Title: Can payers use prices to improve quality? Evidence from English hospitals

Keywords: Financial incentives, quality, prices, unintended effects

Conflict of Interest

There are no financial or personal relationships between the authors and others that might bias this work.

Abstract

In most activity-based financing systems, payers set prices reactively based on historical averages of hospital reported costs. If hospitals respond to prices, payers might set prices proactively to affect the volume of particular treatments or clinical practice. We evaluate the effects of a unique initiative in England in which the price offered to hospitals for discharging patients on the same day as a particular procedure was increased by 24% while the price for inpatient treatment remained unchanged. Using national hospital records for 205,784 patients admitted for the incentivised procedure and 838,369 patients admitted for a range of non-incentivised procedures between 1st December 2007 and 31st March 2011, we consider whether this price change had the intended effect and/or produced unintended effects. We find that the price change led to an almost six percentage point increase in the daycase rate and an eleven percentage point increase in the planned daycase rate. Patients benefited from a lower proportion of procedures reverted to open surgery during a planned laparoscopic procedure and from a reduction in long stays. There was no evidence that readmission and death rates were affected. The results suggest that payers can set prices proactively to incentivise hospitals to improve quality.

Introduction

The use of financial incentives to influence individual and organisational behaviour is widespread in the private sector. However, the trade-off between risk and incentives, the crowding-out of hospitals' motivation and the multiplicity of outcomes that can cause effort diversion are some of the problems that cast doubt on the applicability of such incentives to the healthcare sector (Baker 1992; Burgess & Ratto 2003; Dixit 2002; Goddard et al. 1998; Grout et al. 2000).

Most developed countries' healthcare systems have now moved away from paying hospitals using retrospective cost reimbursement or prospective budgets towards activity-based financing (Busse, 2012). The objectives of activity-based financing are primarily to increase productivity, reduce costs and improve efficiency. Under activity-based financing, treatment episodes are grouped into categories with similar expected resource needs (often Diagnosis Related Groups (DRGs)) and hospitals are reimbursed based on the volumes of these categories of treatment episodes that they provide. In most systems, the rate of reimbursement, or tariff, is based on historical values of the average costs of providing each type of treatment episode reported by hospitals (Busse 2012).

In England, activity-based financing (called *Payment by Results, PbR*) was introduced in 2003/04 (Farrar et al. 2009; Street & Maynard 2007). The main purpose was to reduce waiting times by incentivising hospitals to increase supply, but it was also intended that this system would support the introduction of competition and patient choice (as 'money followed the patient') and lead to increases in efficiency.

Originally, the Department of Health (DH) hoped that hospitals would compete for patients on the basis of quality and that the introduction of PbR would lead to improvements in quality. However, despite evidence that quality was unaffected by the introduction of PbR (Farrar et al. 2009), the DH became concerned that hospitals might reduce quality to keep their costs below the tariff and made a commitment in 2008 to make a proportion of hospital incomes conditional on quality (Department of Health 2008).

As a result of this commitment, the DH experimented with a new method of setting prices in April 2010. This policy was called *Best Practice Tariffs* (BPTs) and was introduced initially for a small number of healthcare interventions. For these interventions, instead of basing prices *reactively* on the average costs reported by hospitals, BPTs were set *proactively* to reflect the costs of delivering best practice. For the remaining interventions, prices continued to be set reactively, based on the average historical costs reported by hospitals.

Most of the literature has considered the unintended effects of price changes on the care provided by hospitals. The main challenge for this literature is finding an exogenous source of variation in prices not related to changes in hospital costs and hence not biased by reverse causality. Dafny (2005) exploited the 1988 U.S. policy change that generated a large and exogenous price change. She examined the impact of a re-classification of the DRG structure wherein the age criterion was removed as an indicator of ‘complications’ from the price schedule. There was evidence of upcoding of complications where this had the largest impact on price, but no effect of the price changes on volumes and intensity. Dafny (2005) therefore concluded that prices could not be used to affect quality.

Other papers have concentrated on the effect of the Balanced Budget Act (BBA) in 1997, which led to a general but non-uniform change in prices across hospitals and activities in the US. Seshamani et al. (2006) found no differences in changes in 30-day mortality rates between hospitals expected to be affected to different degrees by the expected reduction in revenue. Lindrooth et al. (2007) found that the hospitals with the highest proportions of Medicare patients reduced treatment intensity at higher quantiles in the more affected DRGs. Wu and Shen (2011) examined the longer-term effect on mortality following acute myocardial infarction. They found that an adverse effect became evident in 2001-2005 and that hospitals affected most by the BBA reduced nursing input levels in the longer-term.

There is therefore mixed evidence of the impact of price changes on the quality of care provided by hospitals. Our application differs from previous papers by considering hospital responses to an exogenous, *proactive* price change designed to change clinical practice in a highly transparent manner. The link between revenue and the incentivised dimension of clinical practice is easy to measure and observe. The quasi-experimental nature of the BPT, implemented for a specific clinical procedure and not for others, allows us to estimate unbiased effects of hospital responses to price changes.

In the first year of the policy, the DH experimented with three models of BPTs, which were applied to different groups of patients (Audit Commision 2012). These models: (i) paid more for treatment as a daycase compared to treatment as an inpatient; (ii) paid more for achievement of quality standards; or (iii) did not pay hospitals for excessive outpatient visits before or after a procedure. We focus on the procedure for which additional payment was paid for daycase treatment in the first year, cholecystectomy or the removal of the gall bladder. This policy differed from previous arrangements for cholecystectomy, which were continued for all other treatments, of paying a single tariff regardless of whether the patient was treated as a daycase or had an overnight stay. The stated purpose of this new daycase tariff was to improve quality by providing a better patient experience and increasing efficiency. This differential pricing model for daycases and inpatient stays was adopted only for cholecystectomy in 2010/11 and then 12 additional procedures in 2011/12.

The aim of this paper is two-fold. We examine (i) whether the new tariff produced the intended effect on the proportion of patients treated as daycases; and (ii) whether there were unintended effects of the tariff on patient selection, quality and productivity. In order to do this, we perform difference-in-differences and differential-spline analyses between the pre-

2010 payment policy and the post-2010 payment policy. We select a control group comprising other procedures for which similar daycase rates are recommended but a separate daycase price was not introduced.

To preface our findings, we show that the tariff achieved its objective as daycase rates increased significantly by six percentage points. There is no evidence that the price change had a perverse effect on quality in terms of deaths or readmissions following a cholecystectomy. The policy significantly reduced the proportion of patients requiring a reversion from laparoscopic to an open procedure and those requiring a longer length of stay. There is evidence that these effects began when the policy was announced, four months prior to the actual proactive price change.

1. The Best Practice Tariff

1.1. Daycase laparoscopic cholecystectomy

Cholecystectomy is an operation to remove the gall bladder, a small pouch in the abdomen that stores bile. Cholecystectomies are performed under general anaesthetic but can be performed laparoscopically (otherwise known as ‘keyhole surgery’) or as open surgery. An ‘open’ cholecystectomy may be required if the patient has previously had major surgery and has extensive abdominal scarring. If complications such as bleeding occur during laparoscopic surgery, the surgeon may also have to revert to open surgery. Open surgery usually takes longer to perform than keyhole surgery and requires a longer hospital stay.

Laparoscopic surgery was first performed in 1985 and has become the accepted standard (Leeder et al. 2004). The National Health Service (NHS) Institute for Innovation and Improvement found that, in 2005/6, 84% of all cholecystectomies were performed laparoscopically but the national average daycase rate was just 6.4% (NHS Institute for

Innovation and Improvement 2006). There were substantial variations between hospitals in both of these figures.

Laparoscopic cholecystectomy has been placed on lists of procedures that can be performed routinely as a daycase (British Association of Day Surgery 2008; Audit Commision 2001). However, a recent Cochrane review has compared the outcomes of patient groups receiving laparoscopic cholecystectomy and either discharged as a daycase or kept in hospital overnight. The review showed no difference between the two methods of management in terms of morbidity, prolongation of length of stay, readmissions, pain, quality of life, patient satisfaction or speed of return to normal activity (Gurusamy et al. 2008). The clinical evidence that treatment as a daycase is better for patients is therefore ambiguous.

The financial case that daycase treatment is less costly is also contestable. The NHS Institute for Innovation and Improvement developed an optimal ‘pathway of care’ and a wide range of recommendations on how this could be delivered in 2006 (NHS Institute for Innovation and Improvement 2006). Although daycase treatment reduces some aspects of hospital costs by avoiding overnight stays, the recommended pathway requires substantial changes to care delivery across a wide range of dimensions that will require capital and labour investments. Key considerations include the scheduling of daycase patients earlier in the operating list, so as to discharge them on the same day, and having dedicated daycase wards and theatres (British Association of Day Surgery 2008; Leeder et al. 2004; Verma et al. 2011). Clarke et al. (2011) reported that the NHS Institute pathway required more focused contacts with potential patients prior to the procedure, expanding the criteria for daycase surgery, reducing clerical errors by ensuring that patients were scheduled on morning operating lists and reducing conversion rates by increasing the proportion of procedures performed by specialist upper gastrointestinal surgeons. Failures to discharge patients as daycases were linked predominantly to uncontrolled pain, nausea, and vomiting, which it was thought could be avoided in future by better anaesthesia and pain control.

Reducing the conversion rate to open surgery can also successfully increase the daycase rate. Ballal et al. (2009) found lower conversion rates amongst consultants that performed more laparoscopic cholecystectomies, with those performing 70 or more procedures a year having the lowest conversion rate. In addition, those surgeons who attempted a higher proportion of their cholecystectomies laparoscopically had a lower conversion rate, with the surgeons undertaking more than 90% of their work primarily laparoscopically having the lowest conversion rate. Successful daycase management of patients following laparoscopic surgery may therefore require a re-organisation of work across surgeons alongside other cost-increasing activities and may not lead to net cost reductions, at least in the short-term. Hospitals might therefore need a financial incentive to increase their daycase rate.

1.2. The price change

The Best Practice Tariff for cholecystectomy, introduced in April 2010, aimed to incentivise hospitals to provide the procedure as a daycase. The new structure of the tariff was announced in December 2009 (Department of Health 2009) and the full details including prices were published later (Department of Health 2010). Our analysis period begins 24 months before the policy was first announced in December 2007 and ends 12 months after the policy was introduced in March 2011. This provides a four-month period after the policy was announced and before it was introduced when hospitals could have anticipated the price change, followed by a 12-month period in which hospitals experienced new policy. This period of analysis was chosen to give 24 months of data from before the policy was announced but not to include earlier periods when PbR was not yet fully implemented (Department of Health 2012).

Table I shows the prices that were offered for cholecystectomies in each financial year from 2007/8 to 2010/11. In all years, higher prices were offered for patients reported by hospitals as having complications. Until 2008/9, patients aged 70 years and over were paid at the higher rate regardless of whether or not they were reported to have complications. This was abandoned in 2009/10. A substantial decrease in price occurred between 2008/09 and 2009/10 when the classification of treatments into HRGs was updated from Version 3.5 to Version 4. In 2010/11, the pricing structure for cholecystectomies was changed and discriminated between daycase and inpatient procedures. Between 2009/10 and 2010/11 there was a £4 increase in the price for inpatient procedures, regardless of whether or not they had complications. Daycase cholecystectomies were paid at a 24% higher rate than in 2009/10.

(Table I)

To qualify for the Best Practice Tariff, hospitals needed to both schedule the patient as a daycase and discharge the patient on the day the procedure was undertaken. This price change differs from previous ones as it was coupled with a well-publicised policy change and a published target for the daycase rate of 60% (Department of Health 2010).

2. Possible behavioural impacts of the tariff

2.1. Intended effects of BPT

We assess whether the policy achieved its principal objective by looking at the effect of the BPT on the incentivised task, the proportion of cholecystectomies performed as a daycase procedure. In order to be eligible for the higher price, hospitals need to both plan and treat patients as daycases. This criterion also ensures that the procedure had to be laparoscopic, as an open procedure will always require an overnight stay.

We examine the effect of the tariff on the proportion of all episodes that were planned and delivered as daycases. We then examine changes in the proportion of procedures performed laparoscopically. We would expect that the price change would incentivise the targeted clinical practice by increasing the daycase proportion. We might also expect more laparoscopic procedures, though the laparoscopic surgery rate is already high.

2.2. Unintended effects of BPT

One of the problems with financial incentives is that hospitals might try to achieve the objective of the policy in ways that were not intended by the policy itself. For instance, Dafny (2005) considered two possible responses: i) “nominal” responses, i.e. those that involve a change in hospitals’ coding practices; and ii) “real” responses, i.e. those that affect admissions and the intensity of care provided. Given the relatively substantial revenue gains from achieving the BPT, hospitals could try to increase the proportion of daycase laparoscopic cholecystectomies in several ways.

Hospitals could make “real” changes as follows. First, they could reprioritise patients. Reprioritisation is reflected by inappropriate preferential treatment given to healthier patients, but hospitals could also select patients who were previously deemed to be too risky for a daycase cholecystectomy treatment. We assess the extent of patient selection by looking at the effect of BPT on the age and gender composition of treated patients. Second, the tariff could have a perverse effect on quality. For instance, hospitals could make more mistakes leading to more deaths, fail to improve post-procedure care leading to longer lengths of stay for some patients, and take risks either with the discharge decision leading to higher probability of readmission or with selecting higher risk patients and then reverting to open cholecystectomy. Third, they could respond to the price change by changing productivity. They could change the volume of treated patients or make patients wait longer until a slot in a dedicated daycase facility with a surgeon undertaking laparoscopic procedures is available.

Hospitals could also make “nominal” changes to their behaviour in order to qualify for the tariff. First, they may increase their planned daycase rate as a means to capture as many procedures as possible within the new tariff. This could mean an increase in the number of planned daycases that do not result in a daycase cholecystectomy. Second, hospitals may increase the proportion of patients that they code as having complications as they are not paid less for inpatient care if patients are classified as having complications.

3. Summary statistics

3.1. Definition of the sample and variables of interest

Healthcare records were obtained from Hospital Episode Statistics (HES) for the 40 months between the 1st December 2007 and 31st March 2011. These data are available upon request from the NHS Information Centre for Health and Social Care. They contain information on patient characteristics, diagnoses, type of admission, readmissions, discharges and lengths of stay for each treatment episode provided by hospitals in England.

We only use data for patients admitted electively, funded by the NHS, and with an admission date no earlier than 1st December 2007. Episodes that involve a cholecystectomy were selected using the OPCS-4 codes (J183, J188, J189 and J268). Episodes that involved procedures that were not subjected to the change in tariff but could be performed as daycases were selected using OPCS-4 codes from the BADS Directory of Procedures (British Association of Day Surgery 2008). This directory contains the BADS recommendations for which surgeries are appropriate as a daycase or short stay. The procedure codes used for the control group are given in Table II. The target for the daycase proportion for cholecystectomies is 60%. As only seven procedures in the BADS directory had a recommended daycase rate of exactly 60%, we selected a list of 74 control procedures with recommended daycase proportions of 60% +/- 15%. The control group includes procedures undertaken in the following eight specialities: Ear, Nose and Throat; General Surgery; Gynaecology; Ophthalmology; Orthopaedic; Urology; Vascular and Medical. We removed episodes that included both a cholecystectomy code and a control procedure code.

The dataset was then aggregated by organisation, month of admission and whether the episode was for cholecystectomy or a control procedure in one of the eight specialties. 169 of the organisations are NHS or Foundation Trusts, 21 are independent sector hospitals and 15 are Primary Care Trusts that provide care directly rather than commission it.

The variables we use to determine the behavioural effects of the tariff are defined as follows. Daycases are defined as patients who have been admitted for treatment just for the day. We generated the daycase proportion as the proportion of total episodes planned and delivered as a daycase. The planned daycase proportion is the number of episodes whose intended clinical management was to treat as a daycase as a proportion of total episodes. The laparoscopic proportion is the share of episodes that have the accompanying procedure code (OPCS4 - Y75.2) indicating a laparoscopic approach, as a proportion of total episodes.

Patient mix is defined by the mean age measured in years and by the proportion of male patients. Patient complexity is measured by the mean number of co-morbidities recorded in the episode.

Amongst episodes planned as daycases, the OPCS4 code Y71.4 indicates those procedures where the surgeon has reverted to open surgery. The readmission rate is the proportion of patients discharged alive who were admitted as an emergency within two days of discharge. Given that these procedures should be treated as daycases or with a one-night stay, we defined long stays as the proportion of patients whose spell lasted for more than one night. The death rate is the proportion of all episodes from which the patient is discharged dead. Volume is the number of episodes involving a cholecystectomy or a control procedure performed by a given hospital in a given month.

The waiting time is the time that elapses between the decision to put the patient on a waiting list for admission to the point at which the patient is actually admitted. Due to changes in national waiting times targets, we begin the analysis of waiting times in April 2008. This is the first year that the 18-week waiting time policy was implemented (Department of Health 2006). To account for a small number of very large values, we analyse the median waiting time for each hospital-month cell.

The HRG tariff for each episode is obtained from HRG version 3.5 for episodes in the 2007/8 and 2008/9 financial years and from HRG version 4 for episodes in 2009/10 and 2010/11. The average HRG tariff for each year is calculated for each control procedure specialty group and for cholecystectomy. This was calculated using the annual composition of HRGs assigned to the control procedures within each of the eight specialties at the national level to ensure that the price variable was independent of hospital and monthly variations in case mix.

3.2. Descriptive statistics

Table III displays the descriptive statistics of the variables used in the empirical analysis, summarised over four periods of time: two 12-month periods before the policy was announced, the anticipation period and the BPT period. Panel A) shows figures for the procedure exposed to the BPT and panel B) focuses on the control procedures.

In general, the daycase and planned daycase proportions are higher amongst control procedures than cholecystectomy, but it is amongst cholecystectomies that there is the largest increase over time, particularly in the anticipation and BPT periods. The laparoscopic proportion is high and stable for cholecystectomies and much lower for the control procedures.

The mean age and proportion of male patients differs between the two groups, but is stable over time for both groups. On average, patients undergoing cholecystectomy have similar numbers of co-morbidities and have a higher proportion of procedures reverted to open surgery. The readmission rate increases for cholecystectomies for the first two periods and increases over the whole period for the controls. The proportion of patients requiring a hospital stay longer than one night decreases in both groups. The death rate is higher for cholecystectomies than for the controls and falls between the first two periods, followed by increases in the death rate in the anticipation and BPT periods.

The median waiting time is higher for cholecystectomies than for the control procedures. The average price for cholecystectomy falls in the first three periods and then increases in the BPT year. For the controls, the average price increases in the first three periods but decreases in the BPT year. We control for these changes in price, which are reactive to the changes in average costs reported by hospitals, by including the price as an explanatory variable.

To summarise, the crude statistics show an increase in the proportion of daycases for the procedure exposed to the BPT, the intended effect of the policy. There is little evidence of unintended effects but, given the other differences between cholecystectomies and the control procedures outlined above, a difference-in-difference analysis is required to establish the causal effect of the policy.

(Table III)

3.3. Graphical analyses

Figure I displays trends in daycase rates for both cholecystectomy and the basket of control procedures over the 40-month period. The vertical lines indicate the months when BPT was announced (at the 25th month, December 2009) and then introduced (at the 29th month, in April 2010). We provide charts for the six least volatile of the 12 outcome variables.

Cholecystectomy and control procedures seem to trend in a similar way for daycases and planned daycase proportion prior to the announcement of the BPT. We formally test this common trend hypothesis below. The gap in outcomes between cholecystectomy and control procedures widens after the BPT was announced showing a potential effect of the policy.

Cholecystectomies and control procedures do not appear to follow common trends in the pre-announcement period for the laparoscopic proportion and long stays in hospital. Whilst the reversion rate decreases noticeably around the time of the policy announcement, laparoscopic procedures were increasing for several months before the BPT was announced. The proportion of patients requiring hospital stays longer than one night was decreasing prior to the BPT and this decline continued afterwards. There does appear to be a common trend in waiting times prior to the new policy. Cholecystectomy waiting times are higher than the control procedures throughout the period, and this difference appears to widen following the introduction of the BPT.

(Figure I)

4. Estimation methods

4.1. Difference in Differences

We analyse the intended and unintended effects of introducing BPTs on several outcome variables, Y, using a difference-in-differences (DiD) methodology. We estimate the following equation using Weighted Least Squares:

$$Y_{ijt} = \alpha_{ij} + \gamma_1 T_t + \gamma_2 P_{it} + \beta_1 D'_{it} + \beta_2 D''_{it} + \varepsilon_{ijt} \qquad (1)$$

where the subscript *i=1,…,I* indicates cholecystectomy (*i*=1) or control procedures grouped by specialty (i=2,..,I); *j=1*,...,*J* indicates the *J* hospital Trusts; *t* indexes the month of observation; α_{ij} are fixed-effects for Trust-specialty combinations; T are month dummies; P

is the HRG tariff; and ε_{ijt} is the error term. We define $D''_{it} = \mathbf{1}[i=1] * T\ [April\ 2010 - March\ 2011]$ as the effect of the price change introduced by the BPT, with β_2 being the DiD coefficient of interest.

There are three weaknesses to the DiD approach. Firstly, the *unobserved temporary component* has to be unrelated to the timing of the introduction of the BPT for cholecystectomy procedures for DiD to be consistent. This is the so-called *Ashenfelter's dip* and occurs when a temporary dip in the cholecystectomies procedures is observed before the BPT was introduced (Heckman & Smith 1994). In this case, the DiD estimator is likely to overestimate the impact of treatment. We define $D'_{it} = \mathbf{1}[i=1] * T[December\ 2009 - March\ 2010]$ as an interaction between cholecystectomy and the anticipation period. This formally tests for a response from providers in anticipation of the policy once it is announced.

The second weakness relates to the *common trend effect*. The DiD common trends assumption is violated if the cholecystectomies and control procedures are affected by different shocks or if common macro shocks affect the cholecystectomies and control procedures differently. We perform a test for common trends between cholecystectomies and control procedures by testing the significance of the interaction between the cholecystectomy dummy and a linear trend measuring the number of months since the beginning of the data period to the month before the policy was announced. For the common trends assumption to be satisfied we have to fail to reject the null hypothesis that the coefficient measuring the difference between control procedures and cholecystectomy is zero. This was undertaken for each dependent variable separately.

The final assumption requires that the composition of the cholecystectomies and control procedures with respect to the fixed effects term must remain unchanged to ensure before-after comparability. This is the *compositional effect over time.*

4.2. Splines

Analysis using the DiD method tests for changes in the *level* of an outcome resulting from a policy change. To test for changes in the *slope* or *trend* of an outcome over time, spline regression can be used (Poirier & Garber 1974). This involves the creation of knots at the points at which the change in outcome is expected to occur. We created knots at December 2009 (month 25) for the anticipation effect and April 2010 (month 29) for the BPT effect. We estimate the following equation using Weighted Least Squares:

$$Y_{ijt} = \alpha_{ij} + \gamma_1 P_{it} + \beta_{1k} \sum_{k=0}^{2} \mathbf{1}\,[t > t_k] \cdot (t - t_k) + \mathbf{1}[i = 1] \cdot \beta_{2k} \sum_{k=0}^{2} \mathbf{1}\,[t > t_k] \cdot (t - t_k) + \varepsilon_{ijt} \quad (2)$$

where t_0=0, t_1=24 and t_2=28 and the other variables are defined as above. β_{20} measures the difference in trend between the control procedures and cholecystectomy in the pre-anticipation period. Its magnitude and statistical significance are indications of the validity of the common trends assumption. $\beta_{11}$and β_{12} capture changes in trend for the control group at the two knots. β_{21} and β_{22} capture additional changes in trend for cholecystectomy at the two knots. β_{21} measures the change in trend in the outcome for cholecystectomy that occurs in the anticipation period. β_{22} measures any additional change in trend in the BPT period compared to the anticipation period, with $\beta_{21} + \beta_{22}$ capturing the change in trend compared to the pre-announcement period.

5. Results

5.1. Difference-in-differences regression results

The pre-trend tests indicate that a control group consisting of procedures from all of the eight specialties did not follow the same trend as cholecystectomy for daycases prior to the announcement of the BPT. Procedures in gynaecology contributed to the test failing more than any other specialty. We proceed by presenting results for a control group where the Gynaecology procedures have been removed. This results in a basket of controls of 838,369 episodes grouped into seven specialties and 205,784 cholecystectomy episodes. The appendix contains results for each of the eight specialties individually.

In Table IV we present the DiD estimation results for each outcome variable. The results shaded in bold are those where the assumption of common pre-trends is satisfied. We find that the BPTs have achieved their intended effects. The daycase proportion increased by 5.8 percentage points. The planned daycase rate also increased by 11.1 percentage points. There is significant evidence of an anticipation effect following the announcement of the policy of 1.7 percentage points for daycases and 4.2 percentage points for planned daycases.

BPTs have achieved their intended effect without any perverse effect on quality. The reversion rate fell by 4 per 1,000 in anticipation of the policy and by a further 0.7 per 1,000 when the policy came into effect. The proportion of patients needing a stay longer than one night fell by 2.2 percentage points in the anticipation period and by a further 2.2 (4.4 in total) percentage points when the policy started. There were no statistically significant effects on death and readmission rates or the gender mix of the patients.

The laparoscopic proportion, the mean number of comorbidities, mean age, volume and median waiting times do not satisfy the pre-trends assumptions with the basket of control procedures. The analysis by individual procedure group shown in the Appendix allows us to comment on the effect of the BPT on these outcomes where the pre-trends assumption was satisfied. The laparoscopic proportion increased compared to two out of the three specialities, the mean number of comorbidities compared to four out of six specialities, the mean age decreased compared to four out of five specialities, provider volume increased compared to four out of five specialties and the median waiting time increased compare to all three specialities where the pre-trend assumption was satisfied.

The analysis by individual procedure group shown in the Appendix also acts as a robustness check for the outcomes where a significant effect is found using the control group. The effect for daycases is positive and statistically significant in all the specialties where the pre-trends assumption is satisfied. The same is true for planned daycases. The effect for reversions is negative and statistically significant in all specialities. The effect on the proportion of patients needing a stay longer than one night is negative in all specialities and statistically significant in three out of five cases.

5.2. Spline regression results

The results for the spline regressions are given in Table V. The coefficients which measure the effect of the policy are those on the additional anticipation and BPT splines for cholecystectomy. Emboldened cells indicate results for models in which the pre-trends assumption is satisfied. As an example, Figure II plots the predicted daycase rate against month and shows the change in slope at the knots when the policy was announced and then implemented.

The results indicate that there was a significant increase in the trend for daycase procedures when the policy was announced. However, this increase in trend slows once the policy came into effect, as signalled by the negative coefficient on the BPT spline. Overall, however, the trend in the daycase rate remains higher than in the pre-anticipation period for cholecystectomy and the same as in the pre-anticipation period for the controls. Planned daycases also show a positive change in trend in the anticipation period which continues into the BPT period. The change in slope for the reversion rate occurs in the anticipation period and returns close to the pre-announcement trend once the policy was implemented. In anticipation of the policy, the trend for the proportion of patients staying over one night decreases. This effect is dampened in the BPT period but the sum of the coefficients suggests a decrease in trend in the BPT period compared to the pre-announcement period. As with the DiD results, there are no significant changes in death or readmission rates or the gender mix.

6. Discussion

Activity-based financing incentivises hospitals to reduce unit costs and may facilitate patient choice and competition but, unless demand is responsive to quality, may encourage hospitals to reduce quality in order to contain costs. The prices paid in such systems are typically based on the average historical costs of treatments reported by hospitals. If hospitals respond to prices, payers might consider setting prices proactively to encourage increases in volume for particular treatments or to change clinical practice, rather than setting prices reactively in response to changes in hospitals ' reported costs.

In this paper we considered how hospitals responded to a proactive price change introduced for one surgical procedure, cholecystectomy, for all hospitals in England in 2010/11. This price change encouraged hospitals to both plan and achieve discharge of patients on the same day as the surgical procedure was undertaken. This daycase treatment was believed to improve patient experience and reduce costs, though the published evidence from trials on the effects on patients is equivocal and the initiative required hospitals to make substantial capital and labour investments and fundamentally re-organise the way in which they provided care. We undertook a difference-in-differences analysis, comparing the surgical procedure to which the price change was applied to a control group of other surgical procedures which continued to be priced on a reactive basis. We examined whether the proactive price change had the intended effect on patient management and whether hospitals reacted in a range of unintended ways.

This paper provides evidence that the new BPT introduced in 2010 by the Department of Health achieved its intended objective. The proportion of patients treated as daycases for cholecystectomy increased by over 5.8 percentage points. Reversions to open surgery and lengths of stay also fell and there were no indications of negative effects on the quality of care or patient outcomes.

Our study is limited in scope to only the short-term effects of the BPTs. Future research will address the question whether proactive price changes can produce persistent changes in clinical practice. A further limitation of our current study, which will be addressed in future research, is the study of the effect of BPTs on the more recently included procedures. A final criticism stems from the argument that the price incentive might have been affected by the reputational effect of the daycase rate. As daycase rates were not made public, we can rule out that this was the case. However, the change in clinical practice due to pecuniary measures might have been coupled with a government target measure being perceived as a mission (Besley & Ghatak 2003)

Our analysis provides evidence that payers can act proactively in their price-setting and might expect a substantial response from hospitals. The substantial effect of this pricing change may be due to its large magnitude (24%) and the clear link between the tariff structure and the changes in care delivery that were required. Payers can also expect hospitals to respond in anticipation of a well-publicised change in policy.

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Table I – Tariff prices for cholecystectomies (2007/8 to 2010/11)

Financial year	*Without complications*	*With complications*
2007/08	£1,777 (patient <70years and without complications)	£2,328 (patient >69years or with complications)
2008/09	£1,837 (patient <70years and without complications)	£2,371 (patient >69years or with complications)
2009/10	£1,365 (without complications)	£2,131 (with complications)
2010/11	£1,694 (daycase without complications) £1,369 (inpatient without complications)	£2,164 (open procedure or laparoscopic procedure with complications)

Source: Department of Health (2014)

Table II – OPCS codes used for potential control group

Speciality group (grouping from BADS)	*OPCS4 procedure code*
Ears, Nose and Throat	D141 D142 D144 D148 D149 D16* E025 E026 E031 E036 E04* E142
General	H511 H59* H601 H602 H603 H608 H609 T21*
Gynaecology♦	Q075 Q22* Q23* Q24* Q25* Q381 Q382 Q388 Q389 Q39* Q49* T42* P233 P237 P234
Ophthalmology	C18* C791 C792
Orthopaedic	W283 W051 W55*"
Urology	M441 M442 M662 N27*
Vascular	L741 L742 L84* L85* L871 L872 L873 L874 L875 L876 L878 L879
Medical	J38* J39* J40* J41* J42* J43* J44* K601 K603 K601 K603 K608 K609 K611 K613 K618 K619

Source: British Association of Day Surgery, (2008)

* = all 4 character codes are used that begin with these 3 characters

♦ dropped from preferred control group

Table III - Descriptive statistics

	A) Cholecystectomies (to which BPTs were applied)				B) BADS procedures (to which BPTs were not applied)			
	Dec'07-Nov'08	Dec'08-Nov'09	Dec'09-Mar'10	Apr'10-Mar'11	Dec'07-Nov'08	Dec'08-Nov'09	Dec'09-Mar'10	Apr'10-Mar'11
Daycase proportion	0.180	0.202	0.246	0.300	0.476	0.496	0.510	0.520
Planned daycase proportion	0.363	0.408	0.473	0.545	0.585	0.605	0.620	0.628
Laparoscopic proportion	0.862	0.874	0.890	0.898	0.046	0.057	0.063	0.069
Mean age	51.573	51.426	51.275	51.262	47.776	48.202	48.123	48.346
Male patient proportion	0.250	0.250	0.256	0.247	0.483	0.477	0.478	0.471
Number of comorbidities	1.282	1.461	1.540	1.923	1.315	1.482	1.620	2.008
Reversion rate (per 1000)	35.406	35.408	30.817	30.316	0.746	0.869	0.995	1.062
Readmission rate (per 1000)	15.910	16.387	16.121	16.501	7.564	7.739	7.798	8.192
Proportion staying > 1 night	0.299	0.278	0.238	0.220	0.173	0.168	0.161	0.159
Death rate (per 1000)	1.322	1.022	1.141	1.171	0.515	0.492	0.611	0.573
HRG tariff (£'000)	2.056	1.988	1.951	1.975	1.470	1.862	2.022	1.726
Median waiting time (days)	56.000	60.000	65.000	64.500	52.000	54.500	57.000	56.000

Note: The first data period for waiting times is the eight months between April and November 2008 to avoid the change in waiting times targets.

Table IV– Difference-in-differences regression results using preferred control group

	Daycase proportion	*Planned daycase proportion*	*Laparoscopic proportion*	*Readmission rate*	*Number of comorbidities*	*Reversion rate*	*Long stay proportion*	*Death rate*	*Mean age*	*Male patient proportion*	*Volume*	*Median waiting time*
Anticipation period	**0.0174***	**0.0415****	0.0202**	**-0.00329**	-0.00907	**-4.034***	**-0.0226*****	**-0.0461**	-0.500**	**0.00202**	0.959*	2.303
	(2.07)	**(3.31)**	(2.71)	**(-0.00)**	(-0.29)	**(-2.31)**	**(-4.34)**	**(-0.12)**	(-2.74)	**(0.48)**	(2.45)	(1.95)
BPT year	**0.0580*****	**0.111*****	0.0317***	**-0.0728**	0.0157	**-4.722*****	**-0.0438*****	**0.0424**	-0.537***	**0.00149**	1.119**	3.902**
	(5.93)	**(7.31)**	(3.36)	**(-0.10)**	(0.51)	**(-3.99)**	**(-7.99)**	**(0.21)**	(-4.58)	**(0.48)**	(2.67)	(2.83)
HRG tariff	**-0.0156***	**-0.0306*****	-0.00981**	**-0.543**	0.0202	**-1.047**	**0.0267****	**0.0671**	-0.167	**-0.000108**	0.381	-1.319
	(-2.39)	**(-3.65)**	(-2.66)	**(-0.79)**	(0.40)	**(-1.53)**	**(3.21)**	**(0.15)**	(-1.09)	**(-0.04)**	(0.84)	(-1.57)
Observations	**47516**	**47437**	47517	**46332**	47517	**47517**	**47512**	**47517**	47517	**47491**	47517	42182
R^2	**0.817**	**0.790**	0.982	**0.089**	0.776	**0.447**	**0.743**	**0.143**	0.857	**0.709**	0.853	0.555

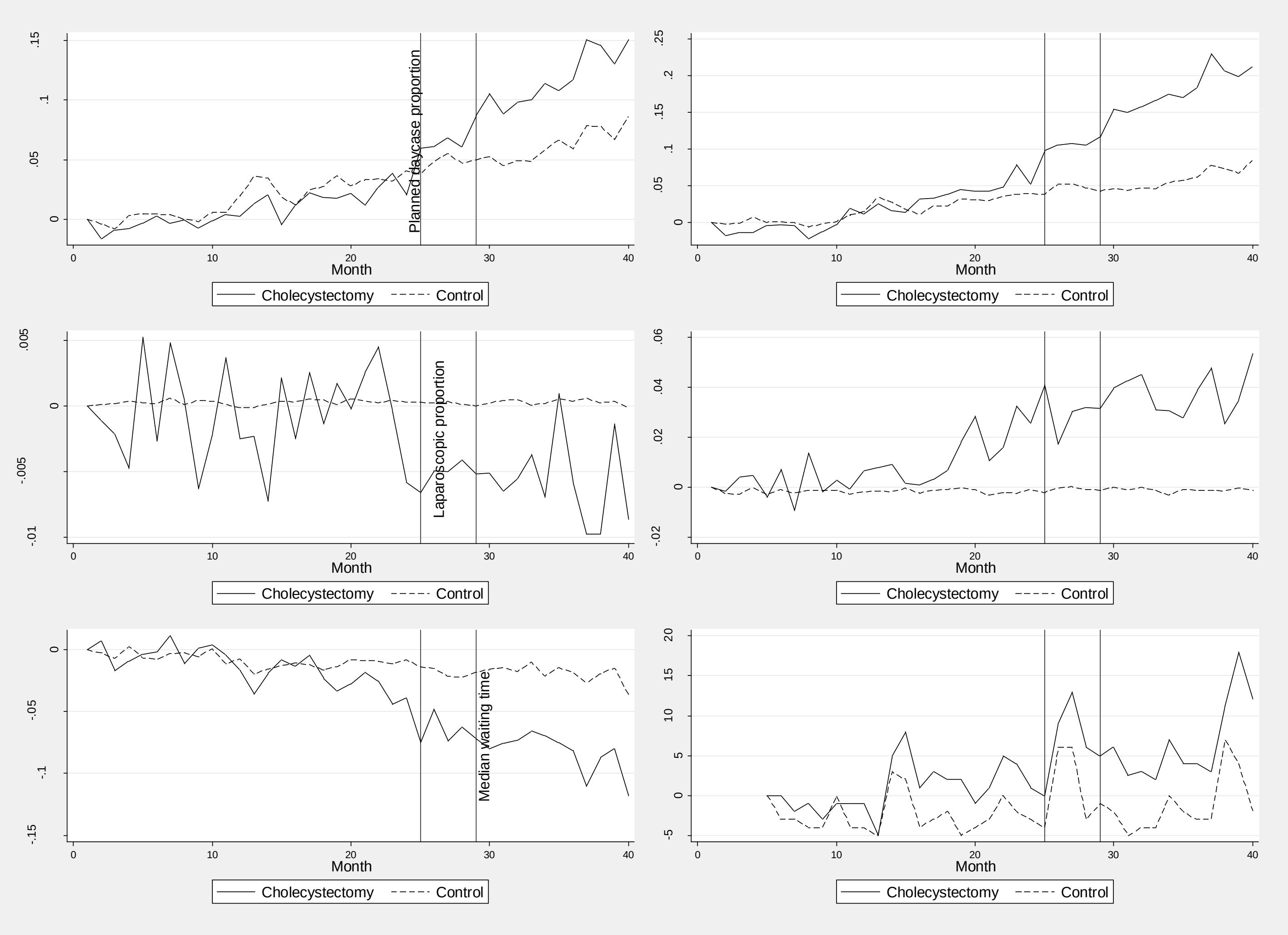
Note: Preferred control is based on pre-trend tests and consists of 7 out of 8 of the specialties, Gynaecology is dropped.
Bold cells are where the pre-trend assumption is satisfied.
All models include 40 month dummies and Trust-specialty fixed effects.
Observations are Trust-speciality-month combinations. Regressions weighted by volume (except volume regression).
Provider cluster robust t statistics in parentheses.
$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table V – Spline regression model results using preferred control group

	Daycase proportion	*Planned daycase proportion*	*Laparoscopic proportion*	*Readmission rate*	*Number of comorbidities*	*Reversion rate*	*Long stay proportion*	*Death rate*	*Mean age*	*Male patient proportion*	*Volume*	*Median waiting time*
Controls												
Linear trend	**0.00214*****	**0.00250*****	0.0000313	**0.0172**	0.0113***	**0.0173***	**-0.00147*****	**-0.00629**	0.0176*	**0.0000320**	-0.0257	0.143
	(6.17)	**(6.28)**	(0.72)	**(0.61)**	(5.77)	**(2.00)**	**(-5.88)**	**(-0.51)**	(2.48)	**(0.18)**	(-1.79)	(1.52)
Anticipation spline	**0.0000465**	**-0.000657**	0.000167	**-0.0333**	0.0354***	**-0.0566**	**0.00152**	**0.0407**	0.0209	**-0.000844**	0.166*	-0.179
	(0.03)	**(-0.42)**	(1.19)	**(-0.25)**	(5.13)	**(-1.43)**	**(1.46)**	**(0.83)**	(0.65)	**(-1.10)**	(2.43)	(-0.49)
BPT spline	**0.000856**	**0.00139**	-0.000285	**0.0894**	-0.0117	**0.0405**	**-0.000670**	**-0.0401**	-0.0349	**0.000936**	-0.197**	0.347
	(0.63)	**(0.90)**	(-1.82)	**(0.54)**	(-1.68)	**(0.96)**	**(-0.71)**	**(-0.95)**	(-1.02)	**(1.08)**	(-3.08)	(1.17)
Additional terms for cholecystectomy												
Linear trend	**-0.000203**	**0.00158**	0.00159***	**0.0813**	0.00536*	**0.0417**	**-0.0000832**	**-0.00474**	-0.0200*	**0.0000270**	0.0751*	0.183*
	(-0.34)	**(1.65)**	(3.91)	**(1.17)**	(2.34)	**(0.43)**	**(-0.17)**	**(-0.23)**	(-2.05)	**(0.11)**	(2.45)	(2.22)
Anticipation spline	**0.00928*****	**0.0120*****	0.000588	**-0.202**	-0.0126	**-1.118***	**-0.00777*****	**0.0682**	-0.0280	**0.000663**	0.158	-0.0322
	(3.87)	**(3.39)**	(0.32)	**(-0.54)**	(-1.42)	**(-2.25)**	**(-3.96)**	**(0.62)**	(-0.57)	**(0.46)**	(1.09)	(-0.09)
BPT spline	**-0.00567***	**-0.00772**	-0.00133	**0.0438**	0.00470	**0.967**	**0.00620****	**-0.0956**	0.0244	**-0.000764**	-0.304	0.155
	(-2.11)	**(-1.97)**	(-0.64)	**(0.10)**	(0.48)	**(1.70)**	**(3.12)**	**(-0.78)**	(0.41)	**(-0.47)**	(-1.92)	(0.35)
HRG tariff (thousand £)	**-0.0115**	**-0.0154***	-0.000694	**0.133**	0.0344	**-0.165**	**0.0205****	**0.00807**	-0.222	**0.00302**	0.610	0.335
	(-1.84)	**(-2.16)**	(-0.93)	**(0.23)**	(0.68)	**(-1.24)**	**(2.71)**	**(0.02)**	(-1.63)	**(1.04)**	(1.62)	(0.44)
Observations	**47516**	**47437**	47517	**46332**	47517	**47517**	**47512**	**47517**	47517	**47491**	47517	42182
R^2	**0.817**	**0.790**	0.982	**0.088**	0.774	**0.446**	**0.742**	**0.142**	0.857	**0.708**	0.846	0.550

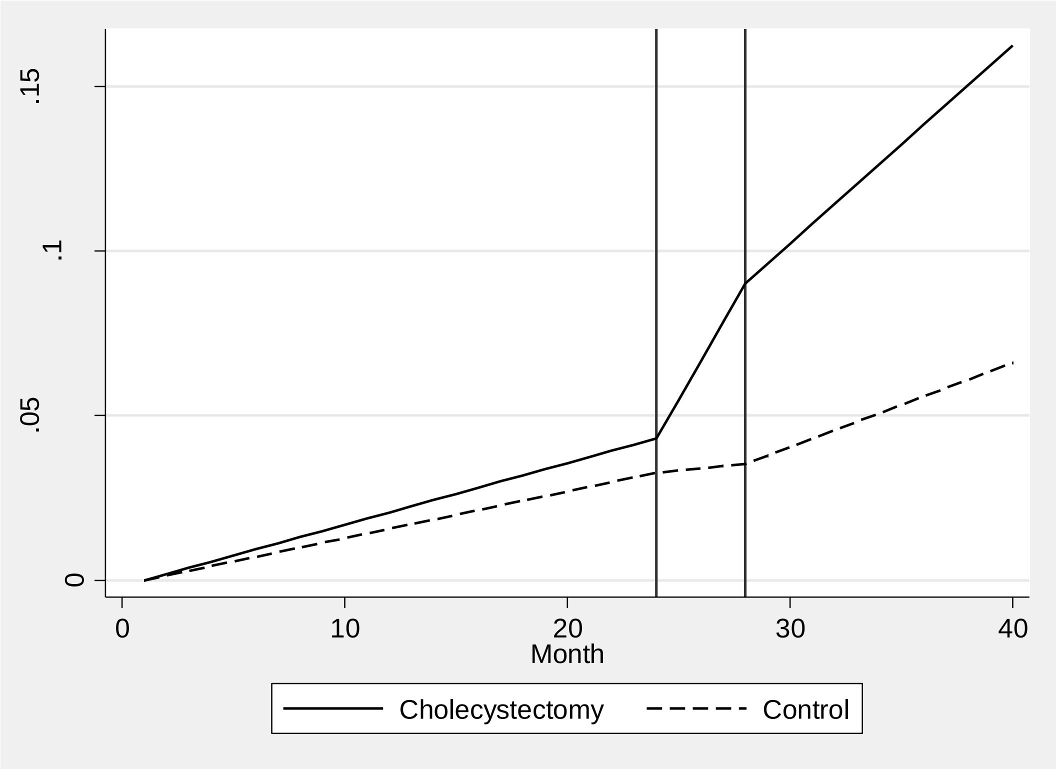
Note: Preferred control is based on pre-trend tests and consists of 7 out of 8 of the specialties, Gynaecology is dropped.
The linear trend coefficient for cholecystectomy tests the pre-trend assumption. The coefficient on the BPT spline is additional to the coefficient on the anticipation spline.
Bold cells are where the pre-trend assumption is satisfied.
All models include Trust-specialty fixed effects.
Observations are Trust-specialty-month combinations. Regressions weighted by volume (except volume regression).
Provider cluster robust t statistics in parentheses.
$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure I – trends for selected outcome variables for cholecystectomy and control group



Notes: Series are indexed to their values in the first month.

Figure II – Predicted daycase rates from the spline regression model



Notes: Series are indexed to their values in the first month.

Appendix

Appendix table I– Difference-in-difference terms using control procedures in each of the eight specialties separately

Specialty	*Daycase proportion*	*Planned daycase proportion*	*Laparoscopic proportion*	*Readmission rate*	*Mean comorbidities*	*Reversion rate*	*Long stay proportion*	*Death rate*	*Mean age*	*Male patient proportion*	*Provider volume*	*Median waiting time*	*Number of episodes*
Ear, nose and throat	**0.0302***	**0.0707*****	0.0331**	**0.0548**	0.123***	**-4.532*****	-0.0531***	**0.0553**	**-0.247**	**0.00353**	1.205*	**1.957**	181,550
	(2.28)	**(3.38)**	(3.34)	**(0.06)**	(3.69)	**(-3.80)**	(-8.87)	**(0.28)**	**(-1.53)**	**(0.85)**	(2.25)	**(0.82)**	
General	**0.0472*****	**0.102*****	**0.0301****	**0.683**	**0.0870****	**-5.154*****	**-0.0341*****	**-0.164**	**-0.120**	**0.00596**	1.336**	2.157	76,669
	(4.62)	**(7.11)**	**(3.13)**	**(0.53)**	**(3.14)**	**(-3.97)**	**(-5.99)**	**(-0.75)**	**(-0.47)**	**(0.96)**	(3.20)	(1.56)	
Gynaecology	0.102***	0.151***	**-0.0274***	**1.143**	**-0.0590**	**-5.896*****	**-0.0185***	**0.126**	-0.427*	**-0.00448**	-1.737**	-0.570	141,662
	(10.16)	(9.38)	**(-2.57)**	**(1.17)**	**(-1.61)**	**(-4.86)**	**(-2.30)**	**(0.63)**	(-2.05)	**(-1.37)**	(-3.09)	(-0.13)	
Ophthalmology	**0.0449***	**0.127*****	0.0371**	**-0.379**	**0.0194**	**-4.250*****	**-0.0150**	**0.0376**	**-0.433***	**-0.00496**	**-0.381**	**8.592*****	94,982
	(2.00)	**(4.91)**	(3.26)	**(-0.33)**	**(0.18)**	**(-3.35)**	**(-1.05)**	**(0.19)**	**(-2.17)**	**(-1.00)**	**(-0.62)**	**(4.37)**	
Orthopaedic	**0.0762*****	0.118***	0.0232**	**-0.836**	**0.0268**	**-5.571*****	-0.0411***	**0.0495**	- 1.111***	**0.0124***	**0.320**	1.561	137,383
	(8.29)	(8.61)	(3.32)	**(-0.85)**	**(0.78)**	**(-4.19)**	(-6.41)	**(0.22)**	(-4.87)	**(2.53)**	**(0.66)**	(0.86)	
Urology	**0.114*****	0.156***	**0.0364****	**2.752**	-0.210***	**-4.269****	**-0.0174**	**0.140**	**-1.163****	**0.00261**	**0.985**	1.771	33,365
	(8.41)	(8.33)	**(3.18)**	**(1.51)**	(-3.47)	**(-3.25)**	**(-1.61)**	**(0.36)**	**(-3.24)**	**(0.65)**	**(1.90)**	(1.03)	
Vascular	**0.0666*****	**0.120*****	0.0320**	**-1.230**	**0.0173**	**-4.578*****	**-0.0494*****	**0.278**	- 0.860***	**-0.0132***	**3.756*****	5.752**	118,409
	(4.95)	**(6.77)**	(3.32)	**(-1.40)**	**(0.34)**	**(-3.85)**	**(-7.72)**	**(1.26)**	(-4.18)	**(-2.35)**	**(7.04)**	(3.06)	
Medical	**0.0924*****	**0.156*****	0.0280**	**0.00952**	**-0.476****	**-5.214*****	-0.0874***	**-0.444**	**0.154**	**-0.00646**	**0.0472**	**1.595**	54,349
	(4.08)	**(6.02)**	(3.33)	**(0.01)**	**(-2.80)**	**(-4.26)**	(-3.88)	**(-0.44)**	**(0.64)**	**(-0.87)**	**(0.05)**	**(0.82)**	
Control group	**0.0580*****	**0.111*****	0.0317***	**-0.0728**	0.0157	**-4.722*****	**-0.0438*****	**0.0424**	-0.537***	**0.00149**	1.119**	3.902**	838,369
	(5.93)	**(7.31)**	(3.36)	**(-0.10)**	(0.51)	**(-3.99)**	**(-7.99)**	**(0.21)**	(-4.58)	**(0.48)**	(2.67)	(2.83)	

Note: Preferred control is based on pre-trend tests and consists of 7 out of 8 of the specialties, Gynaecology is dropped.
Bold cells are where the pre-trend assumption is satisfied.
All models include 40 month dummies and Trust-specialty fixed effects.
Observations are Trust-speciality-month combinations. Regressions weighted by volume (except volume regression).
Provider cluster robust t statistics in parentheses.
$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix table II – Pre-trend test results for control procedures in each of the eight specialties separately

Specialty	*Daycase proportion*	*Planned daycase proportion*	*Laparoscopic proportion*	*Readmission rate*	*Mean comorbidities*	*Reversion rate*	*Long stay proportion*	*Death rate*	*Mean age*	*Male patient proportion*	*Provider volume*	*Median waiting time*
Ear, nose and throat	-0.0000819 (-0.08)	0.00111 (0.90)	0.00145*** (3.94)	0.0211 (0.23)	0.00694* (2.55)	0.0381 (0.38)	-0.00119* (-2.38)	-0.00432 (-0.27)	0.00470 (0.27)	0.0000543 (0.11)	0.119* (2.47)	-0.244 (-1.68)
General	0.000159 (0.19)	0.00151 (1.38)	0.00126 (1.62)	-0.0283 (-0.19)	0.00480 (1.69)	-0.0265 (-0.17)	-0.000224 (-0.34)	-0.00114 (-0.04)	-0.0353 (-1.43)	0.00112 (1.82)	0.0676* (2.08)	-0.697*** (-4.39)
Gynaecology	0.00244** (3.14)	0.00399*** (3.64)	-0.000991 (-1.17)	-0.0710 (-0.55)	0.00550 (1.76)	0.0208 (0.18)	-0.00127 (-1.79)	-0.00932 (-0.38)	-0.0511** (-2.61)	-0.0000301 (-0.10)	-0.0821* (-2.26)	-0.360* (-2.02)
Ophthalmology	0.0000282 (0.02)	0.00256 (1.67)	0.00141*** (3.71)	0.211 (1.73)	-0.000710 (-0.10)	0.0279 (0.28)	0.00185 (1.69)	-0.00749 (-0.41)	-0.00249 (-0.15)	-0.000538 (-0.89)	-0.0656 (-1.87)	-0.218 (-1.11)
Orthopaedic	0.000594 (0.78)	0.00253* (2.37)	0.00140*** (3.69)	0.0977 (1.04)	0.00234 (0.79)	-0.00194 (-0.02)	-0.00128* (-2.04)	-0.0191 (-0.77)	-0.0717** (-3.04)	0.00103 (1.88)	0.0326 (0.86)	-0.564*** (-3.50)
Urology	0.00189 (1.78)	0.00310* (2.39)	0.000997 (1.18)	-0.200 (-0.90)	-0.0112* (-2.47)	-0.0859 (-0.52)	0.00171 (1.72)	-0.0152 (-0.34)	-0.0113 (-0.29)	0.000217 (0.37)	0.0241 (0.85)	-0.661** (-2.96)
Vascular	-0.000327 (-0.32)	0.00236 (1.77)	0.00123* (2.40)	0.104 (0.93)	0.00340 (0.92)	0.000291 (0.00)	-0.000623 (-1.04)	0.0250 (0.88)	-0.0556* (-2.24)	0.000162 (0.26)	0.0689 (1.51)	-0.300* (-2.08)
Medical	-0.000501 (-0.48)	0.00261 (1.90)	0.00148*** (4.02)	0.0731 (0.45)	0.00786 (1.23)	0.0122 (0.12)	-0.00287** (-2.92)	-0.0965 (-0.76)	-0.0481 (-1.58)	0.000718 (0.83)	0.00801 (0.16)	0.0561 (0.23)
Control group	-0.000203 (-0.34)	0.00158 (1.65)	0.00159*** (3.91)	0.0813 (1.17)	0.00536* (2.34)	0.0417 (0.43)	-0.0000832 (-0.17)	-0.00474 (-0.23)	-0.0200* (-2.05)	0.0000270 (0.11)	0.0751* (2.45)	0.183* (2.22)

Note: Preferred control is based on pre-trend tests and consists of 7 out of 8 of the specialties, Gynaecology is dropped.
All models include Trust-specialty fixed effects.
Observations are Trust-specialty-month combinations. Regressions weighted by volume (except volume regression).
Provider cluster robust t statistics in parentheses.
p < 0.05, ** p < 0.01, *** p < 0.001