RKB			
13	University Hospitals Of Leicester NHS Trust	RWE			
14	University Hospitals Of Morecambe Bay NHS Foundation Trust	RTX		Yes	01/10/2010
15	University Hospitals of North Midlands NHS Trust	RJE	Yes (26)		
16	Walsall Healthcare NHS Trust	RBK			
17	Warrington and Halton Hospitals NHS Foundation Trust	RWW			
18	West Hertfordshire Hospitals NHS Trust	RWG			
19	West Middlesex University Hospital NHS Trust	RFW	Yes (27)		
20	West Suffolk NHS Foundation Trust	RGR		Yes	01/12/2011
21	Western Sussex Hospitals NHS Foundation Trust	RYR		Yes	01/07/2013
22	Weston Area Health NHS Trust	RA3			
23	Whipps Cross University Hospital NHS Trust	RGC	Yes (28)		
24	Winchester and Eastleigh Healthcare Trust	RN1	Yes (29)		
25	Wirral University Teaching Hospital NHS Foundation Trust	RBL			
26	Worcestershire Acute Hospitals NHS Trust	RWP			
27	Wrightington, Wigan and Leigh NHS Foundation Trust	RRF			
28	Wye Valley NHS Trust	RLQ	Yes (30)		
29	Yeovil District Hospital NHS Foundation Trust	RA4			
30	York Teaching Hospital NHS Foundation Trust	RCB	Yes (31)		

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- 2 1. Acquired by Royal Free London NHS FT in 2014
- 3
- 4 2. Merged with Newham University Hospital NHS Trust and Whipps Cross University Hospital NHS Trust to form Barts Health NHS Trust in 2012
- 5
- 6 3. Formed from the merger of Barts and the London NHS Trust, Whipps Cross University Hospital NHS Trust and Newham University Hospital NHS
- 7 Trust in 2012
- 8
- 9 4. Acquired Trafford Healthcare NHS Trust in Apr 2012
- 10
- 11 5. Acquired West Middlesex University Hospital NHS Trust in Sep 2015
- 12
- 13 6. Merged with North West London Hospitals NHS Trust to form London North West Healthcare NHS Trust in 2014
- 14
- 15 7. Formed by merger of Heatherwood and Wexham Park Hospitals NHS FT and Frimley Park Hospital NHS FT on 1 October 2014
- 16
- 17 8. Formed by acquisition of Winchester and Eastleigh Healthcare Trust by Basingstoke and North Hampshire NHS FT in Jan 2012
- 18
- 19 9. Merged with Frimley Park Hospital NHS FT to form Frimley Health NHS FT on 1 October 2014
- 20
- 21 10. Created in Apr 2012 by a provider split from Isle of Wight NHS PCT (5QT)
- 22
- 23 11. Acquired Princess Royal University Hospital from South London NHS Healthcare Trust's dissolution in Oct 2013
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- 25 12. Formed on 1 Oct 2013 by merger of merger of Lewisham Healthcare NHS Trust and Queen Elizabeth Hospital (previously part of South London
- 26 NHS Healthcare Trust)
- 27
- 28 13. Formed by merger of Ealing Hospital NHS Trust and North West London Hospitals NHS Trust in 2014
- 29
- 30 14. Mid Staffordshire NHS FT which ran Stafford hospital dissolved In Nov 2014. Stafford hospital renamed to County Hospital and acquired by newly
- 31 named University Hospitals of North Midlands NHS Trust
- 32
- 33 15. Merged with Barts and the London NHS Trust and Whipps Cross University Hospital NHS Trust to form Barts Health NHS Trust in 2012
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- 35 16. Merged with Ealing Hospital NHS Trust to form London North West Healthcare NHS Trust in 2014
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- 37 17. Formed from Oxford Radcliffe Hospitals NHS Trust by acquisition of Nuffield Orthopaedic Acute Centre NHS Trust in 2011
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- 39 18. Acquired Barnet and Chase Farm Hospitals NHS Trust in 2014
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- 41 19. Acquired by Royal United Hospital Bath NHS FT on 1 Feb 2015
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- 43 20. Acquired Royal National Hospital For Rheumatic Diseases NHS FT on 1 Feb 2015
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- 45 21. Acquired by York Teaching Hospital NHS Foundation Trust in Jul 2013
- 46 22. Dissolved in Oct 2013

- 1 23. Acquired Cannock Chase Hospital when Mid Staffordshire NHS FT dissolved In Nov 2014
- 2 24. Created on 1 Oct 2015 from South Devon Healthcare NHS Foundation Trust merging with Torbay and Southern Devon Health and Care NHS Trust
- 3 (community and social care services)
- 4
- 5 25. Acquired by Central Manchester University Hospitals NHS FT in Apr 2012
- 6
- 7 26. Formed from University Hospital Of North Staffordshire NHS Trust taking over Stafford Hospital (now named County Hospital) on 1 Nov 2014. Mid
- 8 Staffordshire NHS FT which ran Stafford hospital dissolved In Nov 2014
- 9
- 10 27. Acquired by Chelsea and Westminster Hospital NHS FT in Sep 2015
- 11
- 12 28. Merged with Newham University Hospital NHS Trust and Barts and the London NHS Trust to form Barts Health NHS Trust in 2012
- 13
- 14 29. Acquired by Basingstoke and North Hampshire NHS FT to form Hampshire Hospitals NHS FT in Jan 2012
- 15
- 16 30. Formed from Hereford Hospitals NHS Trust on 1 April 2011 following Herefordshire's health and adult social care providers joining to form an
- 17 integrated provider of acute, community and social care in England
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- 19 31. Acquired Scarborough and North East Yorkshire Healthcare NHS Trust in Jul 2013
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SENSITIVITY ANALYSES AND ADDITIONAL TABLES

Table A. Assessment of the impact of not adjusting for missing 2011 delayed transfer of care data. Abbreviations: CI, confidence interval.

Delayed transfers of care days per hospital bed	n	Trust clusters	Coefficient	95% CI	p-value
Without adjustment for missing 2011 data	837	148	-21.9	-35.5 to -8.4	0.002
With adjustment for missing 2011 data	837	148	-25.1	-39.1 to -11.0	0.001

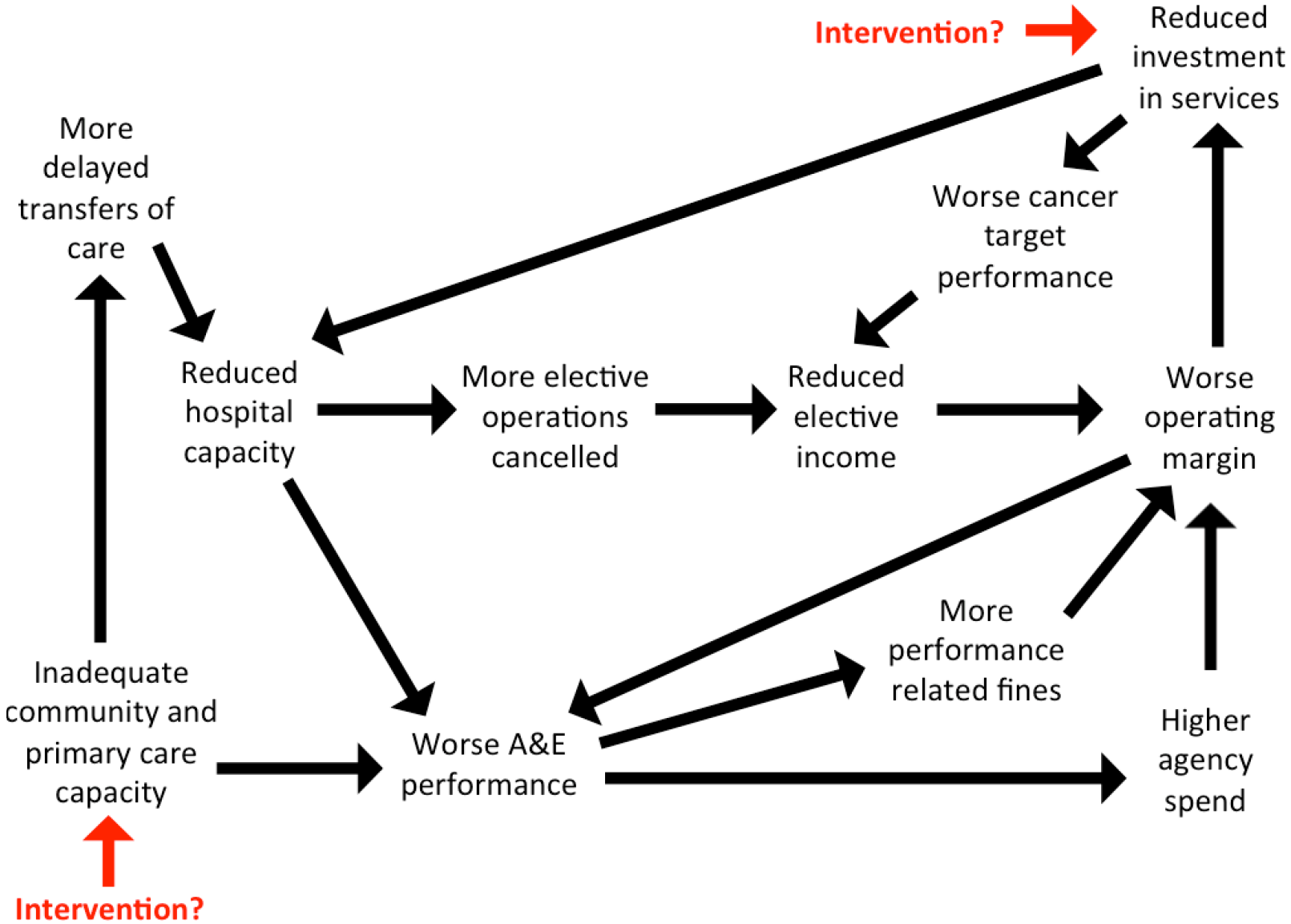
Table B. Association of operating margin with outcomes and process measures. Adjusted regression analyses as per table 3 in the manuscript excluding Trusts that had changed in composition between 2011 and 2016. Abbreviations: A&E, Accident & Emergency; SHMI, Summary Hospital-level Mortality Indicator.

Outcome	n	Trust clusters	Coefficient	95% CI	p-value
Readmission rate (%)	344	119	-0.01	-0.03 to 0.01	0.403
Inpatient satisfaction score (out of 10)	706	119	0.66	-0.23 to 1.55	0.142
A&E 4 hour breach rate (%)	710	119	-0.20	-0.30 to -0.11	<0.001
Delayed transfers of care days per hospital bed	711	119	-29.5	-44.1 to -14.8	<0.001
2 week wait cancer target adherence (%)	710	119	0.05	0.00 to 0.10	0.042
62 day cancer treatment target adherence (%)	710	119	0.12	0.02 to 0.23	0.018

Table C. Association of operating margin with outcomes and process measures (summary model for 2011-13). Operating margin and outcomes were averaged over the 3 years from 2011-13 to form the inputs to the summary model. Readmission rate is not included as data was not available for 2011-13. Abbreviations: A&E, Accident & Emergency; CI, confidence interval.

Agency spend as a proportion of turnover (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	3.9	3.9	4.6	6.0	8.5	9.1
Middle 80%	2.4	2.3	2.6	3.0	4.6	5.1
Best 10%	2.7	2.9	3.4	3.8	4.0	4.5
Ratio of worst to best	1.4	1.3	1.4	1.6	2.1	2.0
Difference (best and worst)	1.2	1.0	1.2	2.2	4.5	4.6

1 PUTATIVE INTERPLAY OF FACTORS AFFECTING TRUST FINANCE AND PERFORMANCE



STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract PAGE 1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found PAGE 2
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported PAGE 4
Objectives	3	State specific objectives, including any pre-specified hypotheses PAGE 4
Methods		
Study design	4	Present key elements of study design early in the paper PAGES 5-7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection PAGES 5-7 (IN SO FAR AS APPLICABLE TO THIS STUDY)
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up PAGE 5 (NO PARTICIPANTS, DESCRIBED FOR CENTRES)
		(b) For matched studies, give matching criteria and number of exposed and unexposed NOT APPLICABLE
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable PAGES 5-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group PAGES 5-7
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at PAGE 5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding PAGES 7-8
		(b) Describe any methods used to examine subgroups and interactions PAGE 7
		(c) Explain how missing data were addressed PAGES 6-7
		(d) If applicable, explain how loss to follow-up was addressed NOT APPLICABLE
		(e) Describe any sensitivity analyses PAGE 8

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Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed NOT APPLICABLE (b) Give reasons for non-participation at each stage NOT APPLICABLE BUT DETAILS GIVEN IN ONLINE APPENDIX REGARDING CHANGE IN COMPOSITION OF TRUSTS (c) Consider use of a flow diagram NOT APPLICABLE
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders NOT APPLICABLE BUT DETAILS FOR TRUSTS GIVEN ON PAGES 9 & 24 (b) Indicate number of participants with missing data for each variable of interest NOT APPLICABLE BUT DETAILS FOR TRUSTS GIVEN ON PAGE 5 IN METHODS SECTION (c) Summarise follow-up time (eg, average and total amount) NOT APPLICABLE AS FOLLOW-UP TIME IS STUDY-PERIOD
Outcome data	15*	Report numbers of outcome events or summary measures over time NOT APPLICABLE IN THE FORMAT OF NUMBER OF OUTCOME EVENTS
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included PAGES 9-11 (b) Report category boundaries when continuous variables were categorized PAGES 9-11 (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period NOT APPLICABLE
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses PAGE 11 AND ONLINE APPENDIX
Discussion		
Key results	18	Summarise key results with reference to study objectives PAGE 11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias PAGES 13-14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence PAGES 14-16
Generalisability	21	Discuss the generalisability (external validity) of the study results PAGES 14-16
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

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Financial Performance of English NHS Trusts and Variation in Clinical Outcomes: A Longitudinal Observational Study

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Financial Performance of English NHS Trusts and Variation in Clinical Outcomes: A Longitudinal Observational Study

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ABSTRACT

Objectives

To examine the association between financial performance as measured by operating margin (surplus/deficit as a proportion of turnover) and clinical outcomes in English NHS trusts.

Setting

Longitudinal, observational study in 149 acute NHS trusts in England between the financial years 2011 and 2016.

Participants

Our analysis focused on the outcomes at individual NHS Trust-level (composed of one or more acute hospitals).

Primary and secondary outcomes

Outcome measures included readmissions, inpatient satisfaction score and the following process measures: emergency department (A&E) waiting time targets, cancer referral and treatment targets, and delayed transfers of care.

Results

There was a progressive increase in the proportion of trusts in financial deficit: 22% in 2011, 27% in 2012, 28% in 2013, 51% in 2014, 68% in 2015 and 91% in 2016. In linear regression analyses, there was no significant association between operating margin and clinical outcomes (readmission rate or inpatient satisfaction score). There was, however, a significant association between operating margin and process measures (delayed transfers of care, A&E breaches and cancer waiting time targets). Between the best and worst financially performing Trusts, there was an approximately 2-fold increase in A&E breaches and delayed transfers of care overall although this variation decreased over the six years. Between the best and worst performing trusts on cancer targets, the magnitude of difference was smaller (1·16 and 1·15-fold), although the variation slowly rose during the six years.

Conclusions

Operating margins in English NHS trusts progressively worsened during 2011-16, and this change was associated with poorer performance on several process measures but not with hospital readmissions or inpatient satisfaction. Significant variation exists between the best and worst financially performing Trusts. Further research is needed to examine the causal nature of relationships between financial performance, process measures and outcomes.

STRENGTHS AND LIMITATIONS

- To our knowledge, one of the first empirical exploratory analyses of the relationship between funding and outcomes in the English NHS
- Operating margin may not be the ideal measure of an organisation's financial position
- The proportion of activity at each Trust which is elective, acute or specialised was not taken into account nor was the percentage of activity subject to a national tariff
- There may be additional unmeasured confounders that have impacted the results
- This observational study is limited to demonstrating associations rather than causal links

INTRODUCTION

The combination of higher demand due to ageing, growing populations, with more chronic illness and disability, in addition to rising treatment and technology costs, is driving increased health spending in high-income countries.¹ The National Health Service (NHS) in England is introducing policies to address these demands, attempting to contain costs while improving health outcomes. The NHS Five Year Forward View, published in October 2014, set out a strategic vision for sustaining a high-quality, comprehensive health system in England.² Specifically, it identified a £22 billion funding gap by 2020/21, based on the current funding trajectory of the NHS, to be met by ambitious efficiency savings of 2-3% annually (given a long-term track-record of 1% each year).

The call for increased efficiency comes in an austere climate, in which individual NHS Trusts are progressively challenged to achieve financial control,^{3,4} while responding to high demand, especially in winter months, reported widely in the British media.⁵ NHS Improvement, the body responsible for overseeing Trust performance, reported an overall third quarter deficit of £886 million for the 2016-17 financial year, £300 million higher than the planned target.⁶ Higher demand for services, with rising emergency attendances and admissions, and delayed transfers of care (DTOCs), have been cited as key reasons for increasing deficit.⁷ While control of Trust financial deficits is important for sustainability of the NHS, there are concerns on the adverse impact of worsening financial performance on clinical outcomes and processes,⁸ but few studies which have explored this relationship.

We investigated the relationship between operating margin (surplus/deficit as a proportion of turnover) at English NHS Trusts during 2011-16, with outcomes and process measures. We selected performance measures that are commonly used for benchmarking performance of NHS Trusts and that could plausibly be related to quality, namely, hospital readmissions, inpatient satisfaction scores, emergency department waiting time targets, cancer referral and treatment targets, and delayed transfers of care.⁹ Lastly, we investigated the variation in outcome and process measures between the financially best and worst performing Trusts, both overall and over time.

METHODS

Data sources and extraction

NHS Hospitals in England are categorised into financially and operationally distinct legal entities known as Trusts, which deliver services on behalf of the NHS. Trusts may be located at multiple sites and can be responsible for one or more hospitals. Well-performing Trusts are able to gain Foundation status, which allows a degree of financial and operational autonomy from the Department of Health. Data was sought for acute NHS Trusts in the 6-year period encompassing the financial years from April 2010 to March 2016.

We obtained financial data for Trusts from the gov.uk open data portal.¹⁰ Where information was lacking for specific Trusts, we sought the original data from the published accounts available on individual Trust websites or from NHS 'The Quarter' reports.¹¹

Data on four financial metrics were extracted and examined: first, the retained surplus/deficit for the financial year; second, the turnover for the Trust (calculated as "Revenue from patient care activities" and "Other operating revenue"); third, trust spend on agency staff, and fourth, spend on consultancy. The precise table IDs and sub-codes for extraction are detailed in the online Supplementary Appendix. Only the first two metrics are measures of financial performance. The second two reflect Trust spending choices and we included these as exploratory variables given the public and media interest in rising agency and consultancy spend.

Bed availability for the quarter preceding the end of each financial year was obtained from publicly available NHS England data¹² with occupancy rate calculated as the percentage of beds (as a proportion of total available) occupied on average during that quarter. Teaching status of the trusts was defined dichotomously on the basis of membership of The Association of UK University Hospitals.¹³ For each NHS Trust, the postcode of the Trust was extracted and used as a proxy for location to calculate the region of the country in which the trust hospitals were located.

1 This postcode data were matched to the 2015 Indices of Multiple Deprivation (IMD) score.¹⁴ The Office
2 for National Statistics uses UK census data to generate the IMD score which encompasses census
3 information from the following domains: income, employment, crime, living environment, health
4 deprivation and disability, education and skills/training, barriers to housing and services.
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10 Using publicly available NHS England datasets, we obtained data on hospital activity in the form of
11 number of annual admissions per Trust and annual outpatient attendances.¹⁵ Data on last-minute
12 elective operation cancellations (for non-clinical reasons) and the number of such patients not being
13 treated within 28 days of such a cancellation were also extracted from publicly available NHS England
14 datasets.¹⁵
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20 **Outcome measures**

21 The outcomes we measured consisted of two clinical measures and three process measures that are
22 commonly used for benchmarking NHS Trusts and have plausible mechanisms for a relation to quality.
23 We openly acknowledge that there are several other outcomes and process measures which may also
24 relate to quality and could have been chosen. Our selection was based on a combination of logistical
25 constraints (i.e. what data was publicly available) and an effort to include measures which are commonly
26 used for benchmarking trusts and thereby also reported in the mainstream media.⁹
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38 The clinical measures were (i) the proportion of discharges readmitted as an emergency within 7 days of
39 discharge and (ii) annual overall patient satisfaction for each trust using data from the National Adult
40 Inpatient Survey compiled by the Care Quality Commission.¹⁶ Data on readmissions was only available
41 for the years 2014-16. The three process measures were: (i) Accident and Emergency (A&E) 4-hour
42 waiting time breaches (ii) delayed transfers of care from an acute Trust, and (iii) cancer waiting time
43 targets.
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51 The first process measure, Accident and Emergency (A&E) 4-hour waiting time breaches, was defined
52 as the percentage of patient attendances in type 1 departments (major A&E) who waited greater than
53 four hours from arrival to admission, transfer or discharge.
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3 The second process measure, a delayed transfer of care from an acute Trust, was said to occur when a
4 patient was ready to depart from acute care but was still occupying a bed. These data were extracted as
5 'total number of bed days attributed to delayed transfers of care' and standardised to number of beds
6 available in the Trust. Delayed transfer of care data were only available for the latter eight months of the
7 2011 financial year. To ensure comparability with other years, a 1.5x multiplier was applied for each trust
8 in this financial year (see online Supplementary Appendix for further details). No other missing data in
9 the study was imputed.
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18 For the third process measure, cancer waiting time targets, we assessed two specific targets (a) the
19 proportion of patients who received a first consultant appointment within two weeks of urgent referral for
20 suspected cancer by their General Practitioner (GP) and (b) the proportion of patients who commenced
21 a first treatment for cancer within 62 days of being urgently referred by their GP.
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28 **Unit of analysis**

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30 Our analysis focused on the outcomes at individual NHS Trust-level (composed of one or more acute
31 hospitals).
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36 **Statistical analysis**

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38 Our financial metric of interest was the annual Trust operating margin. Similarly to prior literature,¹⁷⁻¹⁹ we
39 defined operating margin as the retained surplus (or deficit) for the Trust in a financial year divided by the
40 turnover (turnover being calculated as "Revenue from patient care activities" and "Other operating
41 revenue"). This value was winsorised to set all outliers beyond the 2.5th and 97.5th percentiles to the
42 values at these percentiles. We first calculated summary statistics of the operating surplus/deficit and
43 metrics of trust characteristics, breaking the sample into 4 groups of deciles by Trust margin.
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52 As a second step, we compared the variation in process and outcome measures between the financially
53 best and worst performing trusts as categorised by operating margin decile (highest versus lowest).
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56 Third, we performed multiple linear regression with our outcomes as the dependent variable and the
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1 following independent variables: operating margin, number of beds available and year. Each Trust in
2 each year was treated as a separate observation with standard errors clustered by Trust to account for
3 the non-independence of Trust-level data.
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8 Fourth, we compared outcomes and process measures between 'struggling' and 'non-struggling' Trusts.
9 For this purpose, a struggling Trust was defined as either: (i) in financial or quality special measures as
10 of December 2016 or (ii) a Foundation Trust subject to enforcement actions by Monitor as of September
11 2016. Fifth, we investigated the relationships between delayed transfers of care, cancelled elective
12 operations, agency spend, A&E breaches and operating margin by assessing correlation between these
13 variables over an early period (2011-12) and a late period (2015-16).
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22 We performed sensitivity analyses to assess the impact of (i) adjustment for missing 2011 delayed
23 transfer of care data and (ii) inclusion of Trusts that had changed in composition during the study period.
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28 All reported p -values are two sided with the statistical significance threshold set to a p -value of less than
29 0.05. Given the hypothesis generating nature of this study, no corrections were made for multiple
30 comparisons. Approximately 1 in every 20 comparisons could be expected to achieve statistical
31 significance by chance alone. All analyses were performed using STATA statistical software version 12.1
32 (College Station, TX). This study had no external funding source.
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40 **Patient involvement**

41 Patients were not involved in any aspect of the study design, conduct or in the development of the
42 research question or outcome measures. This study was a retrospective longitudinal observational study
43 of publicly available Trust-level data and therefore there was no active patient recruitment for data
44 collection or requirement for ethical approval.
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RESULTS

Over the 6-year period of study, encompassing the financial years from April 2010 to March 2016, there were changes in the composition to 31 of 149 Trusts. These are detailed in the online Supplementary Appendix and took the form of creation of a new Trust, dissolution of an existing Trust, acquisitions of a hospital or entire Trust to another Trust and mergers between Trusts. 13 Trusts (9%) transitioned to Foundation Status during the 6-year study period. Of the remaining 136 Trusts, 63 (42%) were non Foundation Trusts and 73 (49%) were Foundation Trusts.

There was a progressive increase in the proportion of Trusts in deficit over the 6-year study period: 22% in 2011, 27% in 2012, 28% in 2013, 51% in 2014, 68% in 2015 and 91% in 2016. The distribution of average operating surplus/deficit over the study period is displayed in Figure 1. Operating surplus/deficit varied widely across Trusts ranging from -£250 million to £181 million over the six years. Median operating surplus/deficit over the study period was -£3.8 million (IQR -£8.7 million to -£0.7 million, range -£63.1 million to £32.6 million). Median operating margin over the study period was -1.1% (IQR -2.7% to -0.2%, range -42.5% to 4.6%). Median operating margin was higher in teaching Trusts compared to non-Teaching Trusts (-0.5% versus -1.4%, $p=0.002$) and lowest in the Midlands compared to other regions (-2.3% in the Midlands, -1.2% in London, -0.8% in the South, -1.0% in the North; $p=0.028$).

During the 6-year study period, there was a nationwide decline in overnight general and acute beds from 110,568 to 103,422 (6.5% reduction) with a concomitant increase in day only beds from 11,572 to 12,207 (5.5% increase).

Trust metrics are shown in Table 1 stratified by decile of operating margin. Between the best and worst financially performing Trusts, there was an approximately 1.75-fold and 2-fold increase in agency and consultancy spend respectively as a proportion of turnover. The best financially performing Trusts also had a 1.5-fold higher annual number of outpatient attendances. In contrast, the annual number of admissions, bed occupancy rates and local deprivation scores were broadly similar between the best and worst performing Trusts. The proportion of Trusts with teaching status increased throughout deciles

1 of operating margin. Trends in the variation of operating margin over time with clinical outcomes and
2 process measures are displayed in figures 2 and 3 respectively.
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6 Clinical outcomes and process measures, stratified by decile of operating margin, are shown in table 2.
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8 Between the best and worst financially performing Trusts, there was an approximately 2-fold increase in
9 A&E breach rates and delayed transfers of care. In contrast, despite significant differences between the
10 best and worst performing trusts on cancer targets, the magnitude of difference was much smaller (both
11 approximately 1·15-fold).
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18 Trends in the variation between the best and worst financially performing Trusts over time for both
19 clinical outcomes and process measures are shown in table 3. There was no appreciable variation in
20 readmission rate or inpatient satisfaction score with the latter increasing over time at a slightly faster rate
21 in the worst financially performing Trusts.
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28 Performance on process measures in both the best and worst financially performing Trusts deteriorated
29 over time (table 3). However, variation between the best and worst groups narrowed for A&E breaches,
30 returned to baseline for delayed transfers of care after an initial rise, and rose slowly for both cancer
31 target breaches. The variation in agency spend as a proportion of turnover between the best and worst
32 financially performing trusts increased substantially between 2011 (best 2·7% and worst 3·9%,
33 difference 1·2%) and 2016 (best 4·5% and worst 9·1%, difference 4·6%) (see online Supplementary
34 Appendix for further details).
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44 In our linear regression analyses, there was no significant association between operating margin and
45 clinical outcomes (readmission rate or inpatient satisfaction score; table 4). There was, however, a
46 significant association between operating margin and process measures (delayed transfers of care, A&E
47 breaches and cancer waiting time targets; table 4). Trusts defined as struggling (i.e. in special measures
48 or subject to enforcement action) were associated with worse performance on all process measures but
49 not with readmission rate or inpatient satisfaction scores (table 5).
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1 The associations between delayed transfers of care, elective surgery cancellations, agency spend, A&E
2 breaches and operating margins are displayed in a correlation matrix for the early years (2011 and 2012;
3 figure 4) and the later years (2015 and 2016; figure 5) of the six year study period (same scale applied to
4 figure 4) and the later years (2015 and 2016; figure 5) of the six year study period (same scale applied to
5 both figures 4 and 5). There was weak positive correlation between all factors except operating margin
6 for which there was weak negative correlation with the other measures. These associations were
7 maintained in the later years though with a greater spread among trusts.
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14 Sensitivity analyses are reported in the online Supplementary Appendix. There was no change to the
15 results with and without adjustment for missing 2011 delayed transfer of care data. There was no change
16 to the results when excluding Trusts that had changed in composition over the study period.
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DISCUSSION

Principal findings

Our study has a number of important findings. First, in the period 2011-16, there was a substantial increase in the proportion of NHS Trusts with negative operating margins. Second, the overall variation between the best and worst financially performing Trusts was larger for A&E breach rates and delayed transfers of care than for cancer targets. Third, the variation over time between the best and worst financially performing trusts was static for clinical outcomes and mixed for process measures (decreased over the six years for A&E breaches, was static for delayed transfers of care while increasing slightly for cancer targets). Fourth, there was a significant association between worsened operating margin and deteriorating process measures (four-hour A&E targets, cancer waiting time targets and delayed transfers of care), but not between operating margin and either readmission rates or inpatient satisfaction scores.

Comparison with other studies

The extant literature on the association between financial performance and outcomes comes primarily from the United States (US) and is mixed in pronouncement. Volpp and colleagues assessed the impact of a budget act reducing Medicare reimbursements on processes of care for acute myocardial infarction (MI).²⁰ They found that while the budget act added moderate financial strain to organisations, there was no appreciable worsening of care with respect to MI processes of care or mortality in 236,506 patients from 208 hospitals. An analysis by Bazzoli and colleagues in 2008 concluded that while there may be an association between some measures of financial performance and adverse events, it was much weaker than previously reported by Encinosa and Bernard who found a concerning association between frequency of patient safety alerts and operating margin.^{17,18} Further, a study by Ly and colleagues in over 3,000 US hospitals found that low hospital margins were associated with worse processes of care and higher readmissions, although not with higher mortality.²¹

Placing our findings in the context of earlier studies requires extreme caution given the differences between the US and UK health systems. Specifically, Ly et al. excluded public hospitals (which comprise

1 the vast majority of English hospitals) from their analysis. However, these prior studies do highlight the
2 difficulty in disentangling the relationship between financial performance and outcomes. Meanwhile, a
3 large European cohort study revealed that attempts to save money by cutting nurse to patient ratios may
4 adversely affect patient outcomes.²² An increase in a nurses' workload by one patient increased the
5 likelihood of a 30-day inpatient death by 7% (odds ratio 1.07, 95% CI 1.03 to 1.11).²²
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10 11 12 **Study limitations**

13 Our findings must be borne in light of several study limitations. First, while we had access to a
14 considerable volume of data, the granularity of data was limited. For example, our unit of analysis was at
15 the Trust level, giving a sample size of approximately 149 compared to equivalent US studies that have
16 analysed over 3000 hospitals.²¹ Lack of 'high-frequency' data also prevented us performing interrupted
17 time-series and time-lag analyses.
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26 Second, it may be that operating margin is not the ideal measure of an organisation's financial position.
27 A Trust's deficit may be exaggerated if it realises that a deficit is unavoidable and careful accounting
28 allows for a larger than necessary deficit in one year to ensure a small surplus in the following year (as
29 opposed to two years of deficit); potential gamification.²³ Organisations including NHS Improvement and
30 the Department of Health typically use breakeven performance figures instead of operating
31 surplus/deficits. We chose not to use such figures as the data were not easily available at Trust level for
32 much of the period under investigation.
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42 Third, we utilised only a small selection of existing clinical outcomes and process. This decision was
43 driven by two factors. Logistically, there is limited public access to many clinical outcomes. While there is
44 access to many process measures, we opted for a small selection that is commonly used for
45 benchmarking trusts (i.e. often quoted in media reports and receive major public scrutiny) so as to avoid
46 the issues of multiple comparisons. It is entirely possible that other process measures may well display
47 differing relationships with respect to operating margins.
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1 Fourth, we did not take into account the proportion of activity at each Trust which is elective, acute or
2 specialised nor did we assess the percentage of activity subject to a national tariff. Work from the Health
3 Foundation in 2016 suggests a link between financial performance and the proportion of Trust income
4 arising from activities subject to the national tariff.²⁴ Reimbursement prices for specialist activity tend to
5 be higher than average treatment costs. Furthermore, best practice tariffs tend to reward more efficient
6 treatment delivery such as an increased proportion of day cases. Although there is likely to be correlation
7 between teaching hospital status (which we did assess) and the share of activity subject to a specialised
8 services tariff, this is nonetheless a crude proxy.
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18 Fifth, there may be additional unmeasured confounders that have impacted on our results. For example,
19 surrounding Primary Care systems may impact on the efficiency with which the acute Trusts function. Or
20 alternatively, competition from independent sector treatment centres (ISTCs) may lead to a loss of
21 revenue and market share for some Trusts, who may then need to invest more of their operating funds in
22 attracting patients, especially given an increasing emphasis on patient choice and the freedom for
23 patients to select hospitals by publicly reported outcomes. We adjusted for hospital size in the form of
24 number of beds as well as using operating margin as a more standardised measure of financial
25 performance than gross surplus or deficit (as turnover showed wide variation between trusts). Trusts that
26 treat greater volumes of patients may benefit from economies of scale. However, as with any
27 observational research, we cannot fully discount the impact of confounding on our results. For example,
28 financial underperformance may be a signal of general underperformance in a Trust where clinical and
29 other functions that might be suboptimal affect outcomes. Sixth, we are limited to demonstrating
30 associations rather than causal links.
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46 **Conclusions and policy implications**

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48 Notwithstanding limitations, our findings have important ramifications for clinical leads, managers and
49 policy makers. The relationship between financial performance and clinical outcomes is far more
50 complex and associated with myriad other factors which will vary among Trusts. This is highlighted in a
51 2017 briefing from the Nuffield Trust which discusses the current financial health of Trusts and attempts
52 to predict what is likely to occur in the coming years.²³ Trusts with financial deficits may be spending
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1 more than they can afford (for example, on extra nursing staff) and one could therefore argue that higher
2 quality should be expected for this extra financial outlay. Conversely, the existence of such deficit might
3 instead indicate reduced efficiency and challenged management. Alternatively, financial penalties due to
4 poor clinical performance or financial management could exacerbate deficits. For example, marginal rate
5 payment reductions for emergency admissions, penalties for readmissions and withholding payment for
6 cases resulting in never events. Attempts to redress this balance may inadvertently lead to reflex
7 spending cuts and poorer quality care. The role of clinical leads, management and leadership within a
8 Trust is likely to be a key contributor to how financial deficits impact quality of care. For example, cutting
9 down on management personnel to save costs may result in worse productivity if clinicians have to
10 allocate more time to administrative activities and away from revenue producing clinical activities.

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22 There are a number of specific points to consider also. First, there is substantial variation between
23 Trusts, which in some cases is worsening. Between the best and worst financially performing Trusts,
24 there are up-to 2-fold differences in agency spend, delayed transfers of care, A&E breaches and cancer
25 waiting times. This is notable and needs to be explicitly tackled with greater efficacy. While national
26 regulators such as the Care Quality Commission (CQC) and NHS Improvement do seek to support
27 challenged Trusts, the effectiveness of this has not necessarily translated into improved performance
28 metrics. An argument could also be made that although the magnitude of difference in cancer targets
29 was smaller than for A&E breaches, there may be greater concern from even small increases in cancer
30 waiting times compared to A&E breaches which include less severe illnesses.

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42 Second, the lack of significant association between operating margin and either readmissions or
43 inpatient satisfaction may suggest that clinical outcomes are more resilient to financial pressures than
44 process measures, or that the driver for such clinical metrics is not predominantly financial-based. Third,
45 the recent narrowing of variation between the best and worst performing Trusts on the measures of A&E
46 targets and delayed transfers of care, may be a cause for concern, suggesting that now even the best
47 financially performing Trusts are struggling to manage demand. This indicates that a more system-wide
48 approach to demand-management and improving Trust performance may be required to address the
49 identified deteriorations, given the entire Trust cohort is now showing signs of deterioration. Stated

1 plainly, it seems that even if best practice is adopted from the most well managed Trusts, demands on
2 secondary and tertiary care may not be adequately addressed.
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6 Finally, our inability to demonstrate causal links on the available macro level public data re-emphasises
7 the need for higher quality interventional studies such as cluster randomised trials specifically assessing
8 policy impacts before implementation en masse. Furthermore, studies assessing the micro level
9 spending decisions by Trusts when confronted by financial pressures may also lend more insight into the
10 causal pathway and suggest appropriate targets for intervention.
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18 **Summary**

19 Notwithstanding limitations, our results demonstrate that operating margins at English NHS Trusts have
20 progressively worsened over 2011-16, and that this change correlates with poorer Trust performance on
21 a range of widely benchmarked process measures, but not significantly with readmissions or inpatient
22 satisfaction. The variation between the best and worst financially performing Trusts was larger for A&E
23 breach rates and delayed transfers of care than for cancer targets but showed differing patterns of
24 variation over time. The causal nature of relationships between financial performance, process measures
25 and outcomes remains difficult to disentangle.
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RESEARCH IN CONTEXT

Evidence before this study

We searched the scientific literature to identify original research articles assessing the macro-level association between financial performance and outcomes in the NHS and how such outcomes vary between the best and worst financially performing Trusts. We searched PubMed for manuscripts published in any language up to and including August 15th 2017, using the following search terms: ("NHS"[Ti] OR "National health service"[Ti] OR ("English"[Ti] AND "Hospital"[Tiab])) AND ("Variation"[Tiab] or "Outcome"[Tiab]). 550 records were retrieved but none were deemed includable.

Added value of this study

Most of the extant literature comes from the United States and direct comparison is fraught with difficulty. Our study is the largest analysis to date of the association between financial performance, as measured by operating margin, and outcomes at English NHS Trusts. Operating margins in English NHS trusts progressively worsened during 2011-16, and this change was associated with poorer performance on several process measures but not with hospital readmissions or inpatient satisfaction. Significant variation exists between the best and worst financially performing Trusts.

Implications of all the available evidence

The causal nature of relationships between financial performance, process measures and outcomes remains problematic to entangle but specific findings from our study merit further consideration. The lack of significant association between operating margin and either readmissions or inpatient satisfaction may suggest that clinical outcomes are more resilient to financial pressures than process measures, or that the driver for such clinical metrics is not predominantly financial-based. The recent narrowing of variation between the best and worst performing Trusts on the measures of A&E targets and delayed transfers of care, may be a cause for concern, suggesting that now even the best financially performing Trusts are struggling to manage demand.

CONTRIBUTORSHIP

MN and MM conceived the study. RR and RA had critical input into study direction and interpretation. MN and GK extracted and sorted data for the study. MN performed the analysis and wrote the first draft of the manuscript. All authors (MN, GK, RR, RA, MM) contributed to critical revision of the manuscript for important intellectual content and approved the final version. MN and MM are the guarantors.

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DECLARATION OF INTERESTS

All authors have completed the ICMJE uniform disclosure at www.icmje.org/coi_disclosure.pdf. Mahiben Maruthappu serves as NHS England's Innovation Adviser and is an investor and employee of Cera Care which is a domiciliary care provider. All authors declare no support from any organisation for the submitted work, no financial relationships with any organisations that might have an interest in the submitted work in the previous three years and no other relationships or activities that could appear to have influenced the submitted work.

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DATA SHARING

Raw data and analysis available on request from authors.

TRANSPARENCY STATEMENT

1 The study guarantors (MN and MM) affirm that the manuscript is an honest, accurate, and transparent
2 account of the study being reported; that no important aspects of the study have been omitted; and that
3 any discrepancies from the study as planned have been explained.
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8 **ETHICS**

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10 No ethical approval required as retrospective longitudinal observational study of publicly available Trust-
11 level data.
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FIGURE LEGENDS

Figure 1. Distribution of average operating surplus/deficit over the 2011-16 period.

Figure 2. Trends in operating margin and clinical outcomes over time.

Figure 3. Trends in operating margin and process measures over time. Abbreviations: A&E, Accident & Emergency.

Figure 4. 2011-12 correlation between delayed transfers of care, elective operation cancellations, agency spend, A&E breaches and operating margin. Elective surgery cancellations are last-minute elective operation cancellations (for non-clinical reasons) standardised in this figure to number of available beds at the Trust (as a proxy for hospital capacity). Agency spend is displayed as a proportion of turnover. Operating margin is as defined in study methods. Abbreviations: A&E, Accident & Emergency; DTOC, delayed transfer of care.

Figure 5. 2015-16 correlation between delayed transfers of care, elective operation cancellations, agency spend, A&E breaches and operating margin. Elective surgery cancellations are last-minute elective operation cancellations (for non-clinical reasons) standardised in this figure to number of available beds at the Trust (as a proxy for hospital capacity). Agency spend is displayed as a proportion of turnover. Operating margin is as defined in study methods. Abbreviations: A&E, Accident & Emergency; DTOC, delayed transfer of care.

TABLE LEGENDS

Table 1. Trust metrics by decile of Trust operating margin. Higher deprivation score indicates more deprivation.

Table 2. Outcomes and process measures by decile of Trust operating margin. Values are median (IQR). P-value refers to a one-way analysis of variance (ANOVA) test. Abbreviations: A&E, Accident & Emergency.

Table 3. Variation in outcomes and process measures over time by Trust financial performance. 'Best 10%' refers to Trusts with operating margins in the top 10% of the sample. 'Worst 10%' refers to Trusts with operating margins in the bottom 10% of the sample.

Table 4. Association of operating margin with outcomes and process measures. These estimates are derived from a linear regression with outcome/process measure as the dependent variable and the following independent variables: operating margin, number of beds available and year. Each Trust in each year was treated as a separate observation with standard errors clustered by Trust to account for the non-independence of Trust-level data. Abbreviations: A&E, Accident & Emergency; CI, confidence interval.

Table 5. Outcomes and process measures in trusts struggling (i.e. in special measures or subject to enforcement action) versus those that are not. Values are median (IQR). P-value refers to a Kruskal-Wallis equality-of-populations rank test.

Table 1. Trust metrics by decile of Trust operating margin.

	Operating margin			
	Bottom 10%	11-50%	51-89%	Top 10%
Operating surplus / deficit (£ millions, median (range))	-30.9 (-61.1 to -12.4)	-6.3 (-63.1 to -1.2)	-1.5 (-13.8 to 6.8)	5.4 (1.3 to 32.6)
Agency spend as proportion of turnover (%)	6.9 (2.0)	4.8 (2.4)	3.8 (2.0)	3.9 (1.2)
Consultancy spend as proportion of turnover (%)	0.96 (0.54)	0.44 (0.35)	0.45 (0.74)	0.46 (0.29)
Annual admissions, mean (SD)	26,978 (9,698)	29,006 (13,326)	36,411 (21,300)	30,445 (12,455)
Annual outpatient attendances, mean (SD)	271,508 (109,938)	295,223 (142,784)	374,266 (210,861)	407,595 (209,956)
Bed availability, mean (SD)	716 (267)	718 (321)	822 (387)	740 (226)
Bed occupancy (%)	90.1	88.3	87.2	88.1
Deprivation score, mean (SD)	23.4 (11.8)	19.2 (13.2)	23.3 (14.6)	23.5 (11.9)
Teaching trust (%)	6.7	17.0	33.3	35.7
Foundation status (%)				
Non-foundation trust	40.0	49.2	35.0	42.9
Foundation trust	53.3	47.5	50.0	50.0
Transitioned to Foundation	6.7	3.4	15.0	7.1
Region (%)				
London	20	17	17	21
South	20	17	38	7
Midlands	40	36	15	29
North	20	31	30	43

Table 2. Outcomes/process measures by decile of Trust operating margin.

	Operating margin				p-value
	Bottom 10%	11-50%	51-89%	Top 10%	
Readmission rate (%)	3.6 (3.4 to 3.9)	3.6 (3.1 to 3.9)	3.7 (3.2 to 4.0)	3.3 (3.0 to 3.8)	0.137
Inpatient satisfaction score (out of 10)	8.0 (7.8 to 8.2)	8.0 (7.8 to 8.2)	7.9 (7.7 to 8.1)	7.9 (7.7 to 8.2)	<0.001
4 hour A&E target breach rate (%)	10.2 (6.7 to 15.1)	6.7 (4.9 to 10.7)	5.3 (4.2 to 7.3)	5.3 (3.9 to 6.7)	<0.001
Delayed transfer of care days per hospital bed	11.1 (6.0 to 17.1)	7.4 (4.5 to 10.9)	6.5 (3.7 to 11.0)	5.7 (2.6 to 8.1)	<0.001
Cancer two week wait target adherence (%)	94.9 (93.2 to 96.2)	95.5 (94.2 to 96.7)	95.4 (94.4 to 96.7)	95.6 (95.0 to 96.5)	0.009
Cancer 62 days to first treatment target adherence (%)	86.2 (81.9 to 88.2)	86.6 (83.6 to 89.1)	87.6 (85.6 to 89.6)	88.0 (86.3 to 89.9)	<0.001

Table 3. Variation in outcomes and process measures over time by Trust financial performance.

Readmissions (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	-	-	-	3.6	3.7	3.8
Middle 80%	-	-	-	3.4	3.6	3.6
Best 10%	-	-	-	3.4	3.5	3.6
Ratio of worst to best	-	-	-	1.1	1.0	1.1
Difference (best and worst)	-	-	-	0.2	0.1	0.2
Inpatient satisfaction survey (score out of 10)						
	2011	2012	2013	2014	2015	2016
Worst 10%	7.5	7.7	7.9	7.9	8.0	8.0
Middle 80%	7.7	7.8	7.9	8.0	8.1	8.1
Best 10%	7.8	7.8	7.9	8.0	8.1	8.1
Ratio of worst to best	1.0	1.0	1.0	1.0	1.0	1.0
Difference (best and worst)	0.3	0.1	0.0	0.1	0.1	0.1
Accident & Emergency breach rate (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	8.2	6.4	7.8	7.8	11.9	13.6
Middle 80%	5.2	4.9	6.0	6.3	9.3	12.0
Best 10%	4.2	4.5	5.5	5.9	7.5	10.4
Ratio of worst to best	2.0	1.4	1.4	1.3	1.6	1.3
Difference (best and worst)	4.0	1.9	2.3	1.9	4.4	3.2
Delayed transfers of care days						
	2011	2012	2013	2014	2015	2016
Worst 10%	5,077	6,657	7,248	6,972	7,813	8,284
Middle 80%	4,851	5,082	5,558	6,046	7,311	8,044
Best 10%	3,850	3,722	3,884	3,932	5,712	6,477
Ratio of worst to best	1.3	1.8	1.9	1.8	1.4	1.3
Difference (best and worst)	1,227	2,935	3,364	3,040	2,101	1,807
Cancer two week wait target breach rate (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	4.2	4.2	4.6	4.8	6.2	5.9
Middle 80%	4.3	3.9	4.3	4.4	5.7	5.5
Best 10%	4.6	4.1	4.0	4.6	5.9	5.2
Ratio of worst to best	0.9	1.0	1.2	1.0	1.1	1.1
Difference (best and worst)	-0.4	0.1	0.6	0.2	0.3	0.7
Cancer 62 days to first treatment breach rate (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	11.9	11.7	12.2	13.7	16.6	18.3
Middle 80%	12.1	12.0	12.2	13.4	15.6	16.2
Best 10%	11.9	11.7	10.0	11.7	13.5	15.2
Ratio of worst to best	1.0	1.0	1.2	1.2	1.2	1.2
Difference (best and worst)	0.0	0.0	2.2	2.0	3.1	3.1

Table 4. Association of operating margin on outcomes and process measures.

Outcome	n	Trust clusters	Coefficient	95% CI	p-value
Readmission rate (%)	387	135	-0.012	-0.029 to 0.005	0.164
Inpatient satisfaction score (out of 10)	825	148	0.80	-0.06 to 1.67	0.067
A&E 4 hour breach rate (%)	835	148	-0.24	-0.33 to -0.15	<0.001
Delayed transfers of care days per hospital bed	837	148	-25.1	-39.1 to -11.0	0.001
2 week wait cancer target adherence (%)	833	148	0.05	0.00 to 0.09	0.031
62 day cancer treatment target adherence (%)	833	148	0.12	0.03 to 0.21	0.009

Table 5. Outcomes and process measures in trusts struggling (i.e. in special measures or subject to enforcement action) versus those that are not.

	Struggling trust	Non-struggling trust	p-value
Readmission rate (%)	3.6 (3.1 to 3.9)	3.7 (3.1 to 3.9)	0.285
Inpatient satisfaction score (out of 10)	7.9 (7.8 to 8.1)	7.9 (7.8 to 8.1)	0.378
A&E 4 hour target breach rate (%)	6.8 (5.2 to 10.2)	5.5 (4.2 to 8.3)	<0.001
Delayed transfer of care days per hospital bed	8.2 (4.5 to 11.9)	6.4 (4.0 to 10.4)	0.005
Cancer two week wait target adherence (%)	95.1 (94.0 to 96.4)	95.5 (94.4 to 96.8)	0.002
Cancer 62 days to first treatment target adherence (%)	86.6 (83.7 to 88.9)	87.4 (84.8 to 89.6)	0.002

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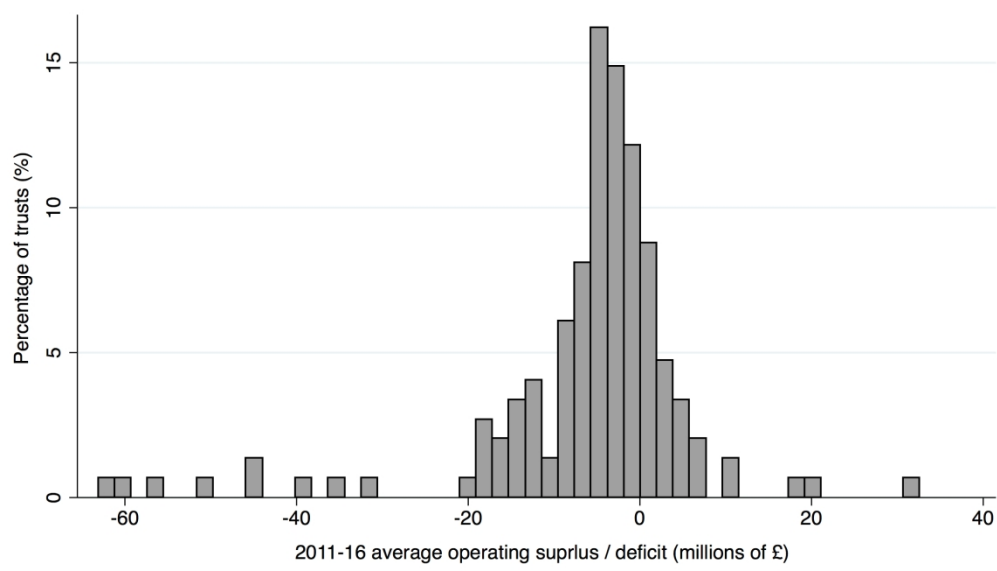


Figure 1. Distribution of average operating surplus/deficit over the 2011-16 period.

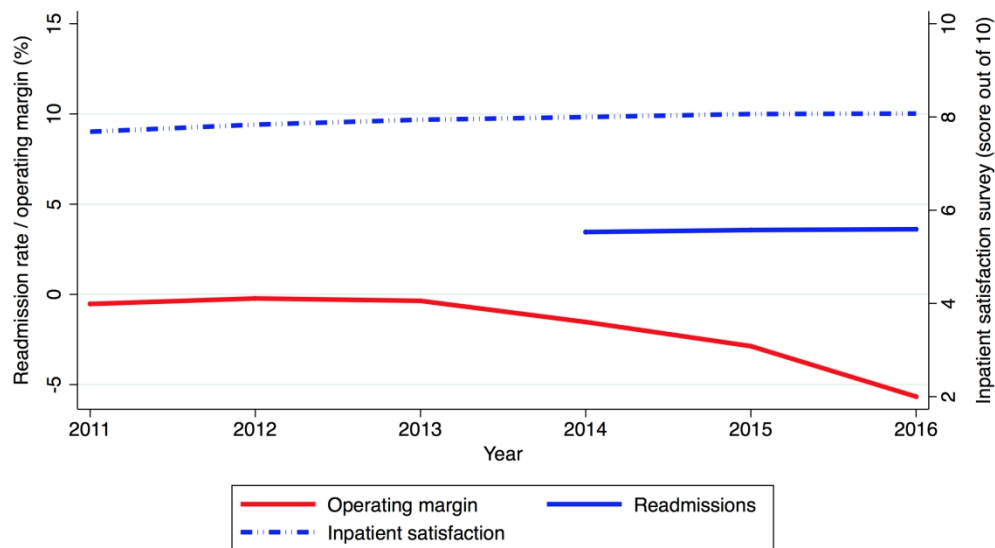


Figure 2. Trends in operating margin and clinical outcomes over time.

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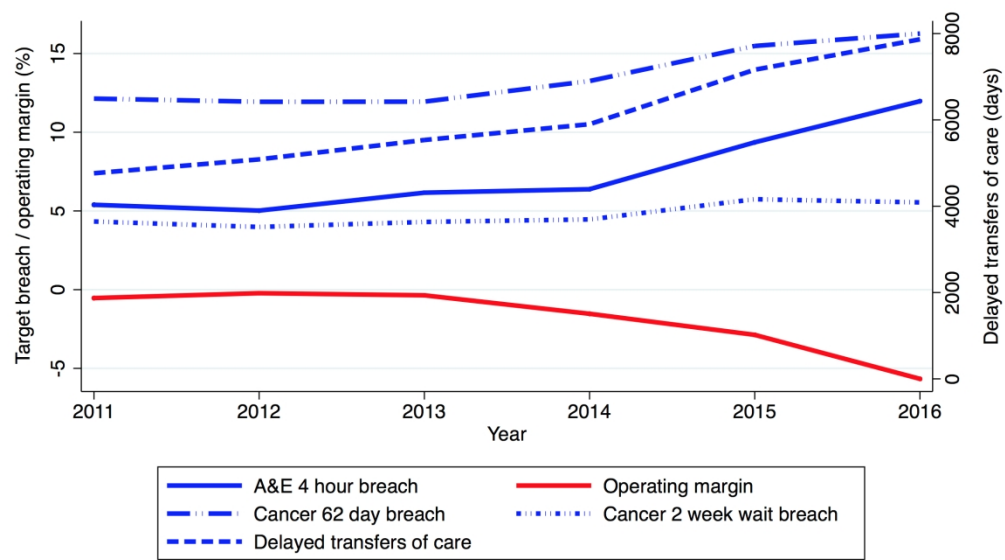


Figure 3. Trends in operating margin and process measures over time. Abbreviations: A&E, Accident & Emergency.

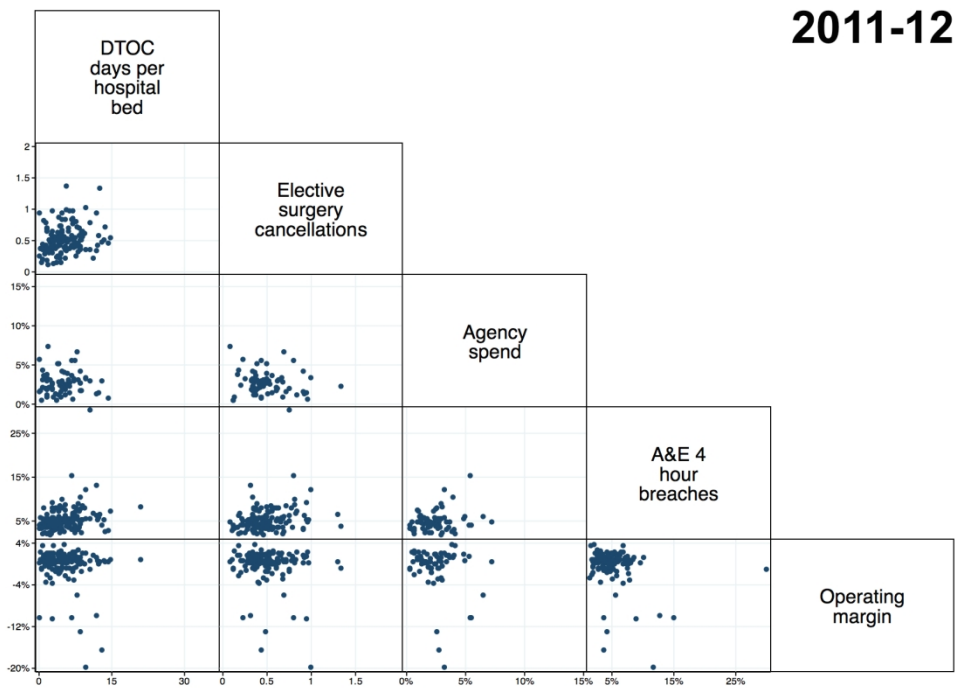


Figure 4. 2011-12 correlation between delayed transfers of care, elective operation cancellations, agency spend, A&E breaches and operating margin. Elective surgery cancellations are last-minute elective operation cancellations (for non-clinical reasons) standardised in this figure to number of available beds at the Trust (as a proxy for hospital capacity). Agency spend is displayed as a proportion of turnover. Operating margin is as defined in study methods. Abbreviations: A&E, Accident & Emergency; DTOC, delayed transfer of care.

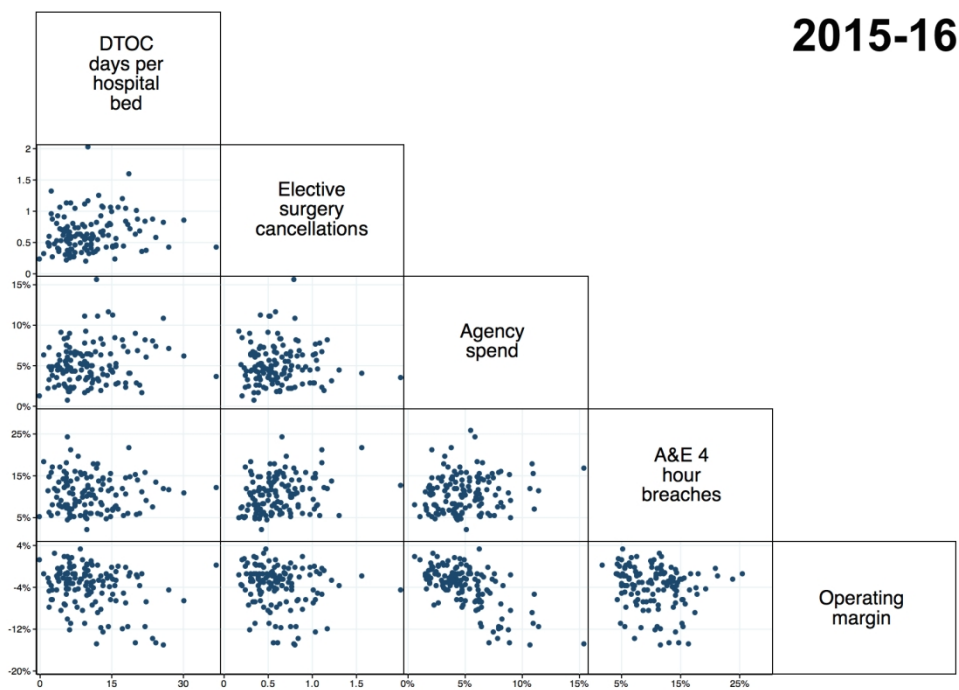


Figure 5. 2015-16 correlation between delayed transfers of care, elective operation cancellations, agency spend, A&E breaches and operating margin. Elective surgery cancellations are last-minute elective operation cancellations (for non-clinical reasons) standardised in this figure to number of available beds at the Trust (as a proxy for hospital capacity). Agency spend is displayed as a proportion of turnover. Operating margin is as defined in study methods. Abbreviations: A&E, Accident & Emergency; DTOC, delayed transfer of care.

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract PAGE 1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found PAGE 2
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported PAGE 4
Objectives	3	State specific objectives, including any pre-specified hypotheses PAGE 4
Methods		
Study design	4	Present key elements of study design early in the paper PAGES 5-7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection PAGES 5-7 (IN SO FAR AS APPLICABLE TO THIS STUDY)
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up PAGE 5 (NO PARTICIPANTS, DESCRIBED FOR CENTRES)
		(b) For matched studies, give matching criteria and number of exposed and unexposed NOT APPLICABLE
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable PAGES 5-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group PAGES 5-7
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at PAGE 5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding PAGES 7-8
		(b) Describe any methods used to examine subgroups and interactions PAGE 7
		(c) Explain how missing data were addressed PAGES 6-7
		(d) If applicable, explain how loss to follow-up was addressed NOT APPLICABLE
		(e) Describe any sensitivity analyses PAGE 8

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60**Results**

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed NOT APPLICABLE (b) Give reasons for non-participation at each stage NOT APPLICABLE BUT DETAILS GIVEN IN ONLINE APPENDIX REGARDING CHANGE IN COMPOSITION OF TRUSTS (c) Consider use of a flow diagram NOT APPLICABLE
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders NOT APPLICABLE BUT DETAILS FOR TRUSTS GIVEN ON PAGES 9 & 24 (b) Indicate number of participants with missing data for each variable of interest NOT APPLICABLE BUT DETAILS FOR TRUSTS GIVEN ON PAGE 5 IN METHODS SECTION (c) Summarise follow-up time (eg, average and total amount) NOT APPLICABLE AS FOLLOW-UP TIME IS STUDY-PERIOD
Outcome data	15*	Report numbers of outcome events or summary measures over time NOT APPLICABLE IN THE FORMAT OF NUMBER OF OUTCOME EVENTS
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included PAGES 9-11 (b) Report category boundaries when continuous variables were categorized PAGES 9-11 (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period NOT APPLICABLE
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses PAGE 11 AND ONLINE APPENDIX
Discussion		
Key results	18	Summarise key results with reference to study objectives PAGE 11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias PAGES 13-14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence PAGES 14-16
Generalisability	21	Discuss the generalisability (external validity) of the study results PAGES 14-16
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

For peer review only

Financial Performance of English NHS Trusts and Clinical Outcomes: A Longitudinal Observational Study

ONLINE SUPPLEMENTAL DATA

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Supplement version: 2.2

FINANCIAL DATA EXTRACTION

Where financial data was extracted from consolidated end of year accounts files via the gov.uk open data portal, the following fields were extracted:

For foundation trusts:

Turnover --> Table ID 1, Subcode 100
Surplus/Deficit --> Table ID 1, Subcode 160
Consultancy --> 07A and 07I, subcode 280
Agency spend --> 1415TRU06_EXP_P13, maincode 01, subcode 180

For non-Foundation trusts:

Turnover --> Table ID CNE, Subcode 120 and 130
Surplus/Deficit --> Table ID CNE, Subcode 390
Consultancy --> 08C, subcode 125 (*only available for 2014-16*)
Agency spend --> 1415TRU09_EMP_P13, maincode 04, subcode 100 (*only available for 2015-16*)

DELAYED TRANSFERS OF CARE IN FINANCIAL YEAR ENDING 2011

Delayed transfer of care data were only available at Trust level for the latter eight months of the 2011 financial year. To ensure comparability with other years, a 1.5x multiplier was applied for each trust in this financial year with a sensitivity analysis to examine any impact of this change.

The total numbers of delayed transfers for all hospitals were available as an aggregate total (data obtained from King's Fund Quarterly Monitoring Report for 2010-11).

The ratio of aggregate delayed transfer of care days for the first 4 months (April 2010 to July 2010) to the last 8 months (August 2010 to March 2011) was 0.492; suggesting that a 1.5x multiplier appeared reasonable.

Year	Month	Number of DTOCs	4-monthly total
2010	Apr	113900	-
2010	May	112442	-
2010	Jun	115336	-
2010	Jul	109918	451596
-	-	-	-
2010	Aug	115855	-
2010	Sep	113246	-
2010	Oct	113091	-
2010	Nov	116466	458658
-	-	-	-
2010	Dec	114346	-
2011	Jan	112386	-
2011	Feb	123130	-
2011	Mar	109362	459224

CHANGES TO TRUST COMPOSITION

The 168 Trusts listed below include specialist Trusts (e.g. Great Ormond Street Hospital for Children NHS Foundation Trust) that were excluded prior to analysis. Changes in composition to the Trusts (creation of a new Trust, dissolution of an existing Trust, acquisitions of a hospital or entire Trust to another Trust and mergers between Trusts) are detailed at the end of the table.

Trust	Trust identifier	Change in composition	Transitioned to Foundation status	Foundation Trust transition date
Aintree University Hospital NHS Foundation Trust	REM			
Airedale NHS Foundation Trust	RCF		Yes	01/06/2010
Alder Hey Children's NHS Foundation Trust	RBS			
Ashford and St Peter's Hospitals NHS Foundation Trust	RTK		Yes	01/12/2010
Barking, Havering and Redbridge University Hospitals NHS Trust	RF4			
Barnet and Chase Farm Hospitals NHS Trust	RVL	Yes (1)		
Barnsley Hospital NHS Foundation Trust	RFF			
Barts and the London NHS Trust	RNJ	Yes (2)		
Barts Health NHS Trust	R1H	Yes (3)		
Basildon and Thurrock University Hospitals NHS Foundation Trust	RDD			
Bedford Hospital NHS Trust	RC1			
Birmingham Children's Hospital NHS Foundation Trust	RQ3			
Birmingham Women's NHS Foundation Trust	RLU			
Blackpool Teaching Hospitals NHS Foundation Trust	RXL			
Bolton NHS Foundation Trust	RMC			
Bradford Teaching Hospitals NHS Foundation Trust	RAE			
Brighton and Sussex University Hospitals NHS Trust	RXH			
Buckinghamshire Healthcare NHS Trust	RXQ			

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3	Burton Hospitals NHS Foundation Trust	RJF		
4	Calderdale and Huddersfield NHS Foundation Trust	RWY		
5	Cambridge University Hospitals NHS Foundation Trust	RGT		
6	Central Manchester University Hospitals NHS Foundation Trust	RW3	Yes (4)	
7	Chelsea and Westminster Hospital NHS Foundation Trust	RQM	Yes (5)	
8	Chesterfield Royal Hospital NHS Foundation Trust	RFS		
9	City Hospitals Sunderland NHS Foundation Trust	RLN		
10	Colchester Hospital University NHS Foundation Trust	RDE		
11	Countess Of Chester Hospital NHS Foundation Trust	RJR		
12	County Durham and Darlington NHS Foundation Trust	RXP		
13	Croydon Health Services NHS Trust	RJ6		
14	Dartford and Gravesham NHS Trust	RN7		
15	Derby Teaching Hospitals NHS Foundation Trust	RTG		
16	Doncaster and Bassetlaw Hospitals NHS Foundation Trust	RP5		
17	Dorset County Hospital NHS Foundation Trust	RBD		
18	Ealing Hospital NHS Trust	RC3	Yes (6)	
19	East and North Hertfordshire NHS Trust	RWH		
20	East Cheshire NHS Trust	RJN		
21	East Kent Hospitals University NHS Foundation Trust	RVV		
22	East Lancashire Hospitals NHS Trust	RXR		
23	East Sussex Healthcare NHS Trust	RXC		
24	Epsom and St Helier University Hospitals NHS Trust	RVR		
25	Frimley Health NHS Foundation Trust	RDU	Yes (7)	
26	Gateshead Health NHS Foundation Trust	RR7		
27	George Eliot Hospital NHS Trust	RLT		
28	Gloucestershire Hospitals NHS Foundation Trust	RTE		
29	Great Ormond Street Hospital for Children NHS Foundation Trust	RP4		Yes
30	Great Western Hospitals NHS Foundation Trust	RN3		01/03/2012
31	Guy's and St Thomas' NHS Foundation Trust	RJ1		
32	Hampshire Hospitals NHS Foundation Trust	RN5	Yes (8)	
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3	Harrogate and District NHS Foundation Trust	RCD		
4	Heart Of England NHS Foundation Trust	RR1		
5	Heatherwood and Wexham Park Hospitals NHS Foundation Trust	RD7	Yes (9)	
6	Hinchingbrooke Health Care NHS Trust	RQQ		
7	Homerton University Hospital NHS Foundation Trust	RQX		
8	Hull and East Yorkshire Hospitals NHS Trust	RWA		
9	Imperial College Healthcare NHS Trust	RYJ		
10	Ipswich Hospital NHS Trust	RGQ		
11	Isle Of Wight NHS Trust	R1F	Yes (10)	
12	James Paget University Hospitals NHS Foundation Trust	RGP		
13	Kettering General Hospital NHS Foundation Trust	RNQ		
14	King's College Hospital NHS Foundation Trust	RJZ	Yes (11)	
15	Kingston Hospital NHS Foundation Trust	RAX		Yes
16	Lancashire Teaching Hospitals NHS Foundation Trust	RXN		01/05/2013
17	Leeds Teaching Hospitals NHS Trust	RR8		
18	Lewisham and Greenwich NHS Trust	RJ2	Yes (12)	
19	Liverpool Heart and Chest NHS Foundation Trust	RBQ		
20	Liverpool Women's NHS Foundation Trust	REP		
21	London North West Healthcare NHS Trust	R1K	Yes (13)	
22	Luton and Dunstable University Hospital NHS Foundation Trust	RC9		
23	Maidstone and Tunbridge Wells NHS Trust	RWF		
24	Medway NHS Foundation Trust	RPA		
25	Mid Cheshire Hospitals NHS Foundation Trust	RBT		
26	Mid Essex Hospital Services NHS Trust	RQ8		
27	Mid Staffordshire NHS Foundation Trust	RJD	Yes (14)	
28	Mid Yorkshire Hospitals NHS Trust	RXF		
29	Milton Keynes University Hospital NHS Foundation Trust	RD8		
30	Moorfields Eye Hospital NHS Foundation Trust	RP6		
31	Newham University Hospital NHS Trust	RNH	Yes (15)	
32	Norfolk and Norwich University Hospitals NHS Foundation Trust	RM1		
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3	North Bristol NHS Trust	RVJ			
4	North Cumbria University Hospitals NHS Trust	RNL			
5	North Middlesex University Hospital NHS Trust	RAP			
6	North Tees and Hartlepool NHS Foundation Trust	RVW			
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8	North West London Hospitals NHS Trust	RV8	Yes (16)		
9	Northampton General Hospital NHS Trust	RNS			
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11	Northern Devon Healthcare NHS Trust	RBZ			
12	Northern Lincolnshire and Goole NHS Foundation Trust	RJL			
13	Northumbria Healthcare NHS Foundation Trust	RTF			
14	Nottingham University Hospitals NHS Trust	RX1			
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16	Oxford University Hospitals NHS Foundation Trust	RTH	Yes (17)	Yes	01/10/2015
17	Papworth Hospital NHS Foundation Trust	RGM			
18	Pennine Acute Hospitals NHS Trust	RW6			
19					
20	Peterborough and Stamford Hospitals NHS Foundation Trust	RGN			
21	Plymouth Hospitals NHS Trust	RK9			
22	Poole Hospital NHS Foundation Trust	RD3			
23	Portsmouth Hospitals NHS Trust	RHU			
24					
25	Queen Victoria Hospital NHS Foundation Trust	RPC			
26	Robert Jones and Agnes Hunt Orthopaedic and District Hospital NHS Foundation Trust	RL1		Yes	01/08/2011
27	Royal Berkshire NHS Foundation Trust	RHW			
28					
29	Royal Brompton and Harefield NHS Foundation Trust	RT3			
30	Royal Cornwall Hospitals NHS Trust	REF			
31	Royal Devon and Exeter NHS Foundation Trust	RH8			
32	Royal Free London NHS Foundation Trust	RAL	Yes (18)	Yes	01/04/2012
33					
34	Royal Liverpool and Broadgreen University Hospitals NHS Trust	RQ6			
35	Royal National Hospital For Rheumatic Diseases NHS Foundation Trust	RBB	Yes (19)		
36	Royal National Orthopaedic Hospital NHS Trust	RAN			
37	Royal Surrey County NHS Foundation Trust	RA2			
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39	Royal United Hospitals Bath NHS Foundation Trust	RD1	Yes (20)	Yes	01/11/2014
40	Salford Royal NHS Foundation Trust	RM3			

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3	Salisbury NHS Foundation Trust	RNZ		
4	Sandwell and West Birmingham Hospitals NHS Trust	RXK		
5	Scarborough and North East Yorkshire Healthcare NHS Trust	RCC	Yes (21)	
6	Sheffield Children's NHS Foundation Trust	RCU		
7	Sheffield Teaching Hospitals NHS Foundation Trust	RHQ		
8	Sherwood Forest Hospitals NHS Foundation Trust	RK5		
9	Shrewsbury and Telford Hospital NHS Trust	RXW		
10	South London NHS Healthcare Trust	RYQ	Yes (22)	
11	South Tees Hospitals NHS Foundation Trust	RTR		
12	South Tyneside NHS Foundation Trust	RE9		
13	South Warwickshire NHS Foundation Trust	RJC		
14	Southend University Hospital NHS Foundation Trust	RAJ		
15	Southport and Ormskirk Hospital NHS Trust	RVY		
16	St George's University Hospitals NHS Foundation Trust	RJ7	Yes	01/02/2015
17	St Helens and Knowsley Hospitals NHS Trust	RBN		
18	Stockport NHS Foundation Trust	RWJ		
19	Surrey and Sussex Healthcare NHS Trust	RTP		
20	Tameside Hospital NHS Foundation Trust	RMP		
21	Taunton and Somerset NHS Foundation Trust	RBA		
22	The Christie NHS Foundation Trust	RBV		
23	The Clatterbridge Cancer Centre NHS Foundation Trust	REN		
24	The Dudley Group NHS Foundation Trust	RNA		
25	The Hillingdon Hospitals NHS Foundation Trust	RAS	Yes	01/04/2011
26	The Newcastle Upon Tyne Hospitals NHS Foundation Trust	RTD		
27	The Princess Alexandra Hospital NHS Trust	RQW		
28	The Queen Elizabeth Hospital, King's Lynn. NHS Foundation Trust	RCX	Yes	01/02/2011
29	The Rotherham NHS Foundation Trust	RFR		
30	The Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust	RDZ		
31	The Royal Marsden NHS Foundation Trust	RPY		
32	The Royal Orthopaedic Hospital NHS Foundation Trust	RRJ		
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3	The Royal Wolverhampton NHS Trust	RL4	Yes (23)	
4	The Walton Centre NHS Foundation Trust	RET		
5	The Whittington Hospital NHS Trust	RKE		
6	Torbay and South Devon NHS Foundation Trust	RA9	Yes (24)	
7	Torbay and South Devon NHS Foundation Trust	RA9	Yes (24)	
8	Trafford Healthcare NHS Trust	RM4	Yes (25)	
9	United Lincolnshire Hospitals NHS Trust	RWD		
10	University College London Hospitals NHS Foundation Trust	RRV		
11	University College London Hospitals NHS Foundation Trust	RRV		
12	University Hospital Of South Manchester NHS Foundation Trust	RM2		
13	University Hospital Southampton NHS Foundation Trust	RHM		Yes 01/10/2011
14	University Hospitals Birmingham NHS Foundation Trust	RRK		
15	University Hospitals Bristol NHS Foundation Trust	RA7		
16	University Hospitals Bristol NHS Foundation Trust	RA7		
17	University Hospitals Coventry and Warwickshire NHS Trust	RKB		
18	University Hospitals Of Leicester NHS Trust	RWE		
19	University Hospitals Of Leicester NHS Trust	RWE		
20	University Hospitals Of Morecambe Bay NHS Foundation Trust	RTX		Yes 01/10/2010
21	University Hospitals of North Midlands NHS Trust	RJE	Yes (26)	
22	Walsall Healthcare NHS Trust	RBK		
23	Warrington and Halton Hospitals NHS Foundation Trust	RWW		
24	Warrington and Halton Hospitals NHS Foundation Trust	RWW		
25	West Hertfordshire Hospitals NHS Trust	RWG		
26	West Middlesex University Hospital NHS Trust	RFW	Yes (27)	
27	West Suffolk NHS Foundation Trust	RGR		Yes 01/12/2011
28	Western Sussex Hospitals NHS Foundation Trust	RYR		Yes 01/07/2013
29	Western Sussex Hospitals NHS Foundation Trust	RYR		Yes 01/07/2013
30	Weston Area Health NHS Trust	RA3		
31	Whipps Cross University Hospital NHS Trust	RGC	Yes (28)	
32	Winchester and Eastleigh Healthcare Trust	RN1	Yes (29)	
33	Winchester and Eastleigh Healthcare Trust	RN1	Yes (29)	
34	Wirral University Teaching Hospital NHS Foundation Trust	RBL		
35	Worcestershire Acute Hospitals NHS Trust	RWP		
36	Wrightington, Wigan and Leigh NHS Foundation Trust	RRF		
37	Wye Valley NHS Trust	RLQ	Yes (30)	
38	Wye Valley NHS Trust	RLQ	Yes (30)	
39	Yeovil District Hospital NHS Foundation Trust	RA4		
40	York Teaching Hospital NHS Foundation Trust	RCB	Yes (31)	

1. Acquired by Royal Free London NHS FT in 2014
2. Merged with Newham University Hospital NHS Trust and Whipps Cross University Hospital NHS Trust to form Barts Health NHS Trust in 2012
3. Formed from the merger of Barts and the London NHS Trust, Whipps Cross University Hospital NHS Trust and Newham University Hospital NHS Trust in 2012
4. Acquired Trafford Healthcare NHS Trust in Apr 2012
5. Acquired West Middlesex University Hospital NHS Trust in Sep 2015
6. Merged with North West London Hospitals NHS Trust to form London North West Healthcare NHS Trust in 2014
7. Formed by merger of Heatherwood and Wexham Park Hospitals NHS FT and Frimley Park Hospital NHS FT on 1 October 2014
8. Formed by acquisition of Winchester and Eastleigh Healthcare Trust by Basingstoke and North Hampshire NHS FT in Jan 2012
9. Merged with Frimley Park Hospital NHS FT to form Frimley Health NHS FT on 1 October 2014
10. Created in Apr 2012 by a provider split from Isle of Wight NHS PCT (5QT)
11. Acquired Princess Royal University Hospital from South London NHS Healthcare Trust's dissolution in Oct 2013
12. Formed on 1 Oct 2013 by merger of merger of Lewisham Healthcare NHS Trust and Queen Elizabeth Hospital (previously part of South London NHS Healthcare Trust)
13. Formed by merger of Ealing Hospital NHS Trust and North West London Hospitals NHS Trust in 2014
14. Mid Staffordshire NHS FT which ran Stafford hospital dissolved In Nov 2014. Stafford hospital renamed to County Hospital and acquired by newly named University Hospitals of North Midlands NHS Trust
15. Merged with Barts and the London NHS Trust and Whipps Cross University Hospital NHS Trust to form Barts Health NHS Trust in 2012
16. Merged with Ealing Hospital NHS Trust to form London North West Healthcare NHS Trust in 2014
17. Formed from Oxford Radcliffe Hospitals NHS Trust by acquisition of Nuffield Orthopaedic Acute Centre NHS Trust in 2011
18. Acquired Barnet and Chase Farm Hospitals NHS Trust in 2014
19. Acquired by Royal United Hospital Bath NHS FT on 1 Feb 2015
20. Acquired Royal National Hospital For Rheumatic Diseases NHS FT on 1 Feb 2015
21. Acquired by York Teaching Hospital NHS Foundation Trust in Jul 2013
22. Dissolved in Oct 2013

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- 3 23. Acquired Cannock Chase Hospital when Mid Staffordshire NHS FT dissolved In Nov 2014
- 4 24. Created on 1 Oct 2015 from South Devon Healthcare NHS Foundation Trust merging with Torbay and Southern Devon Health and Care NHS Trust
- 5 (community and social care services)
- 6
- 7 25. Acquired by Central Manchester University Hospitals NHS FT in Apr 2012
- 8 26. Formed from University Hospital Of North Staffordshire NHS Trust taking over Stafford Hospital (now named County Hospital) on 1 Nov 2014. Mid
- 9 Staffordshire NHS FT which ran Stafford hospital dissolved In Nov 2014
- 10
- 11 27. Acquired by Chelsea and Westminster Hospital NHS FT in Sep 2015
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- 13 28. Merged with Newham University Hospital NHS Trust and Barts and the London NHS Trust to form Barts Health NHS Trust in 2012
- 14
- 15 29. Acquired by Basingstoke and North Hampshire NHS FT to form Hampshire Hospitals NHS FT in Jan 2012
- 16 30. Formed from Hereford Hospitals NHS Trust on 1 April 2011 following Herefordshire's health and adult social care providers joining to form an
- 17 integrated provider of acute, community and social care in England
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- 19 31. Acquired Scarborough and North East Yorkshire Healthcare NHS Trust in Jul 2013
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SENSITIVITY ANALYSES AND ADDITIONAL TABLES

Table A. Assessment of the impact of not adjusting for missing 2011 delayed transfer of care data. Abbreviations: CI, confidence interval.

Delayed transfers of care days per hospital bed	n	Trust clusters	Coefficient	95% CI	p-value
Without adjustment for missing 2011 data	837	148	-21.9	-35.5 to -8.4	0.002
With adjustment for missing 2011 data	837	148	-25.1	-39.1 to -11.0	0.001

Table B. Association of operating margin with outcomes and process measures. Adjusted regression analyses as per table 3 in the manuscript excluding Trusts that had changed in composition between 2011 and 2016. Abbreviations: A&E, Accident & Emergency; SHMI, Summary Hospital-level Mortality Indicator.

Outcome	n	Trust clusters	Coefficient	95% CI	p-value
Readmission rate (%)	344	119	-0.01	-0.03 to 0.01	0.403
Inpatient satisfaction score (out of 10)	706	119	0.66	-0.23 to 1.55	0.142
A&E 4 hour breach rate (%)	710	119	-0.20	-0.30 to -0.11	<0.001
Delayed transfers of care days per hospital bed	711	119	-29.5	-44.1 to -14.8	<0.001
2 week wait cancer target adherence (%)	710	119	0.05	0.00 to 0.10	0.042
62 day cancer treatment target adherence (%)	710	119	0.12	0.02 to 0.23	0.018

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Table C. Association of operating margin with outcomes and process measures (summary model for 2011-13). Operating margin and outcomes were averaged over the 3 years from 2011-13 to form the inputs to the summary model. Readmission rate is not included as data was not available for 2011-13. Abbreviations: A&E, Accident & Emergency; CI, confidence interval.

Agency spend as a proportion of turnover (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	3.9	3.9	4.6	6.0	8.5	9.1
Middle 80%	2.4	2.3	2.6	3.0	4.6	5.1
Best 10%	2.7	2.9	3.4	3.8	4.0	4.5
Ratio of worst to best	1.4	1.3	1.4	1.6	2.1	2.0
Difference (best and worst)	1.2	1.0	1.2	2.2	4.5	4.6

Table D. Outcomes and process measures in Foundation trusts versus non-foundation trusts. Excludes trusts that changed in composition or transitioned to Foundation status during the study period. Values are median (IQR). P-value refers to a Kruskal-Wallis equality-of-populations rank test.

	Foundation trust	Non-foundation trust	p-value
Readmission rate (%)	3.5 (3.0 to 3.9)	3.7 (3.3 to 4.0)	<0.001
Inpatient satisfaction score (out of 10)	8.0 (7.8 to 8.2)	7.8 (7.7 to 8.0)	<0.001
A&E 4 hour target breach rate (%)	5.4 (4.2 to 7.8)	6.9 (4.9 to 10.5)	<0.001
Delayed transfer of care days per hospital bed	6.8 (3.5 to 11.0)	7.0 (4.5 to 11.2)	0.241
Cancer two week wait target adherence (%)	95.5 (94.6 to 96.7)	94.9 (94.0 to 96.3)	<0.001
Cancer 62 days to first treatment target adherence (%)	87.7 (85.4 to 89.7)	86.2 (82.5 to 88.2)	<0.001

Tables E1 & E2. Association of operating margin on outcomes and process measures. Association of operating margin with outcomes and process measures. These estimates are derived from a linear regression with outcome/process measure as the dependent variable and the following independent variables: operating margin, number of beds available and year. Each Trust in each year was treated as a separate observation with standard errors clustered by Trust to account for the non-independence of Trust-level data. Abbreviations: A&E, Accident & Emergency; CI, confidence interval. E1 includes Foundation trusts only. E2 includes non-Foundation trusts only. Trusts that transitioned to Foundation status are excluded in both tables.

Table E1. Association of operating margin on outcomes and process measures in Foundation trusts.

Outcome	n	Trust clusters	Coefficient	95% CI	p-value
Readmission rate (%)	206	71	-0.015	-0.039 to 0.008	0.202
Inpatient satisfaction score (out of 10)	429	73	0.52	-0.46 to 1.49	0.293
A&E 4 hour breach rate (%)	430	73	-0.25	-0.37 to -0.13	<0.001
Delayed transfers of care days per hospital bed	431	73	-21.8	-40.7 to -2.9	0.024
2 week wait cancer target adherence (%)	431	73	0.05	-0.01 to 0.10	0.083
62 day cancer treatment target adherence (%)	431	73	0.08	-0.02 to 0.17	0.110

Table E2. Association of operating margin on outcomes and process measures in non-foundation trusts.

Outcome	n	Trust clusters	Coefficient	95% CI	p-value
Readmission rate (%)	142	51	0.004	-0.023 to 0.032	0.751
Inpatient satisfaction score (out of 10)	318	62	1.59	0.43 to 2.76	0.008
A&E 4 hour breach rate (%)	327	62	-0.23	-0.39 to -0.07	0.005
Delayed transfers of care days per hospital bed	328	62	-39.2	-63.3 to -15.1	0.002
2 week wait cancer target adherence (%)	324	62	0.26	-0.06 to 0.11	0.527
62 day cancer treatment target adherence (%)	324	62	0.22	0.05 to 0.38	0.010

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Financial Performance of English NHS Trusts and Variation in Clinical Outcomes: A Longitudinal Observational Study

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Financial Performance of English NHS Trusts and Variation in Clinical Outcomes: A Longitudinal Observational Study

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1 ABSTRACT

2 3 4 5 Objectives

6 To examine the association between financial performance as measured by operating margin
7 (surplus/deficit as a proportion of turnover) and clinical outcomes in English NHS trusts.
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10 11 Setting

12 Longitudinal, observational study in 149 acute NHS trusts in England between the financial years 2011 and
13 2016.
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16 17 Participants

18 Our analysis focused on outcomes at individual NHS Trust-level (composed of one or more acute hospitals).
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22 23 Primary and secondary outcomes

24 Outcome measures included readmissions, inpatient satisfaction score and the following process measures:
25 emergency department (A&E) waiting time targets, cancer referral and treatment targets, and delayed
26 transfers of care.
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30 31 Results

32 There was a progressive increase in the proportion of trusts in financial deficit: 22% in 2011, 27% in 2012,
33 28% in 2013, 51% in 2014, 68% in 2015 and 91% in 2016. In linear regression analyses, there was no
34 significant association between operating margin and clinical outcomes (readmission rate or inpatient
35 satisfaction score). There was, however, a significant association between operating margin and process
36 measures (delayed transfers of care, A&E breaches and cancer waiting time targets). Between the best and
37 worst financially performing Trusts, there was an approximately 2-fold increase in A&E breaches and
38 delayed transfers of care overall although this variation decreased over the six years. Between the best and
39 worst performing trusts on cancer targets, the magnitude of difference was smaller (1·16 and 1·15-fold),
40 although the variation slowly rose during the six years.
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48 49 Conclusions

50 Operating margins in English NHS trusts progressively worsened during 2011-16, and this change was
51 associated with poorer performance on several process measures but not with hospital readmissions or
52 inpatient satisfaction. Significant variation exists between the best and worst financially performing Trusts.
53 Further research is needed to examine the causal nature of relationships between financial performance,
54 process measures and outcomes.
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STRENGTHS AND LIMITATIONS

- To our knowledge, one of the first empirical exploratory analyses of the relationship between funding and outcomes in the English NHS
- Operating margin may not be the ideal measure of an organisation's financial position
- The proportion of activity at each Trust which is elective, acute or specialised was not taken into account nor was the percentage of activity subject to a national tariff
- There may be additional unmeasured confounders that have impacted the results
- This observational study is limited to demonstrating associations rather than causal links

INTRODUCTION

The combination of higher demand due to ageing, growing populations, with more chronic illness and disability, in addition to rising treatment and technology costs, is driving increased health spending in high-income countries.¹ The National Health Service (NHS) in England is introducing policies to address these demands, attempting to contain costs while improving health outcomes. The NHS Five Year Forward View, published in October 2014, set out a strategic vision for sustaining a high-quality, comprehensive health system in England.² Specifically, it identified a £22 billion funding gap by 2020/21, based on the current funding trajectory of the NHS, to be met by ambitious efficiency savings of 2-3% annually (given a long-term track-record of 1% each year).

The call for increased efficiency comes in an austere climate, in which individual NHS Trusts are progressively challenged to achieve financial control,^{3,4} while responding to high demand, especially in winter months, reported widely in the British media.⁵ NHS Improvement, the body responsible for overseeing Trust performance, reported an overall third quarter deficit of £886 million for the 2016-17 financial year, £300 million higher than the planned target.⁶ Higher demand for services, with rising emergency attendances and admissions, and delayed transfers of care (DTOCs), have been cited as key reasons for increasing deficit.⁷ While control of Trust financial deficits is important for sustainability of the NHS, there are concerns on the adverse impact of worsening financial performance on clinical outcomes and processes,⁸ but few studies which have explored this relationship.

We investigated the relationship between operating margin (surplus/deficit as a proportion of turnover) at English NHS Trusts during 2011-16, with outcomes and process measures. We selected performance measures that are commonly used for benchmarking performance of NHS Trusts and that could plausibly be related to quality, namely, hospital readmissions, inpatient satisfaction scores, emergency department waiting time targets, cancer referral and treatment targets, and delayed transfers of care.⁹ Lastly, we

1 investigated the variation in outcome and process measures between the financially best and worst
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3 performing Trusts, both overall and over time.
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METHODS

Data sources and extraction

NHS Hospitals in England are categorised into financially and operationally distinct legal entities known as Trusts, which deliver services on behalf of the NHS. Trusts may be located at multiple sites and can be responsible for one or more hospitals. Well-performing Trusts are able to gain Foundation status, which allows a degree of financial and operational autonomy from the Department of Health. Data was sought for acute NHS Trusts in the 6-year period encompassing the financial years from April 2010 to March 2016.

We obtained financial data for Trusts from the gov.uk open data portal.¹⁰ Where information was lacking for specific Trusts, we sought the original data from the published accounts available on individual Trust websites or from NHS 'The Quarter' reports.¹¹

Data on four financial metrics were extracted and examined: first, the retained surplus/deficit for the financial year; second, the turnover for the Trust (calculated as "Revenue from patient care activities" and "Other operating revenue"); third, trust spend on agency staff, and fourth, spend on consultancy. The precise table IDs and sub-codes for extraction are detailed in the online Supplementary Appendix. Only the first two metrics are measures of financial performance. The second two reflect Trust spending choices and we included these as exploratory variables given the public and media interest in rising agency and consultancy spend.

Bed availability for the quarter preceding the end of each financial year was obtained from publicly available NHS England data¹² with occupancy rate calculated as the percentage of beds (as a proportion of total available) occupied on average during that quarter. Teaching status of the trusts was defined dichotomously on the basis of membership of The Association of UK University Hospitals.¹³ For each NHS Trust, the postcode of the Trust was extracted and used as a proxy for location to calculate the region of the country in which the trust hospitals were located.

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3 This postcode data were matched to the 2015 Indices of Multiple Deprivation (IMD) score.¹⁴ The Office for
4 National Statistics uses UK census data to generate the IMD score which encompasses census information
5 from the following domains: income, employment, crime, living environment, health deprivation and
6 disability, education and skills/training, barriers to housing and services.
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13 Using publicly available NHS England datasets, we obtained data on hospital activity in the form of number
14 of annual admissions per Trust and annual outpatient attendances.¹⁵ Data on last-minute elective operation
15 cancellations (for non-clinical reasons) and the number of such patients not being treated within 28 days of
16 such a cancellation were also extracted from publicly available NHS England datasets.¹⁵
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24 **Outcome measures**

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26 The outcomes we measured consisted of two clinical measures and three process measures that are
27 commonly used for benchmarking NHS Trusts and have plausible mechanisms for a relation to quality. We
28 openly acknowledge that there are several other outcomes and process measures which may also relate to
29 quality and could have been chosen. Our selection was based on a combination of logistical constraints (i.e.
30 what data was publicly available) and an effort to include measures which are commonly used for
31 benchmarking trusts and thereby also reported in the mainstream media.⁹
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41 The clinical measures were (i) the proportion of discharges readmitted as an emergency within 7 days of
42 discharge and (ii) annual overall patient satisfaction for each trust using data from the National Adult
43 Inpatient Survey compiled by the Care Quality Commission.¹⁶ Data on readmissions was only available for
44 the years 2014-16. The three process measures were: (i) Accident and Emergency (A&E) 4-hour waiting
45 time breaches (ii) delayed transfers of care from an acute Trust, and (iii) cancer waiting time targets.
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1 The first process measure, Accident and Emergency (A&E) 4-hour waiting time breaches, was defined as
2 the percentage of patient attendances in type 1 departments (major A&E) who waited greater than four
3 hours from arrival to admission, transfer or discharge.
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9 The second process measure, a delayed transfer of care from an acute Trust, was said to occur when a
10 patient was ready to depart from acute care but was still occupying a bed. These data were extracted as
11 'total number of bed days attributed to delayed transfers of care' and standardised to number of beds
12 available in the Trust. Delayed transfer of care data were only available for the latter eight months of the
13 2011 financial year. To ensure comparability with other years, a 1.5x multiplier was applied for each trust in
14 this financial year (see online Supplementary Appendix for further details). No other missing data in the
15 study was imputed.
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26 For the third process measure, cancer waiting time targets, we assessed two specific targets (a) the
27 proportion of patients who received a first consultant appointment within two weeks of urgent referral for
28 suspected cancer by their General Practitioner (GP) and (b) the proportion of patients who commenced a
29 first treatment for cancer within 62 days of being urgently referred by their GP.
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37 **Unit of analysis**

38 Our analysis focused on the outcomes at individual NHS Trust-level (composed of one or more acute
39 hospitals).
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45 **Statistical analysis**

46 Our financial metric of interest was the annual Trust operating margin. Similarly to prior literature,¹⁷⁻¹⁹ we
47 defined operating margin as the retained surplus (or deficit) for the Trust in a financial year divided by the
48 turnover (turnover being calculated as "Revenue from patient care activities" and "Other operating
49 revenue"). This value was winsorised to set all outliers beyond the 2.5th and 97.5th percentiles to the values
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1 at these percentiles. We first calculated summary statistics of the operating surplus/deficit and metrics of
2 trust characteristics, breaking the sample into 4 groups of deciles by Trust margin.
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7 As a second step, we compared the variation in process and outcome measures between the financially
8 best and worst performing trusts as categorised by operating margin decile (highest versus lowest). Third,
9 we performed multiple linear regression with our outcomes as the dependent variable and the following
10 independent variables: operating margin, number of beds available and year. Each Trust in each year was
11 treated as a separate observation with standard errors clustered by Trust to account for the non-
12 independence of Trust-level data.
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22 Fourth, we compared outcomes and process measures between 'struggling' and 'non-struggling' Trusts. For
23 this purpose, a struggling Trust was defined as either: (i) in financial or quality special measures as of
24 December 2016 or (ii) a Foundation Trust subject to enforcement actions by Monitor as of September 2016.
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27 Fifth, we investigated the relationships between delayed transfers of care, cancelled elective operations,
28 agency spend, A&E breaches and operating margin by assessing correlation between these variables over
29 an early period (2011-12) and a late period (2015-16).
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37 We performed sensitivity analyses to assess the impact of (i) adjustment for missing 2011 delayed transfer
38 of care data and (ii) inclusion of Trusts that had changed in composition during the study period.
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43 All reported p -values are two sided with the statistical significance threshold set to a p -value of less than
44 0.05. Given the hypothesis generating nature of this study, no corrections were made for multiple
45 comparisons. Approximately 1 in every 20 comparisons could be expected to achieve statistical significance
46 by chance alone. All analyses were performed using STATA statistical software version 12.1 (College
47 Station, TX). This study had no external funding source.
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56 Patient involvement

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1 Patients were not involved in any aspect of the study design, conduct or in the development of the research
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3 question or outcome measures. This study was a retrospective longitudinal observational study of publicly
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5 available Trust-level data and therefore there was no active patient recruitment for data collection or
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7 requirement for ethical approval.
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RESULTS

Over the 6-year period of study, encompassing the financial years from April 2010 to March 2016, there were changes in the composition to 31 of 149 Trusts. These are detailed in the online Supplementary Appendix and took the form of creation of a new Trust, dissolution of an existing Trust, acquisitions of a hospital or entire Trust to another Trust and mergers between Trusts. 13 Trusts (9%) transitioned to Foundation Status during the 6-year study period. Of the remaining 136 Trusts, 63 (42%) were non Foundation Trusts and 73 (49%) were Foundation Trusts.

There was a progressive increase in the proportion of Trusts in deficit over the 6-year study period: 22% in 2011, 27% in 2012, 28% in 2013, 51% in 2014, 68% in 2015 and 91% in 2016. The distribution of average operating surplus/deficit over the study period is displayed in Figure 1. Operating surplus/deficit varied widely across Trusts ranging from -£250 million to £181 million over the six years. Median operating surplus/deficit over the study period was -£3.8 million (IQR -£8.7 million to -£0.7 million, range -£63.1 million to £32.6 million). Median operating margin over the study period was -1.1% (IQR -2.7% to -0.2%, range -42.5% to 4.6%). Median operating margin was higher in teaching Trusts compared to non-Teaching Trusts (-0.5% versus -1.4%, $p=0.002$) and lowest in the Midlands compared to other regions (-2.3% in the Midlands, -1.2% in London, -0.8% in the South, -1.0% in the North; $p=0.028$).

During the 6-year study period, there was a nationwide decline in overnight general and acute beds from 110,568 to 103,422 (6.5% reduction) with a concomitant increase in day only beds from 11,572 to 12,207 (5.5% increase).

Trust metrics are shown in Table 1 stratified by decile of operating margin. Between the best and worst financially performing Trusts, there was an approximately 1.75-fold and 2-fold increase in agency and consultancy spend respectively as a proportion of turnover. The best financially performing Trusts also had a 1.5-fold higher annual number of outpatient attendances. In contrast, the annual number of admissions,

1 bed occupancy rates, local deprivation scores and proportion of Foundation Trusts were broadly similar
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3 between the best and worst performing Trusts. The proportion of Trusts with teaching status increased
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5 throughout deciles of operating margin. Trends in the variation of operating margin over time with clinical
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7 outcomes and process measures are displayed in figures 2 and 3 respectively.
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11 Clinical outcomes and process measures, stratified by decile of operating margin, are shown in table 2.
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13 Between the best and worst financially performing Trusts, there was an approximately 2-fold increase in
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15 A&E breach rates and delayed transfers of care. In contrast, despite significant differences between the best
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17 and worst performing trusts on cancer targets, the magnitude of difference was smaller (both approximately
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19 1.15-fold).
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24 Trends in the variation between the best and worst financially performing Trusts over time for both clinical
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26 outcomes and process measures are shown in table 3. There was no appreciable variation in readmission
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28 rate or inpatient satisfaction score with the latter increasing over time at a slightly faster rate in the worst
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30 financially performing Trusts.
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35 Performance on process measures in both the best and worst financially performing Trusts deteriorated
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37 over time (table 3). However, variation between the best and worst groups narrowed for A&E breaches,
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39 returned to baseline for delayed transfers of care after an initial rise, and rose slowly for both cancer target
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41 breaches. The variation in agency spend as a proportion of turnover between the best and worst financially
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43 performing trusts increased substantially between 2011 (best 2.7% and worst 3.9%, difference 1.2%) and
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45 2016 (best 4.5% and worst 9.1%, difference 4.6%) (see table A in online Supplementary Appendix).
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50 In our linear regression analyses, there was no significant association between operating margin and clinical
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52 outcomes (readmission rate or inpatient satisfaction score; table 4). There was, however, a significant
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54 association between operating margin and process measures (delayed transfers of care, A&E breaches and
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56 cancer waiting time targets; table 4). Trusts defined as struggling (i.e. in special measures or subject to
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1 enforcement action) were associated with worse performance on all process measures but not with
2 readmission rate or inpatient satisfaction scores (table 5). Foundation Trusts were associated with better
3 performance on clinical outcomes and all process measures except delayed transfers of care (see table B in
4 online Supplementary Appendix). Broadly speaking, the associations between operating margins and
5 outcomes/process measures were not as strong for Foundation Trusts as non-Foundation Trusts (see
6 tables C1 & C2 in online Supplementary Appendix).
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16 The associations between delayed transfers of care, elective surgery cancellations, agency spend, A&E
17 breaches and operating margins are displayed in a correlation matrix for the early years (2011 and 2012;
18 figure 4) and the later years (2015 and 2016; figure 5) of the six year study period (same scale applied to
19 both figures 4 and 5). There was weak positive correlation between all factors except operating margin for
20 which there was weak negative correlation with the other measures. These associations were maintained in
21 the later years though with a greater spread among trusts.
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30 Sensitivity analyses are reported in the online Supplementary Appendix. There was no change to the results
31 with and without adjustment for missing 2011 delayed transfer of care data (Table D in online
32 Supplementary Appendix). There was no change to the results when excluding Trusts that had changed in
33 composition over the study period (Table E in online Supplementary Appendix).
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DISCUSSION

Principal findings

Our study has a number of important findings. First, in the period 2011-16, there was a substantial increase in the proportion of NHS Trusts with negative operating margins. Second, the overall variation between the best and worst financially performing Trusts was larger for A&E breach rates and delayed transfers of care than for cancer targets. Third, the variation over time between the best and worst financially performing trusts was static for clinical outcomes and mixed for process measures (decreased over the six years for A&E breaches, was static for delayed transfers of care while increasing slightly for cancer targets). Fourth, there was a significant association between worsened operating margin and deteriorating process measures (four-hour A&E targets, cancer waiting time targets and delayed transfers of care), but not between operating margin and either readmission rates or inpatient satisfaction scores.

Comparison with other studies

The extant literature on the association between financial performance and outcomes comes primarily from the United States (US) and is mixed in pronouncement. Volpp and colleagues assessed the impact of a budget act reducing Medicare reimbursements on processes of care for acute myocardial infarction (MI).²⁰ They found that while the budget act added moderate financial strain to organisations, there was no appreciable worsening of care with respect to MI processes of care or mortality in 236,506 patients from 208 hospitals. An analysis by Bazzoli and colleagues in 2008 concluded that while there may be an association between some measures of financial performance and adverse events, it was much weaker than previously reported by Encinosa and Bernard who found a concerning association between frequency of patient safety alerts and operating margin.^{17,18} Further, a study by Ly and colleagues in over 3,000 US hospitals found that low hospital margins were associated with worse processes of care and higher readmissions, although not with higher mortality.²¹

1 Placing our findings in the context of earlier studies requires extreme caution given the differences between
2 the US and UK health systems. Specifically, Ly et al. excluded public hospitals (which comprise the vast
3 majority of English hospitals) from their analysis. However, these prior studies do highlight the difficulty in
4 disentangling the relationship between financial performance and outcomes. Meanwhile, a large European
5 cohort study revealed that attempts to save money by cutting nurse to patient ratios may adversely affect
6 patient outcomes.²² An increase in a nurses' workload by one patient increased the likelihood of a 30-day
7 inpatient death by 7% (odds ratio 1.07, 95% CI 1.03 to 1.11).²²

17 **Study limitations**

18 Our findings must be borne in light of several study limitations. First, while we had access to a considerable
19 volume of data, the granularity of data was limited. For example, our unit of analysis was at the Trust level,
20 giving a sample size of approximately 149 compared to equivalent US studies that have analysed over 3000
21 hospitals.²¹ Lack of 'high-frequency' data also prevented us performing interrupted time-series and time-lag
22 analyses.

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33 Second, it may be that operating margin is not the ideal measure of an organisation's financial position. A
34 Trust's deficit may be exaggerated if it realises that a deficit is unavoidable and careful accounting allows for
35 a larger than necessary deficit in one year to ensure a small surplus in the following year (as opposed to two
36 years of deficit); potential gamification.²³ Organisations including NHS Improvement and the Department of
37 Health typically use breakeven performance figures instead of operating surplus/deficits. We chose not to
38 use such figures as the data were not easily available at Trust level for much of the period under
39 investigation.

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49 Third, we utilised only a small selection of existing clinical outcomes and process. This decision was driven
50 by two factors. Logistically, there is limited public access to many clinical outcomes. While there is access to
51 many process measures, we opted for a small selection that is commonly used for benchmarking trusts (i.e.
52 often quoted in media reports and receive major public scrutiny) so as to avoid the issues of multiple

1 comparisons. It is entirely possible that other process measures may well display differing relationships with
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3 respect to operating margins.
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7 Fourth, we did not take into account the proportion of activity at each Trust which is elective, acute or
8 specialised nor did we assess the percentage of activity subject to a national tariff. Work from the Health
9 Foundation in 2016 suggests a link between financial performance and the proportion of Trust income
10 arising from activities subject to the national tariff.²⁴ Reimbursement prices for specialist activity tend to be
11 higher than average treatment costs. Furthermore, best practice tariffs tend to reward more efficient
12 treatment delivery such as an increased proportion of day cases. Although there is likely to be correlation
13 between teaching hospital status (which we did assess) and the share of activity subject to a specialised
14 services tariff, this is nonetheless a crude proxy.
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26 Fifth, there may be additional unmeasured confounders that have impacted on our results. For example,
27 surrounding Primary Care systems may impact on the efficiency with which the acute Trusts function. Or
28 alternatively, competition from independent sector treatment centres (ISTCs) may lead to a loss of revenue
29 and market share for some Trusts, who may then need to invest more of their operating funds in attracting
30 patients, especially given an increasing emphasis on patient choice and the freedom for patients to select
31 hospitals by publicly reported outcomes. We adjusted for hospital size in the form of number of beds as well
32 as using operating margin as a more standardised measure of financial performance than gross surplus or
33 deficit (as turnover showed wide variation between trusts). Trusts that treat greater volumes of patients may
34 benefit from economies of scale. However, as with any observational research, we cannot fully discount the
35 impact of confounding on our results. For example, financial underperformance may be a signal of general
36 underperformance in a Trust where clinical and other functions that might be suboptimal affect outcomes.
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49 Sixth, we are limited to demonstrating associations rather than causal links.
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54 **Conclusions and policy implications**

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1 Notwithstanding limitations, our findings have important ramifications for clinical leads, managers and policy
2 makers. The relationship between financial performance and clinical outcomes is far more complex and
3 associated with myriad other factors which will vary among Trusts. This is highlighted in a 2017 briefing from
4 the Nuffield Trust which discusses the current financial health of Trusts and attempts to predict what is likely
5 to occur in the coming years.²³ Trusts with financial deficits may be spending more than they can afford (for
6 example, on extra nursing staff) and one could therefore argue that higher quality should be expected for
7 this extra financial outlay. Conversely, the existence of such deficit might instead indicate reduced efficiency
8 and challenged management. Alternatively, financial penalties due to poor clinical performance or financial
9 management could exacerbate deficits. For example, marginal rate payment reductions for emergency
10 admissions, penalties for readmissions and withholding payment for cases resulting in never events.
11 Attempts to redress this balance may inadvertently lead to reflex spending cuts and poorer quality care. The
12 role of clinical leads, management and leadership within a Trust is likely to be a key contributor to how
13 financial deficits impact quality of care. For example, cutting down on management personnel to save costs
14 may result in worse productivity if clinicians have to allocate more time to administrative activities and away
15 from revenue producing clinical activities. In this regard, it is interesting that the associations between
16 operating margins and outcomes/process measures were not as strong for Foundation versus non-
17 Foundation Trusts. It may be that an earlier move to new reimbursement and funding models exposed
18 Foundation Trusts to financial stress that inoculated them to some extent against later financial pressures.
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41 There are a number of specific points to consider also. First, there is substantial variation between Trusts,
42 which in some cases is worsening. Between the best and worst financially performing Trusts, there are up-to
43 2-fold differences in agency spend, delayed transfers of care, A&E breaches and cancer waiting times. This
44 is notable and needs to be explicitly tackled with greater efficacy. While national regulators such as the Care
45 Quality Commission (CQC) and NHS Improvement do seek to support challenged Trusts, the effectiveness
46 of this has not necessarily translated into improved performance metrics. An argument could also be made
47 that although the magnitude of difference in cancer targets was smaller than for A&E breaches, there may
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1 be greater concern from even small increases in cancer waiting times compared to A&E breaches which
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3 include less severe illnesses.
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7 Second, the lack of significant association between operating margin and either readmissions or inpatient
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9 satisfaction may suggest that clinical outcomes are more resilient to financial pressures than process
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11 measures, or that the driver for such clinical metrics is not predominantly financial-based. Third, the recent
12
13 narrowing of variation between the best and worst performing Trusts on the measures of A&E targets and
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15 delayed transfers of care, may be a cause for concern, suggesting that now even the best financially
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17 performing Trusts are struggling to manage demand. This indicates that a more system-wide approach to
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19 demand-management and improving Trust performance may be required to address the identified
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21 deteriorations, given the entire Trust cohort is now showing signs of deterioration. Stated plainly, it seems
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23 that even if best practice is adopted from the most well managed Trusts, demands on secondary and tertiary
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25 care may not be adequately addressed.
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30 Finally, studies assessing the micro level spending decisions by Trusts when confronted by financial
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32 pressures may lend more insight into the causal pathway and suggest appropriate targets for intervention
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34 (see figure A in in online Supplementary Appendix).
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39 **Summary**

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41 Notwithstanding limitations, our results demonstrate that operating margins at English NHS Trusts have
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43 progressively worsened over 2011-16, and that this change correlates with poorer Trust performance on a
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45 range of widely benchmarked process measures, but not significantly with readmissions or inpatient
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47 satisfaction. The variation between the best and worst financially performing Trusts was larger for A&E
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49 breach rates and delayed transfers of care than for cancer targets but showed differing patterns of variation
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51 over time. The causal nature of relationships between financial performance, process measures and
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53 outcomes remains difficult to disentangle.
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COMPETING INTERESTS STATEMENT

All authors have completed the ICMJE uniform disclosure at [ww.icmje.org/coi_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf). Mahiben Maruthappu serves as NHS England's Innovation Adviser and is a co-founder of Cera, a technology-enabled homecare provider. All authors declare no support from any organisation for the submitted work, no financial relationships with any organisations that might have an interest in the submitted work in the previous three years and no other relationships or activities that could appear to have influenced the submitted work.

CONTRIBUTORSHIP

MN and MM conceived the study. RR and RA had critical input into study direction and interpretation. MN and GK extracted and sorted data for the study. MN performed the analysis and wrote the first draft of the manuscript. All authors (MN, GK, RR, RA, MM) contributed to critical revision of the manuscript for important intellectual content and approved the final version. MN and MM are the guarantors.

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DATA SHARING

Raw data and analysis available on request from authors.

TRANSPARENCY STATEMENT

The study guarantors (MN and MM) affirm that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

ETHICS

No ethical approval required as retrospective longitudinal observational study of publicly available Trust-level data.

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FIGURE LEGENDS

Figure 1. Distribution of average operating surplus/deficit over the 2011-16 period.

Figure 2. Trends in operating margin and clinical outcomes over time.

Figure 3. Trends in operating margin and process measures over time. Abbreviations: A&E, Accident & Emergency.

Figure 4. 2011-12 correlation between delayed transfers of care, elective operation cancellations, agency spend, A&E breaches and operating margin. Elective surgery cancellations are last-minute elective operation cancellations (for non-clinical reasons) standardised in this figure to number of available beds at the Trust (as a proxy for hospital capacity). Agency spend is displayed as a proportion of turnover. Operating margin is as defined in study methods. Abbreviations: A&E, Accident & Emergency; DTOC, delayed transfer of care.

Figure 5. 2015-16 correlation between delayed transfers of care, elective operation cancellations, agency spend, A&E breaches and operating margin. Elective surgery cancellations are last-minute elective operation cancellations (for non-clinical reasons) standardised in this figure to number of available beds at the Trust (as a proxy for hospital capacity). Agency spend is displayed as a proportion of turnover. Operating margin is as defined in study methods. Abbreviations: A&E, Accident & Emergency; DTOC, delayed transfer of care.

TABLE LEGENDS

Table 1. Trust metrics by decile of Trust operating margin. Higher deprivation score indicates more deprivation.

Table 2. Outcomes and process measures by decile of Trust operating margin. Values are median (IQR). P-value refers to a one-way analysis of variance (ANOVA) test. Abbreviations: A&E, Accident & Emergency.

Table 3. Variation in outcomes and process measures over time by Trust financial performance. 'Best 10%' refers to Trusts with operating margins in the top 10% of the sample. 'Worst 10%' refers to Trusts with operating margins in the bottom 10% of the sample.

Table 4. Association of operating margin with outcomes and process measures. These estimates are derived from a linear regression with outcome/process measure as the dependent variable and the following independent variables: operating margin, number of beds available and year. Each Trust in each year was treated as a separate observation with standard errors clustered by Trust to account for the non-independence of Trust-level data. Abbreviations: A&E, Accident & Emergency; CI, confidence interval.

Table 5. Outcomes and process measures in trusts struggling (i.e. in special measures or subject to enforcement action) versus those that are not. Values are median (IQR). P-value refers to a Kruskal-Wallis equality-of-populations rank test.

Table 1. Trust metrics by decile of Trust operating margin.

	Operating margin			
	Bottom 10%	11-50%	51-89%	Top 10%
Operating surplus / deficit (£ millions, median (range))	-30.9 (-61.1 to -12.4)	-6.3 (-63.1 to -1.2)	-1.5 (-13.8 to 6.8)	5.4 (1.3 to 32.6)
Agency spend as proportion of turnover (%)	6.9 (2.0)	4.8 (2.4)	3.8 (2.0)	3.9 (1.2)
Consultancy spend as proportion of turnover (%)	0.96 (0.54)	0.44 (0.35)	0.45 (0.74)	0.46 (0.29)
Annual admissions, mean (SD)	26,978 (9,698)	29,006 (13,326)	36,411 (21,300)	30,445 (12,455)
Annual outpatient attendances, mean (SD)	271,508 (109,938)	295,223 (142,784)	374,266 (210,861)	407,595 (209,956)
Bed availability, mean (SD)	716 (267)	718 (321)	822 (387)	740 (226)
Bed occupancy (%)	90.1	88.3	87.2	88.1
Deprivation score, mean (SD)	23.4 (11.8)	19.2 (13.2)	23.3 (14.6)	23.5 (11.9)
Teaching trust (%)	6.7	17.0	33.3	35.7
Foundation status (%)				
Non-foundation trust	40.0	49.2	35.0	42.9
Foundation trust	53.3	47.5	50.0	50.0
Transitioned to Foundation	6.7	3.4	15.0	7.1
Region (%)				
London	20	17	17	21
South	20	17	38	7
Midlands	40	36	15	29
North	20	31	30	43

Table 2. Outcomes/process measures by decile of Trust operating margin.

	Operating margin				p-value
	Bottom 10%	11-50%	51-89%	Top 10%	
Readmission rate (%)	3.6 (3.4 to 3.9)	3.6 (3.1 to 3.9)	3.7 (3.2 to 4.0)	3.3 (3.0 to 3.8)	0.137
Inpatient satisfaction score (out of 10)	8.0 (7.8 to 8.2)	8.0 (7.8 to 8.2)	7.9 (7.7 to 8.1)	7.9 (7.7 to 8.2)	<0.001
4 hour A&E target breach rate (%)	10.2 (6.7 to 15.1)	6.7 (4.9 to 10.7)	5.3 (4.2 to 7.3)	5.3 (3.9 to 6.7)	<0.001
Delayed transfer of care days per hospital bed	11.1 (6.0 to 17.1)	7.4 (4.5 to 10.9)	6.5 (3.7 to 11.0)	5.7 (2.6 to 8.1)	<0.001
Cancer two week wait target adherence (%)	94.9 (93.2 to 96.2)	95.5 (94.2 to 96.7)	95.4 (94.4 to 96.7)	95.6 (95.0 to 96.5)	0.009
Cancer 62 days to first treatment target adherence (%)	86.2 (81.9 to 88.2)	86.6 (83.6 to 89.1)	87.6 (85.6 to 89.6)	88.0 (86.3 to 89.9)	<0.001

Table 3. Variation in outcomes and process measures over time by Trust financial performance.

Readmissions (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	-	-	-	3·6	3·7	3·8
Middle 80%	-	-	-	3·4	3·6	3·6
Best 10%	-	-	-	3·4	3·5	3·6
Ratio of worst to best	-	-	-	1·1	1·0	1·1
Difference (best and worst)	-	-	-	0·2	0·1	0·2
Inpatient satisfaction survey (score out of 10)						
	2011	2012	2013	2014	2015	2016
Worst 10%	7·5	7·7	7·9	7·9	8·0	8·0
Middle 80%	7·7	7·8	7·9	8·0	8·1	8·1
Best 10%	7·8	7·8	7·9	8·0	8·1	8·1
Ratio of worst to best	1·0	1·0	1·0	1·0	1·0	1·0
Difference (best and worst)	0·3	0·1	0·0	0·1	0·1	0·1
Accident & Emergency breach rate (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	8·2	6·4	7·8	7·8	11·9	13·6
Middle 80%	5·2	4·9	6·0	6·3	9·3	12·0
Best 10%	4·2	4·5	5·5	5·9	7·5	10·4
Ratio of worst to best	2·0	1·4	1·4	1·3	1·6	1·3
Difference (best and worst)	4·0	1·9	2·3	1·9	4·4	3·2
Delayed transfers of care days						
	2011	2012	2013	2014	2015	2016
Worst 10%	5,077	6,657	7,248	6,972	7,813	8,284
Middle 80%	4,851	5,082	5,558	6,046	7,311	8,044
Best 10%	3,850	3,722	3,884	3,932	5,712	6,477
Ratio of worst to best	1·3	1·8	1·9	1·8	1·4	1·3
Difference (best and worst)	1,227	2,935	3,364	3,040	2,101	1,807
Cancer two week wait target breach rate (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	4·2	4·2	4·6	4·8	6·2	5·9
Middle 80%	4·3	3·9	4·3	4·4	5·7	5·5
Best 10%	4·6	4·1	4·0	4·6	5·9	5·2
Ratio of worst to best	0·9	1·0	1·2	1·0	1·1	1·1
Difference (best and worst)	-0·4	0·1	0·6	0·2	0·3	0·7
Cancer 62 days to first treatment breach rate (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	11·9	11·7	12·2	13·7	16·6	18·3
Middle 80%	12·1	12·0	12·2	13·4	15·6	16·2

Best 10%	11.9	11.7	10.0	11.7	13.5	15.2
Ratio of worst to best	1.0	1.0	1.2	1.2	1.2	1.2
Difference (best and worst)	0.0	0.0	2.2	2.0	3.1	3.1

Table 4. Association of operating margin on outcomes and process measures.

Outcome	n	Trust clusters	Coefficient	95% CI	p-value
Readmission rate (%)	387	135	-0.012	-0.029 to 0.005	0.164
Inpatient satisfaction score (out of 10)	825	148	0.80	-0.06 to 1.67	0.067
A&E 4 hour breach rate (%)	835	148	-0.24	-0.33 to -0.15	<0.001
Delayed transfers of care days per hospital bed	837	148	-25.1	-39.1 to -11.0	0.001
2 week wait cancer target adherence (%)	833	148	0.05	0.00 to 0.09	0.031
62 day cancer treatment target adherence (%)	833	148	0.12	0.03 to 0.21	0.009

Table 5. Outcomes and process measures in trusts struggling (i.e. in special measures or subject to enforcement action) versus those that are not.

	Struggling trust	Non-struggling trust	p-value
Readmission rate (%)	3.6 (3.1 to 3.9)	3.7 (3.1 to 3.9)	0.285
Inpatient satisfaction score (out of 10)	7.9 (7.8 to 8.1)	7.9 (7.8 to 8.1)	0.378
A&E 4 hour target breach rate (%)	6.8 (5.2 to 10.2)	5.5 (4.2 to 8.3)	<0.001
Delayed transfer of care days per hospital bed	8.2 (4.5 to 11.9)	6.4 (4.0 to 10.4)	0.005
Cancer two week wait target adherence (%)	95.1 (94.0 to 96.4)	95.5 (94.4 to 96.8)	0.002
Cancer 62 days to first treatment target adherence (%)	86.6 (83.7 to 88.9)	87.4 (84.8 to 89.6)	0.002

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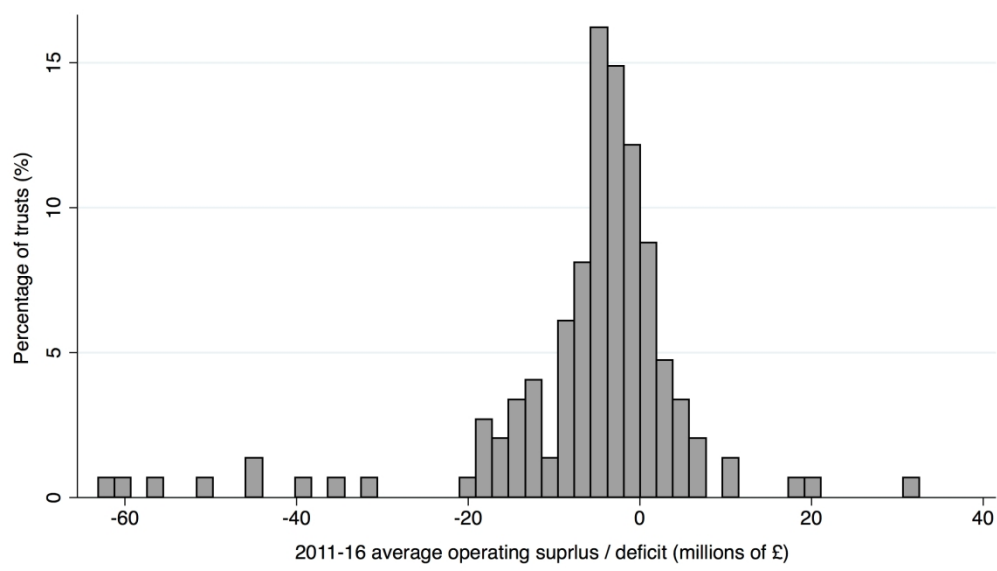


Figure 1. Distribution of average operating surplus/deficit over the 2011-16 period.

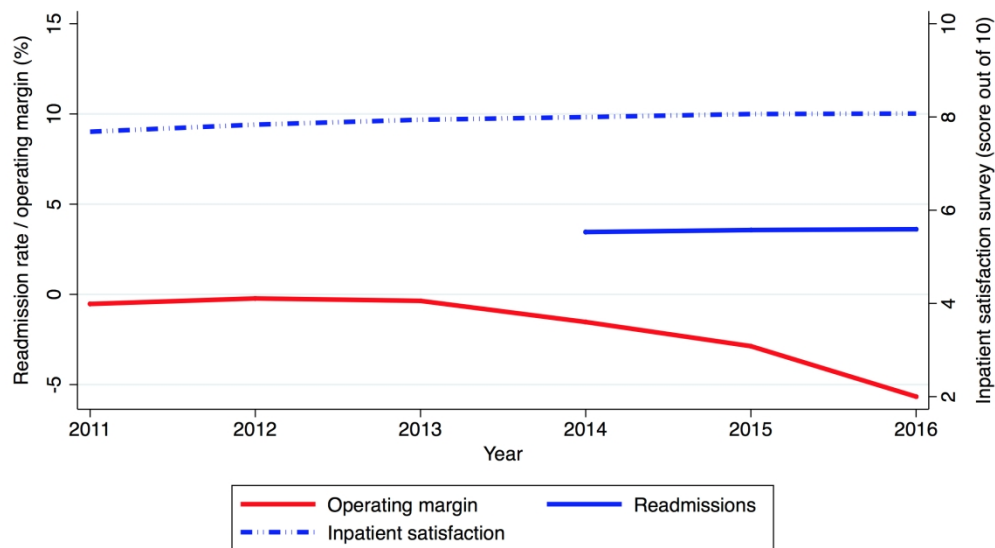


Figure 2. Trends in operating margin and clinical outcomes over time.

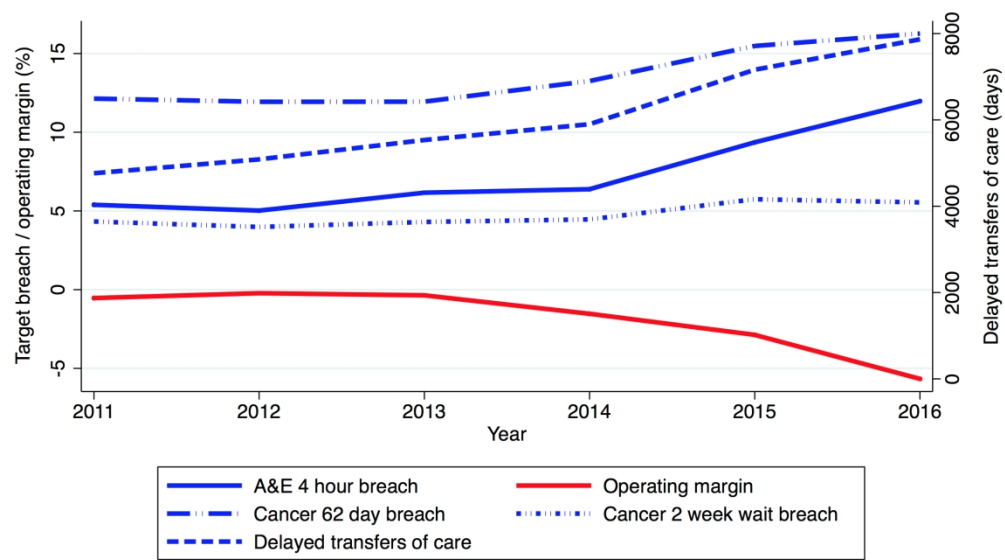


Figure 3. Trends in operating margin and process measures over time. Abbreviations: A&E, Accident & Emergency.

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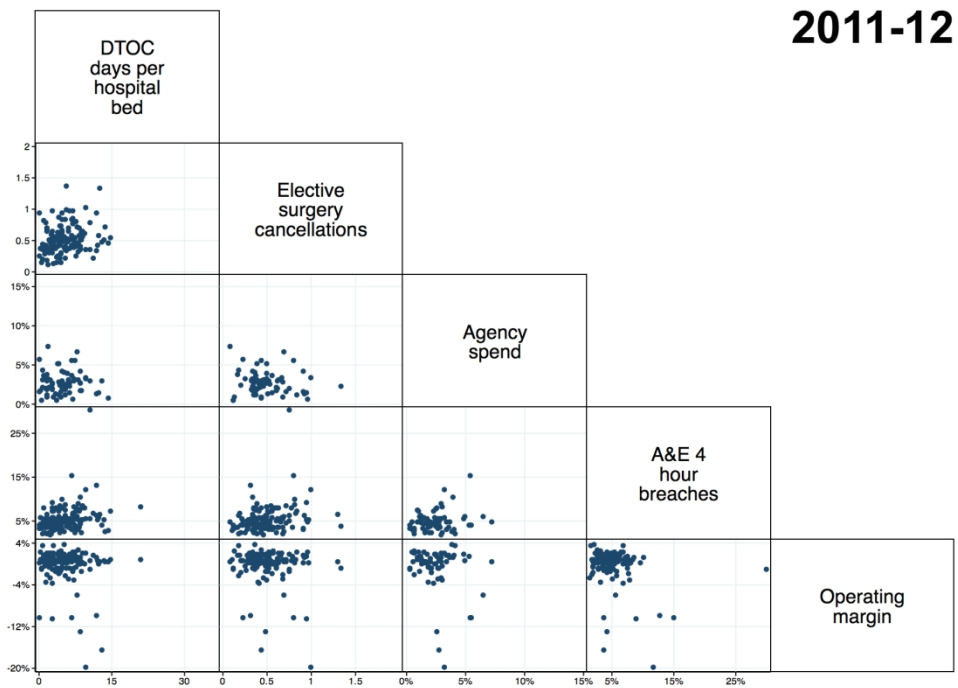


Figure 4. 2011-12 correlation between delayed transfers of care, elective operation cancellations, agency spend, A&E breaches and operating margin. Elective surgery cancellations are last-minute elective operation cancellations (for non-clinical reasons) standardised in this figure to number of available beds at the Trust (as a proxy for hospital capacity). Agency spend is displayed as a proportion of turnover. Operating margin is as defined in study methods. Abbreviations: A&E, Accident & Emergency; DTOC, delayed transfer of care.

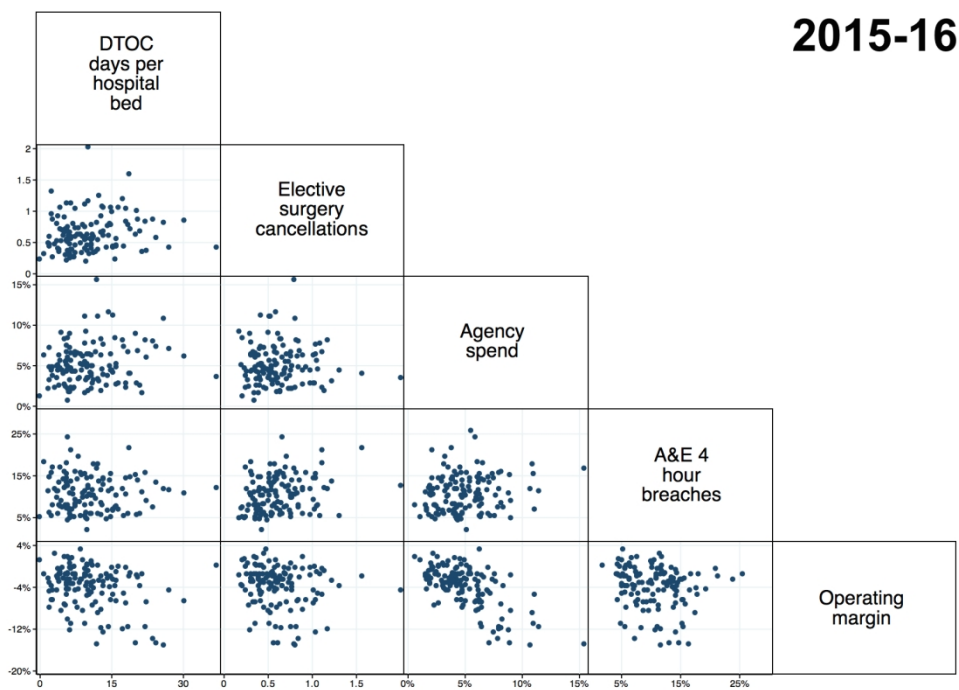


Figure 5. 2015-16 correlation between delayed transfers of care, elective operation cancellations, agency spend, A&E breaches and operating margin. Elective surgery cancellations are last-minute elective operation cancellations (for non-clinical reasons) standardised in this figure to number of available beds at the Trust (as a proxy for hospital capacity). Agency spend is displayed as a proportion of turnover. Operating margin is as defined in study methods. Abbreviations: A&E, Accident & Emergency; DTOC, delayed transfer of care.

Financial Performance of English NHS Trusts and Clinical Outcomes: A Longitudinal Observational Study

ONLINE SUPPLEMENTAL DATA

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Supplement version: 2.3

FINANCIAL DATA EXTRACTION

Where financial data was extracted from consolidated end of year accounts files via the gov.uk open data portal, the following fields were extracted:

For foundation trusts:

Turnover	--> Table ID 1, Subcode 100
Surplus/Deficit	--> Table ID 1, Subcode 160
Consultancy	--> 07A and 07I, subcode 280
Agency spend	--> 1415TRU06_EXP_P13, maincode 01, subcode 180

For non-Foundation trusts:

Turnover	--> Table ID CNE, Subcode 120 and 130
Surplus/Deficit	--> Table ID CNE, Subcode 390
Consultancy	--> 08C, subcode 125 (only available for 2014-16)
Agency spend	--> 1415TRU09_EMP_P13, maincode 04, subcode 100 (only available for 2015-16)

1 DELAYED TRANSFERS OF CARE IN FINANCIAL YEAR ENDING 2011

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4 Delayed transfer of care data were only available at Trust level for the latter eight months of the
5 2011 financial year. To ensure comparability with other years, a 1.5x multiplier was applied for
6 each trust in this financial year with a sensitivity analysis to examine any impact of this change.
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11 The total numbers of delayed transfers for all hospitals were available as an aggregate total
12 (data obtained from King's Fund Quarterly Monitoring Report for 2010-11).
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16 The ratio of aggregate delayed transfer of care days for the first 4 months (April 2010 to July
17 2010) to the last 8 months (August 2010 to March 2011) was 0.492; suggesting that a 1.5x
18 multiplier appeared reasonable.
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Year	Month	Number of DTOCs	4-monthly total
2010	Apr	113900	-
2010	May	112442	-
2010	Jun	115336	-
2010	Jul	109918	451596
-	-	-	-
2010	Aug	115855	-
2010	Sep	113246	-
2010	Oct	113091	-
2010	Nov	116466	458658
-	-	-	-
2010	Dec	114346	-
2011	Jan	112386	-
2011	Feb	123130	-
2011	Mar	109362	459224

CHANGES TO TRUST COMPOSITION

The 168 Trusts listed below include specialist Trusts (e.g. Great Ormond Street Hospital for Children NHS Foundation Trust) that were excluded prior to analysis. Changes in composition to the Trusts (creation of a new Trust, dissolution of an existing Trust, acquisitions of a hospital or entire Trust to another Trust and mergers between Trusts) are detailed at the end of the table.

Trust	Trust identifier	Change in composition	Transitioned to Foundation status	Foundation Trust transition date
Aintree University Hospital NHS Foundation Trust	REM			
Airedale NHS Foundation Trust	RCF		Yes	01/06/2010
Alder Hey Children's NHS Foundation Trust	RBS			
Ashford and St Peter's Hospitals NHS Foundation Trust	RTK		Yes	01/12/2010
Barking, Havering and Redbridge University Hospitals NHS Trust	RF4			
Barnet and Chase Farm Hospitals NHS Trust	RVL	Yes (1)		
Barnsley Hospital NHS Foundation Trust	RFF			
Barts and the London NHS Trust	RNJ	Yes (2)		
Barts Health NHS Trust	R1H	Yes (3)		
Basildon and Thurrock University Hospitals NHS Foundation Trust	RDD			
Bedford Hospital NHS Trust	RC1			
Birmingham Children's Hospital NHS Foundation Trust	RQ3			
Birmingham Women's NHS Foundation Trust	RLU			
Blackpool Teaching Hospitals NHS Foundation Trust	RXL			
Bolton NHS Foundation Trust	RMC			
Bradford Teaching Hospitals NHS Foundation Trust	RAE			
Brighton and Sussex University Hospitals NHS Trust	RXH			
Buckinghamshire Healthcare NHS Trust	RXQ			

1	Burton Hospitals NHS Foundation Trust	RJF			
2	Calderdale and Huddersfield NHS Foundation Trust	RWY			
3	Cambridge University Hospitals NHS Foundation Trust	RGT			
4	Central Manchester University Hospitals NHS Foundation Trust	RW3	Yes (4)		
5	Chelsea and Westminster Hospital NHS Foundation Trust	RQM	Yes (5)		
6	Chesterfield Royal Hospital NHS Foundation Trust	RFS			
7	City Hospitals Sunderland NHS Foundation Trust	RLN			
8	Colchester Hospital University NHS Foundation Trust	RDE			
9	Countess Of Chester Hospital NHS Foundation Trust	RJR			
10	County Durham and Darlington NHS Foundation Trust	RXP			
11	Croydon Health Services NHS Trust	RJ6			
12	Dartford and Gravesham NHS Trust	RN7			
13	Derby Teaching Hospitals NHS Foundation Trust	RTG			
14	Doncaster and Bassetlaw Hospitals NHS Foundation Trust	RP5			
15	Dorset County Hospital NHS Foundation Trust	RBD			
16	Ealing Hospital NHS Trust	RC3	Yes (6)		
17	East and North Hertfordshire NHS Trust	RWH			
18	East Cheshire NHS Trust	RJN			
19	East Kent Hospitals University NHS Foundation Trust	RVV			
20	East Lancashire Hospitals NHS Trust	RXR			
21	East Sussex Healthcare NHS Trust	RXC			
22	Epsom and St Helier University Hospitals NHS Trust	RVR			
23	Frimley Health NHS Foundation Trust	RDU	Yes (7)		
24	Gateshead Health NHS Foundation Trust	RR7			
25	George Eliot Hospital NHS Trust	RLT			
26	Gloucestershire Hospitals NHS Foundation Trust	RTE			
27	Great Ormond Street Hospital for Children NHS Foundation Trust	RP4		Yes	01/03/2012
28	Great Western Hospitals NHS Foundation Trust	RN3			
29	Guy's and St Thomas' NHS Foundation Trust	RJ1			
30	Hampshire Hospitals NHS Foundation Trust	RN5	Yes (8)		

1	Harrogate and District NHS Foundation Trust	RCD			
2	Heart Of England NHS Foundation Trust	RR1			
3	Heatherwood and Wexham Park Hospitals NHS Foundation Trust	RD7	Yes (9)		
4	Hinchingbrooke Health Care NHS Trust	RQQ			
5	Homerton University Hospital NHS Foundation Trust	RQX			
6	Hull and East Yorkshire Hospitals NHS Trust	RWA			
7	Imperial College Healthcare NHS Trust	RYJ			
8	Ipswich Hospital NHS Trust	RGQ			
9	Isle Of Wight NHS Trust	R1F	Yes (10)		
10	James Paget University Hospitals NHS Foundation Trust	RGP			
11	Kettering General Hospital NHS Foundation Trust	RNQ			
12	King's College Hospital NHS Foundation Trust	RJZ	Yes (11)		
13	Kingston Hospital NHS Foundation Trust	RAX		Yes	01/05/2013
14	Lancashire Teaching Hospitals NHS Foundation Trust	RXN			
15	Leeds Teaching Hospitals NHS Trust	RR8			
16	Lewisham and Greenwich NHS Trust	RJ2	Yes (12)		
17	Liverpool Heart and Chest NHS Foundation Trust	RBQ			
18	Liverpool Women's NHS Foundation Trust	REP			
19	London North West Healthcare NHS Trust	R1K	Yes (13)		
20	Luton and Dunstable University Hospital NHS Foundation Trust	RC9			
21	Maidstone and Tunbridge Wells NHS Trust	RWF			
22	Medway NHS Foundation Trust	RPA			
23	Mid Cheshire Hospitals NHS Foundation Trust	RBT			
24	Mid Essex Hospital Services NHS Trust	RQ8			
25	Mid Staffordshire NHS Foundation Trust	RJD	Yes (14)		
26	Mid Yorkshire Hospitals NHS Trust	RXF			
27	Milton Keynes University Hospital NHS Foundation Trust	RD8			
28	Moorfields Eye Hospital NHS Foundation Trust	RP6			
29	Newham University Hospital NHS Trust	RNH	Yes (15)		
30	Norfolk and Norwich University Hospitals NHS Foundation Trust	RM1			

1	North Bristol NHS Trust	RVJ			
2	North Cumbria University Hospitals NHS Trust	RNL			
3	North Middlesex University Hospital NHS Trust	RAP			
4	North Tees and Hartlepool NHS Foundation Trust	RVW			
5	North West London Hospitals NHS Trust	RV8	Yes (16)		
6	Northampton General Hospital NHS Trust	RNS			
7	Northern Devon Healthcare NHS Trust	RBZ			
8	Northern Lincolnshire and Goole NHS Foundation Trust	RJL			
9	Northumbria Healthcare NHS Foundation Trust	RTF			
10	Nottingham University Hospitals NHS Trust	RX1			
11	Oxford University Hospitals NHS Foundation Trust	RTH	Yes (17)	Yes	01/10/2015
12	Papworth Hospital NHS Foundation Trust	RGM			
13	Pennine Acute Hospitals NHS Trust	RW6			
14	Peterborough and Stamford Hospitals NHS Foundation Trust	RGN			
15	Plymouth Hospitals NHS Trust	RK9			
16	Poole Hospital NHS Foundation Trust	RD3			
17	Portsmouth Hospitals NHS Trust	RHU			
18	Queen Victoria Hospital NHS Foundation Trust	RPC			
19	Robert Jones and Agnes Hunt Orthopaedic and District Hospital NHS Foundation Trust	RL1		Yes	01/08/2011
20	Royal Berkshire NHS Foundation Trust	RHW			
21	Royal Brompton and Harefield NHS Foundation Trust	RT3			
22	Royal Cornwall Hospitals NHS Trust	REF			
23	Royal Devon and Exeter NHS Foundation Trust	RH8			
24	Royal Free London NHS Foundation Trust	RAL	Yes (18)	Yes	01/04/2012
25	Royal Liverpool and Broadgreen University Hospitals NHS Trust	RQ6			
26	Royal National Hospital For Rheumatic Diseases NHS Foundation Trust	RBB	Yes (19)		
27	Royal National Orthopaedic Hospital NHS Trust	RAN			
28	Royal Surrey County NHS Foundation Trust	RA2			
29	Royal United Hospitals Bath NHS Foundation Trust	RD1	Yes (20)	Yes	01/11/2014
30	Salford Royal NHS Foundation Trust	RM3			

1	Salisbury NHS Foundation Trust	RNZ			
2	Sandwell and West Birmingham Hospitals NHS Trust	RXK			
3	Scarborough and North East Yorkshire Healthcare NHS Trust	RCC	Yes (21)		
4	Sheffield Children's NHS Foundation Trust	RCU			
5	Sheffield Teaching Hospitals NHS Foundation Trust	RHQ			
6	Sherwood Forest Hospitals NHS Foundation Trust	RK5			
7	Shrewsbury and Telford Hospital NHS Trust	RXW			
8	South London NHS Healthcare Trust	RYQ	Yes (22)		
9	South Tees Hospitals NHS Foundation Trust	RTR			
10	South Tyneside NHS Foundation Trust	RE9			
11	South Warwickshire NHS Foundation Trust	RJC			
12	Southend University Hospital NHS Foundation Trust	RAJ			
13	Southport and Ormskirk Hospital NHS Trust	RVY			
14	St George's University Hospitals NHS Foundation Trust	RJ7		Yes	01/02/2015
15	St Helens and Knowsley Hospitals NHS Trust	RBN			
16	Stockport NHS Foundation Trust	RWJ			
17	Surrey and Sussex Healthcare NHS Trust	RTP			
18	Tameside Hospital NHS Foundation Trust	RMP			
19	Taunton and Somerset NHS Foundation Trust	RBA			
20	The Christie NHS Foundation Trust	RBV			
21	The Clatterbridge Cancer Centre NHS Foundation Trust	REN			
22	The Dudley Group NHS Foundation Trust	RNA			
23	The Hillingdon Hospitals NHS Foundation Trust	RAS		Yes	01/04/2011
24	The Newcastle Upon Tyne Hospitals NHS Foundation Trust	RTD			
25	The Princess Alexandra Hospital NHS Trust	RQW			
26	The Queen Elizabeth Hospital, King's Lynn. NHS Foundation Trust	RCX		Yes	01/02/2011
27	The Rotherham NHS Foundation Trust	RFR			
28	The Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust	RDZ			
29	The Royal Marsden NHS Foundation Trust	RPY			
30	The Royal Orthopaedic Hospital NHS Foundation Trust	RRJ			

1	The Royal Wolverhampton NHS Trust	RL4	Yes (23)		
2	The Walton Centre NHS Foundation Trust	RET			
3	The Whittington Hospital NHS Trust	RKE			
4	Torbay and South Devon NHS Foundation Trust	RA9	Yes (24)		
5	Trafford Healthcare NHS Trust	RM4	Yes (25)		
6	United Lincolnshire Hospitals NHS Trust	RWD			
7	University College London Hospitals NHS Foundation Trust	RRV			
8	University Hospital Of South Manchester NHS Foundation Trust	RM2			
9	University Hospital Southampton NHS Foundation Trust	RHM		Yes	01/10/2011
10	University Hospitals Birmingham NHS Foundation Trust	RRK			
11	University Hospitals Bristol NHS Foundation Trust	RA7			
12	University Hospitals Coventry and Warwickshire NHS Trust	RKB			
13	University Hospitals Of Leicester NHS Trust	RWE			
14	University Hospitals Of Morecambe Bay NHS Foundation Trust	RTX		Yes	01/10/2010
15	University Hospitals of North Midlands NHS Trust	RJE	Yes (26)		
16	Walsall Healthcare NHS Trust	RBK			
17	Warrington and Halton Hospitals NHS Foundation Trust	RWW			
18	West Hertfordshire Hospitals NHS Trust	RWG			
19	West Middlesex University Hospital NHS Trust	RFW	Yes (27)		
20	West Suffolk NHS Foundation Trust	RGR		Yes	01/12/2011
21	Western Sussex Hospitals NHS Foundation Trust	RYR		Yes	01/07/2013
22	Weston Area Health NHS Trust	RA3			
23	Whipps Cross University Hospital NHS Trust	RGC	Yes (28)		
24	Winchester and Eastleigh Healthcare Trust	RN1	Yes (29)		
25	Wirral University Teaching Hospital NHS Foundation Trust	RBL			
26	Worcestershire Acute Hospitals NHS Trust	RWP			
27	Wrightington, Wigan and Leigh NHS Foundation Trust	RRF			
28	Wye Valley NHS Trust	RLQ	Yes (30)		
29	Yeovil District Hospital NHS Foundation Trust	RA4			
30	York Teaching Hospital NHS Foundation Trust	RCB	Yes (31)		

- 1
- 2 1. Acquired by Royal Free London NHS FT in 2014
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- 4 2. Merged with Newham University Hospital NHS Trust and Whipps Cross University Hospital NHS Trust to form Barts Health NHS Trust in 2012
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- 6 3. Formed from the merger of Barts and the London NHS Trust, Whipps Cross University Hospital NHS Trust and Newham University Hospital NHS
- 7 Trust in 2012
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- 9 4. Acquired Trafford Healthcare NHS Trust in Apr 2012
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- 11 5. Acquired West Middlesex University Hospital NHS Trust in Sep 2015
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- 13 6. Merged with North West London Hospitals NHS Trust to form London North West Healthcare NHS Trust in 2014
- 14
- 15 7. Formed by merger of Heatherwood and Wexham Park Hospitals NHS FT and Frimley Park Hospital NHS FT on 1 October 2014
- 16
- 17 8. Formed by acquisition of Winchester and Eastleigh Healthcare Trust by Basingstoke and North Hampshire NHS FT in Jan 2012
- 18
- 19 9. Merged with Frimley Park Hospital NHS FT to form Frimley Health NHS FT on 1 October 2014
- 20
- 21 10. Created in Apr 2012 by a provider split from Isle of Wight NHS PCT (5QT)
- 22
- 23 11. Acquired Princess Royal University Hospital from South London NHS Healthcare Trust's dissolution in Oct 2013
- 24
- 25 12. Formed on 1 Oct 2013 by merger of merger of Lewisham Healthcare NHS Trust and Queen Elizabeth Hospital (previously part of South London
- 26 NHS Healthcare Trust)
- 27
- 28 13. Formed by merger of Ealing Hospital NHS Trust and North West London Hospitals NHS Trust in 2014
- 29
- 30 14. Mid Staffordshire NHS FT which ran Stafford hospital dissolved In Nov 2014. Stafford hospital renamed to County Hospital and acquired by newly
- 31 named University Hospitals of North Midlands NHS Trust
- 32
- 33 15. Merged with Barts and the London NHS Trust and Whipps Cross University Hospital NHS Trust to form Barts Health NHS Trust in 2012
- 34
- 35 16. Merged with Ealing Hospital NHS Trust to form London North West Healthcare NHS Trust in 2014
- 36
- 37 17. Formed from Oxford Radcliffe Hospitals NHS Trust by acquisition of Nuffield Orthopaedic Acute Centre NHS Trust in 2011
- 38
- 39 18. Acquired Barnet and Chase Farm Hospitals NHS Trust in 2014
- 40
- 41 19. Acquired by Royal United Hospital Bath NHS FT on 1 Feb 2015
- 42
- 43 20. Acquired Royal National Hospital For Rheumatic Diseases NHS FT on 1 Feb 2015
- 44
- 45 21. Acquired by York Teaching Hospital NHS Foundation Trust in Jul 2013
- 46 22. Dissolved in Oct 2013

- 1 23. Acquired Cannock Chase Hospital when Mid Staffordshire NHS FT dissolved In Nov 2014
- 2 24. Created on 1 Oct 2015 from South Devon Healthcare NHS Foundation Trust merging with Torbay and Southern Devon Health and Care NHS Trust
- 3 (community and social care services)
- 4
- 5 25. Acquired by Central Manchester University Hospitals NHS FT in Apr 2012
- 6
- 7 26. Formed from University Hospital Of North Staffordshire NHS Trust taking over Stafford Hospital (now named County Hospital) on 1 Nov 2014. Mid
- 8 Staffordshire NHS FT which ran Stafford hospital dissolved In Nov 2014
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- 10 27. Acquired by Chelsea and Westminster Hospital NHS FT in Sep 2015
- 11
- 12 28. Merged with Newham University Hospital NHS Trust and Barts and the London NHS Trust to form Barts Health NHS Trust in 2012
- 13
- 14 29. Acquired by Basingstoke and North Hampshire NHS FT to form Hampshire Hospitals NHS FT in Jan 2012
- 15
- 16 30. Formed from Hereford Hospitals NHS Trust on 1 April 2011 following Herefordshire's health and adult social care providers joining to form an
- 17 integrated provider of acute, community and social care in England
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- 19 31. Acquired Scarborough and North East Yorkshire Healthcare NHS Trust in Jul 2013
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SENSITIVITY ANALYSES, ADDITIONAL TABLES AND FIGURES

Table A. Association of operating margin with outcomes and process measures (summary model for 2011-13). Operating margin and outcomes were averaged over the 3 years from 2011-13 to form the inputs to the summary model. Readmission rate is not included as data was not available for 2011-13. Abbreviations: A&E, Accident & Emergency; CI, confidence interval.

Agency spend as a proportion of turnover (%)						
	2011	2012	2013	2014	2015	2016
Worst 10%	3.9	3.9	4.6	6.0	8.5	9.1
Middle 80%	2.4	2.3	2.6	3.0	4.6	5.1
Best 10%	2.7	2.9	3.4	3.8	4.0	4.5
Ratio of worst to best	1.4	1.3	1.4	1.6	2.1	2.0
Difference (best and worst)	1.2	1.0	1.2	2.2	4.5	4.6

Table B. Outcomes and process measures in Foundation trusts versus non-foundation trusts. Excludes trusts that changed in composition or transitioned to Foundation status during the study period. Values are median (IQR). P-value refers to a Kruskal-Wallis equality-of-populations rank test.

	Foundation trust	Non-foundation trust	p-value
Readmission rate (%)	3.5 (3.0 to 3.9)	3.7 (3.3 to 4.0)	<0.001
Inpatient satisfaction score (out of 10)	8.0 (7.8 to 8.2)	7.8 (7.7 to 8.0)	<0.001
A&E 4 hour target breach rate (%)	5.4 (4.2 to 7.8)	6.9 (4.9 to 10.5)	<0.001
Delayed transfer of care days per hospital bed	6.8 (3.5 to 11.0)	7.0 (4.5 to 11.2)	0.241
Cancer two week wait target adherence (%)	95.5 (94.6 to 96.7)	94.9 (94.0 to 96.3)	<0.001
Cancer 62 days to first treatment target adherence (%)	87.7 (85.4 to 89.7)	86.2 (82.5 to 88.2)	<0.001

Tables C1 & C2. Association of operating margin on outcomes and process measures. Association of operating margin with outcomes and process measures. These estimates are derived from a linear regression with outcome/process measure as the dependent variable and the following independent variables: operating margin, number of beds available and year. Each Trust in each year was treated as a separate observation with standard errors clustered by Trust to account for the non-independence of Trust-level data. Abbreviations: A&E, Accident & Emergency; CI, confidence interval. E1 includes Foundation trusts only. E2 includes non-Foundation trusts only. Trusts that transitioned to Foundation status are excluded in both tables.

Table C1. Association of operating margin on outcomes and process measures in Foundation trusts.

Outcome	n	Trust clusters	Coefficient	95% CI	p-value
Readmission rate (%)	206	71	-0.015	-0.039 to 0.008	0.202
Inpatient satisfaction score (out of 10)	429	73	0.52	-0.46 to 1.49	0.293
A&E 4 hour breach rate (%)	430	73	-0.25	-0.37 to -0.13	<0.001
Delayed transfers of care days per hospital bed	431	73	-21.8	-40.7 to -2.9	0.024
2 week wait cancer target adherence (%)	431	73	0.05	-0.01 to 0.10	0.083
62 day cancer treatment target adherence (%)	431	73	0.08	-0.02 to 0.17	0.110

Table C2. Association of operating margin on outcomes and process measures in non-foundation trusts.

Outcome	n	Trust clusters	Coefficient	95% CI	p-value
Readmission rate (%)	142	51	0.004	-0.023 to 0.032	0.751
Inpatient satisfaction score (out of 10)	318	62	1.59	0.43 to 2.76	0.008
A&E 4 hour breach rate (%)	327	62	-0.23	-0.39 to -0.07	0.005
Delayed transfers of care days per hospital bed	328	62	-39.2	-63.3 to -15.1	0.002
2 week wait cancer target adherence (%)	324	62	0.26	-0.06 to 0.11	0.527
62 day cancer treatment target adherence (%)	324	62	0.22	0.05 to 0.38	0.010

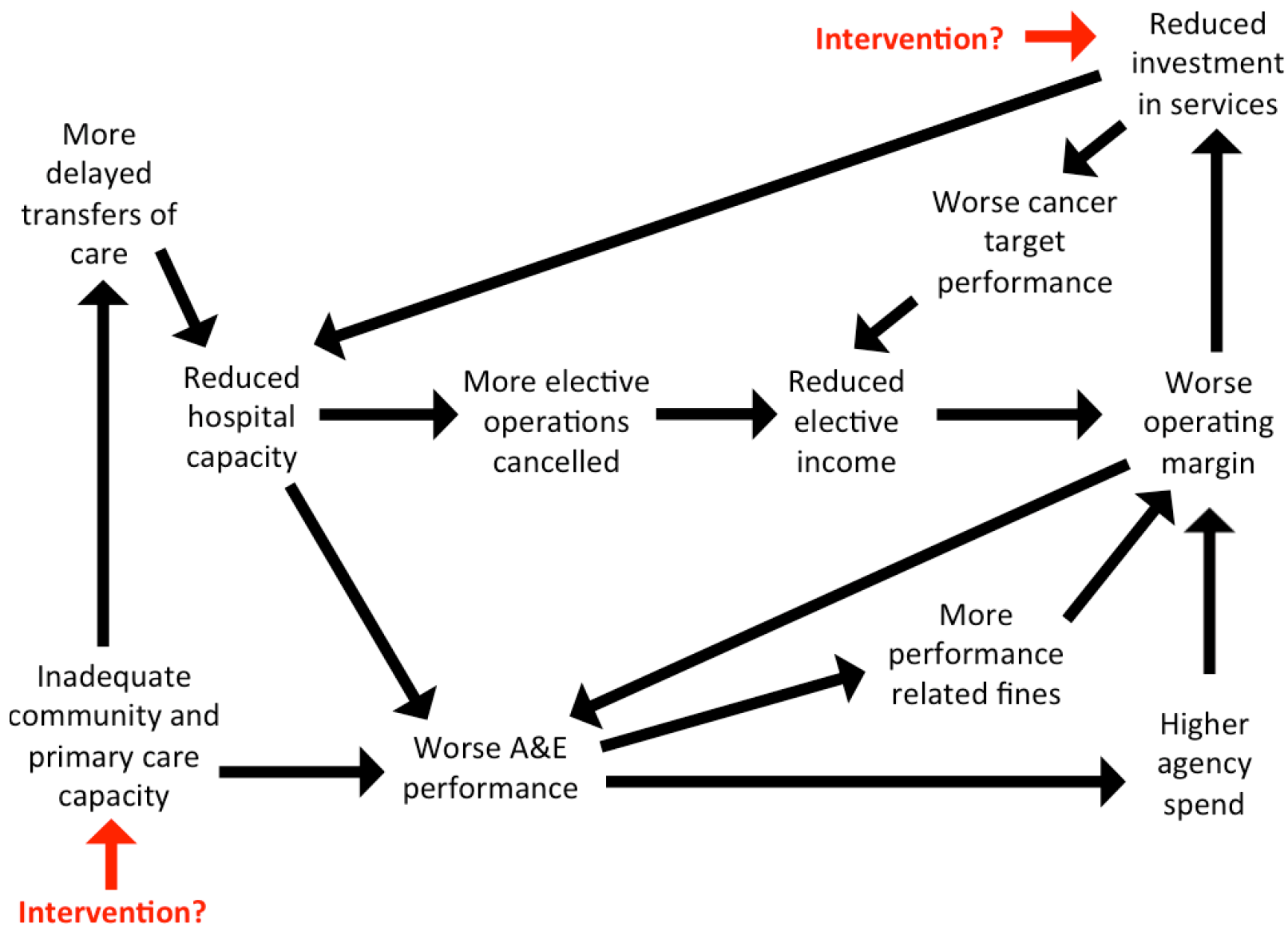
Table D. Assessment of the impact of not adjusting for missing 2011 delayed transfer of care data. Abbreviations: CI, confidence interval.

Delayed transfers of care days per hospital bed	n	Trust clusters	Coefficient	95% CI	p-value
Without adjustment for missing 2011 data	837	148	-21.9	-35.5 to -8.4	0.002
With adjustment for missing 2011 data	837	148	-25.1	-39.1 to -11.0	0.001

Table E. Association of operating margin with outcomes and process measures. Adjusted regression analyses as per table 3 in the manuscript excluding Trusts that had changed in composition between 2011 and 2016. Abbreviations: A&E, Accident & Emergency; SHMI, Summary Hospital-level Mortality Indicator.

Outcome	n	Trust clusters	Coefficient	95% CI	p-value
Readmission rate (%)	344	119	-0.01	-0.03 to 0.01	0.403
Inpatient satisfaction score (out of 10)	706	119	0.66	-0.23 to 1.55	0.142
A&E 4 hour breach rate (%)	710	119	-0.20	-0.30 to -0.11	<0.001
Delayed transfers of care days per hospital bed	711	119	-29.5	-44.1 to -14.8	<0.001
2 week wait cancer target adherence (%)	710	119	0.05	0.00 to 0.10	0.042
62 day cancer treatment target adherence (%)	710	119	0.12	0.02 to 0.23	0.018

Figure A. Putative interplay of factors affecting Trust finance and performance.



STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract PAGE 1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found PAGE 2
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported PAGE 4
Objectives	3	State specific objectives, including any pre-specified hypotheses PAGE 4
Methods		
Study design	4	Present key elements of study design early in the paper PAGES 5-7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection PAGES 5-7 (IN SO FAR AS APPLICABLE TO THIS STUDY)
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up PAGE 5 (NO PARTICIPANTS, DESCRIBED FOR CENTRES)
		(b) For matched studies, give matching criteria and number of exposed and unexposed NOT APPLICABLE
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable PAGES 5-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group PAGES 5-7
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at PAGE 5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding PAGES 7-8
		(b) Describe any methods used to examine subgroups and interactions PAGE 7
		(c) Explain how missing data were addressed PAGES 6-7
		(d) If applicable, explain how loss to follow-up was addressed NOT APPLICABLE
		(e) Describe any sensitivity analyses PAGE 8

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Results		
Participants	13*	<p>(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed</p> <p>NOT APPLICABLE</p> <p>(b) Give reasons for non-participation at each stage</p> <p>NOT APPLICABLE BUT DETAILS GIVEN IN ONLINE APPENDIX REGARDING CHANGE IN COMPOSITION OF TRUSTS</p> <p>(c) Consider use of a flow diagram</p> <p>NOT APPLICABLE</p>
Descriptive data	14*	<p>(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders</p> <p>NOT APPLICABLE BUT DETAILS FOR TRUSTS GIVEN ON PAGES 9 & 24</p> <p>(b) Indicate number of participants with missing data for each variable of interest</p> <p>NOT APPLICABLE BUT DETAILS FOR TRUSTS GIVEN ON PAGE 5 IN METHODS SECTION</p> <p>(c) Summarise follow-up time (eg, average and total amount)</p> <p>NOT APPLICABLE AS FOLLOW-UP TIME IS STUDY-PERIOD</p>
Outcome data	15*	<p>Report numbers of outcome events or summary measures over time</p> <p>NOT APPLICABLE IN THE FORMAT OF NUMBER OF OUTCOME EVENTS</p>
Main results	16	<p>(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included</p> <p>PAGES 9-11</p> <p>(b) Report category boundaries when continuous variables were categorized</p> <p>PAGES 9-11</p> <p>(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period</p> <p>NOT APPLICABLE</p>
Other analyses	17	<p>Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses</p> <p>PAGE 11 AND ONLINE APPENDIX</p>
Discussion		
Key results	18	<p>Summarise key results with reference to study objectives</p> <p>PAGE 11</p>
Limitations	19	<p>Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias</p> <p>PAGES 13-14</p>
Interpretation	20	<p>Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence</p> <p>PAGES 14-16</p>
Generalisability	21	<p>Discuss the generalisability (external validity) of the study results</p> <p>PAGES 14-16</p>
Other information		
Funding	22	<p>Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based</p>

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

For peer review only