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**The Effects on Waiting Times of
Expanding Provider Choice:
Evidence from a Policy Experiment**

CHE Research Paper 1

The effects on waiting times

of expanding provider choice:

evidence from a policy experiment

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Abstract

Long waiting times for inpatient treatment in the UK National Health Service have long been a source of great popular and political concern, and therefore a target for policy initiatives. One such is the London Patient Choice Project, under which patients at risk of breaching inpatient waiting time targets were offered the choice of an alternative hospital with a guaranteed shorter wait. This paper uses a difference in difference econometric methodology to infer the impact of the choice project on ophthalmology waiting times. In line with our theoretical predictions, it finds that the project led to lower average waiting times in the London region and a convergence in waiting times amongst London hospitals.

1   Introduction

1.1   The policy background

The bulk of UK health care is delivered by the National Health Service (NHS), funded out of general taxation, with primary and secondary care largely free of direct charges to patients. Almost all citizens are registered with an NHS general practitioner (GP) and - apart from those admitted through accident and emergency units - no patient can be seen by an NHS specialist without being referred by a GP.   The GP is a gatekeeper for non-emergency (elective) secondary care, and has also had a dominant role in determining which specialist a patient will see, and therefore which hospital she will be treated in. Once a referral has been made, there have historically been long delays for patients awaiting a first visit to an outpatient department, and subsequently for those awaiting inpatient treatment. For example, in 2000 the mean waiting time in England for a first outpatient appointment for ophthalmology patients was 11.7 weeks, and for subsequent inpatient admission an additional 27.6 weeks.

The waiting times for elective inpatient surgery have as a result been a highly politically charged feature of the English NHS (Yates, 1987; 1995). In 2000 the national government set a target of a maximum inpatient waiting time, measured from the time a specialist advised treatment was necessary to receipt of the treatment, of 15 months by March 2002, of twelve months by March 2003, and of three months by the end of 2008. Targets for waits for a first appointment with the specialist were also set (although delays for diagnostic tests were not included) (Department of Health, 2000). Subsequently, an even more ambitious target of eighteen weeks maximum has been set for the period from an initial referral to a hospital specialist to eventual treatment (HM Treasury, 2004).   Numerous initiatives have been introduced in pursuit of these objectives, including London Patient Choice Project (LPCP), the subject of this paper.

1.2   The London Patient Choice Project

The London Patient Choice Project offered some patients awaiting elective surgery some element of choice over when and where they received treatment. If they were awaiting inpatient treatment at a participating London hospital, and were in danger of breaching the 6 month waiting time target, they offered the patient the choice of being treated in her current hospital, or of receiving treatment with a guaranteed shorter wait at one of two alternative providers.

London hospitals could participate in the LPCP as "exporters" (whose patients could be offered choice of treatment elsewhere), or as "importers" who treated the patients referred from exporters. Alternatively, hospitals could decide not to participate as either exporters or importers. The LPCP management team was provided with a budget directly from the national ministry to purchase operations at fixed price per patient from designated importers, in the form of existing hospitals or new providers known as Treatment Centres. (Treatment Centres are similar to Single Specialty Hospitals in the US, and differ from standard public hospitals in that they do not accept emergency admissions.) Note that the LPCP budget was not taken directly from the existing budgets of London hospitals, so the Project implied an increase in the total supply of surgical capacity in London. Exporting hospitals supplied the LPCP team with the names of London resident patients expected to breach the six month target waiting time. Each patient was then contacted by the LPCP team and offered an agreed date for admission at an importer.

All London NHS hospitals were subject to the national performance ratings regime, which gave managers a very strong incentive to adhere to the challenging waiting time targets (Smith, 2005). A hospital with long waiting times therefore had an incentive to join LPCP as an exporter in order to meet waiting time targets, since its exported patients had shorter waiting times. Moreover, it did not directly lose income by exporting patients. A hospital with short waiting times had a direct financial incentive to participate as an importer, so long as its own waiting time performance was not adversely affected.

The LPCP was applied first to ophthalmology from October 2002, covering about two thirds of all procedures in the speciality. The initiative was extended to orthopaedics, ENT and general surgery during April 2003 and to a number of other routine acute procedures later in 2003. By June 2004, 22,500 patients had been offered choice and 15,000 (66%) had accepted treatment at another hospital (Dawson *et al*, 2004).   Of the 20 London NHS hospitals providing ophthalmology services, 10 were exporters, 4 were importers and 6 chose not to participate. 79% of patients exercising choice were treated at treatment centres.

The LPCP offers an opportunity to examine the impact on waiting times of offering a greater degree of choice to hospital patients within a planned health system. In contrast to many NHS initiatives, it applied only to one region of England, and so its impact can be assessed by using careful comparison with other parts of the country.   This paper therefore uses econometric methods to examine the impact of LPCP on the levels and distribution of ophthalmology waiting times in London.   It is part of a larger project that examined the system-wide impact of the LPCP (Dawson *et al*, 2004). We first present a theoretical model that captures the main aspects of patient choice relevant to this study. We then present our data sources and empirical methods.   Results for the ophthalmology specialty are then presented. Finally, some implications for policy are drawn.

2   Choice and waiting times: theoretical model

In this section we present a theoretical model that seeks to capture and distinguish the effects of two essential components of LPCP: increased choice for patients and an increase in the total supply of elective care. We start by holding total supply fixed to focus on the effects of choice. Suppose there are two geographical areas. In the pre-choice regime, the population of each area is assigned to the single hospital in the area. The demand for elective care depends on local patient characteristics and the waiting time at the local hospital: $x_i = D_i(w_i)$ (*i*=1,2). Each provider has fixed capacity S_i. The market in each area clears:

$$D_i(w_i) - S_i = 0, \quad i = 1, 2 \tag{1}$$

yielding the waiting times in each area in the no choice era as:

$$w_i^{nc} = w_i(S_i), \quad w_i' = 1/D_i' \quad i = 1, 2 \tag{2}$$

The average waiting time across both areas is:

$$\overline{w}^{nc} = \frac{D_1(w_1)w_1 + D_2(w_2)w_2}{D_1(w_1) + D_2(w_2)} = \frac{S_1 w_1 + S_2 w_2}{S_1 + S_2} \tag{3}$$

When choice is introduced, patients in either area are allowed to go to either hospital. The market equilibrium condition is now:

$$D_1(w) + D_2(w) - S_1 - S_2 = 0 \tag{4}$$

yielding the same equilibrium waiting time in each area of:

$$w^c = w^c(S_1 + S_2) \tag{5}$$

Comparison of (3) and (5) shows whether choice increases or decreases the average waiting time. By assuming linear demand curves $x_i = a_i - b_i w_i$ it is possible to solve for the change in average waiting time as functions of the parameters a_i, b_i, S_i (*i* = 1, 2). It can be shown

that the mean waiting time will not be constant unless one makes highly restrictive assumptions about the relationships amongst the parameters.

More generally, we can proceed by modelling choice as equivalent to the transfer of capacity from the area with low waiting time to the area with the high waiting time until waiting times are equalised. (The transfer can be thought of as requiring that some of the beds in the 'importing' area can be used to treat patients from the 'exporting' area.) Thus, letting area 1 be the high waiting time area and t be the amount of capacity transferred, the waiting times become:[1]

$$w_1 = w_1(S_1 + t), \quad w_2 = w_2(S_2 - t) \tag{6}$$

and the mean wait is:

$$\overline{w}(t) = \frac{[D_1(w_1(S_1 + t)) - t]w_1(S_1 + t) + [D_2(w_2(S_2 - t)) + t]w_2(S_2 - t)}{D_1(w_1(S_1 + t)) + D_2(w_2(S_2 - t))}$$

$$= \frac{S_1 w_1(S_1 + t) + S_2 w_2(S_2 - t)}{S_1 + S_2} \tag{7}$$

t^c is the amount of capacity that must be transferred to equalise waiting times and is defined by:

$$w_1(S_1 + t^c) = w_2(S_1 - t^c) = w^c(S_1 + S_2) \tag{8}$$

We can characterise the no choice regime by $t = 0$ the full (completely unrestricted) choice regime by $t = t^c$ and the effect of full choice relative to no choice on average waiting times is $\overline{w}(t^c) - \overline{w}(0)$.

We require specific assumptions about functional forms and parameters in order to determine if full choice increases or reduces mean waiting times. But we can make some progress by examining the effect of a small increase in choice by differentiating $\overline{w}(t)$ with respect to t.

Notice from (7) that the mean wait is the mean waiting list divided by the total supply: $\overline{w}(t) = \overline{L}(t)/[S_1 + S_2]$. Since we assume initially that choice has no effect on total supply, the sign of the marginal effect of extra choice on the mean wait is the same as the sign of the effect of extra choice on the mean waiting list:

$$\frac{d\overline{L}(t)}{dt} = [(S_1 + t)w_1' + w_1] - [(S_2 - t)w_2' + w_2] = [D_1 w_1' + w_1] - [D_2 w_2' + w_2]$$

$$= \left[\frac{1}{\varepsilon_1} + 1\right]w_1 - \left[\frac{1}{\varepsilon_2} + 1\right]w_2 \tag{9}$$

where ε_i is the elasticity of demand with respect to waiting time.

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1. We assume implicitly here that patients in area 1 look only at the waiting time at hospital 1 in deciding whether to join the list at hospital 1. Thus they ignore the possibility of getting transferred to hospital 2. This seems reasonable for the LPCP where patients were offered choice only after they had been on the list at the exporting hospital for several months.

Notice that at $t = t^c$, we would have $w_1 = w_2$ and a small restriction on choice (reduction in t) would increase the mean waiting time if and only if $\varepsilon_1 > \varepsilon_2$. Thus, if demand is less elastic in area 1 and we restrict choice a little, the average waiting time will increase.

If we assume that demand elasticities are equal $\varepsilon_1 = \varepsilon_2 = \varepsilon$ then the sign of (9) is determined by the sign of:

$$(w_1 - w_2)(1 + \varepsilon)\varepsilon \tag{10}$$

Empirical studies (for example, Martin and Smith, 1999; Gravelle, Smith and Xavier, 2003) invariably show quite inelastic demand with respect to waiting time ($0 > \varepsilon > -1$) so that with equal demand elasticities in the two areas an increase in choice will reduce the average waiting time.

So far we have assumed that total supply is not affected by the choice regime, and that there is merely a transfer between hospitals. But LPCP led to an increase in supply. Suppose that the new supply n is available only in hospital 2 (the importer). Then the waiting time at hospital 2 is now $w_1(S_1 - t + n)$ and the mean wait is

$$\overline{w}(t, n) = \frac{S_1 w_1(S_1 + t) + (S_2 + n)w_2(S_2 - t + n)}{S_1 + S_2 + n} \tag{11}$$

which is decreasing in n provided demand at hospital 2 is inelastic ($\varepsilon_2 > -1$).

In fact, much of additional supply in the LPCP was provided at new Treatment Centres rather than importing hospitals. To capture this type of new supply suppose all new supply is provided through Treatment Centres for which the average wait is w_0. Then the mean wait is now

$$\overline{w}(t, n) = \frac{S_1 w_1(S_1 + t + n) + S_2 w_2(S_2 - t) + n w_0}{S_1 + S_2 + n}$$

which is decreasing in n provided that the waiting time at Treatment Centres is less than the weighted average wait in hospitals 1 and 2.[2] Increases in n reduce the wait for patients at the exporting hospital and have no effect on the wait of those in the importing hospital.

Resources devoted to different types of elective care can be varied by hospitals so that the change in incentives created by LPCP may also lead to changes in endogenous supply and hence waiting times. Although these possibilities complicate the theoretical modelling, they do not qualitatively affect the nature of the results (Gravelle, 2005).

The implementation of the LPCP does not correspond exactly to this highly stylized representation. In particular, it emphasizes the impact of patient choice on waiting times without considering the precise financial and other incentives in force in London hospitals, or factors other than waiting time (such as travel distance) that influence patient choice. However, the model does capture many of the essential features of a move towards greater patient choice amongst hospitals. Reasonable assumptions about the parameter estimates suggest that, other things equal, the effect of the LPCP is that

- (a) on average for LPCP hospitals waiting times will fall;
- (b) waiting times will increase in importing hospitals;
- (c) waiting times will fall in exporting hospitals;
- (d) differences in waiting times between importing and exporting hospitals will fall;

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2. Increasing n increases demand and supply at Treatment Centres by the same amount and so does not alter w_0. The sign of $\partial\overline{w}/\partial n$ is the sign of $(S_1 + S_2 + n)S_1 w_1' + (S_1 + S_2)w_0 - (S_1 w_1 + S_2 w_2)$.

3   Methods and data

We use difference in difference (DID) methodology (Blundell and Costa Dias, 2000; Wooldridge, 2002) to identify the effects of the LPCP. We compare the change in ophthalmology waiting times for LPCP hospitals for the three years before (October 1999 to September 2002) and the one year after (October 2002 to September 2003) with the change in waiting times for hospitals in a comparator group over the same period.

Our theoretical model (hypothesis (a)) suggests that choice leads to a reduction in waiting times averaged across importers and exporters. Participation as an exporter or importer was voluntary and 6 out of 20 London hospitals did not join the LPCP. A comparison of waiting times averaged across importers and exporters against waiting times for hospitals outside London may therefore be biased by selection effects. A London hospital's decision to take part in the LPCP is likely to have been influenced by unobservable factors affecting its expectation of its waiting times if it did not join. Hence we test hypothesis (a) by testing for an effect of the LPCP on waiting times for all LPCP hospitals whether importers, exporters or other.

We estimate

$$w_{iq} = \beta_0 + \beta_1 L_i + \sum_{t=1}^{3} \beta_{2t} D_t + \beta_3 Z_{it} + \sum_{q=1}^{3} \beta_{4q} D_q + \sum_{t=1}^{3} \delta_t L_i D_t + \varepsilon_{iq} \tag{12}$$

where
w_{iq} is waiting time for hospital i in quarter q
D_t is a year dummy for t = 1 (1999/00), 2 (2000/01), and 3 (2001/02). The baseline year is 2002/03.
L_i is a dummy variable for LPCP hospitals where L_i = 1 if a hospital is in LPCP and 0 otherwise
Z_{it} are observable factors affecting waiting times for hospital i in quarter t
D_q is a seasonal (quarter) dummy (q = 2,3,4)

The year and seasonal dummies seek to control for all other unobserved temporal factors affecting waiting times. The LPCP main effect L_i controls for all time invariant differences between LPCP hospitals and the control group. The interaction of the year and LPCP dummies identifies the change in waiting times from the base year for LPCP hospitals relative to control hospitals. The DID methodology assumes that all other temporal factors affecting waiting times have the same effects for LPCP hospitals and the control group. Thus we assume any changes over time that we do not control for affect all hospitals in the same way.

The effect of the LPCP on LPCP hospitals is the difference in differences for year 4 (the year when LPCP was in effect) against a previous year. Remembering that we used year 4 (2002/03) as the "baseline year", the difference in difference measure of year 4 against year 3 is

$$\left[E\left(w_{iq} \mid Z_{iq}, D_q, L_t = 1\right) - E\left(w_{iq} \mid Z_{iq}, D_q, L_t = 1, D_3 = 1\right) \right]$$
$$- \left[E\left(w_{iq} \mid Z_{iq}, D_q, L_t = 0\right) - E\left(w_{iq} \mid Z_{iq}, D_q, L_t = 0, D_3 = 1\right) \right]$$
$$= \left[\beta_1 - \left(\beta_1 + \beta_{23} + \delta_3\right) \right] - \left(\beta_{23}\right) = -\delta_3 \tag{13}$$

This is the effect of the LPCP relative to year 3 (October 2001 to September 2002) but we also measure it as the effect relative to year 2   ($-\delta_2$) and to year 1 ($-\delta_1$).

Note that, as 6 out of 20 London hospitals did not participate in the LPCP, the estimated effect of the LPCP on the waiting times of all London hospitals including the non-participants is likely to understate its effect on waiting times averaged across importers and exporters.

Our model in section 2 also generates predictions about the effect of the LPCP on waiting times at exporters, importers and others. We predict that exporting hospitals will have reduced waiting times, importers will have increased waiting times and the others should not

be affected.   We test these predictions with an empirical model that distinguishes between the three types of hospital in London. We estimate

$$w_{iq} = \beta_0 + \sum_{k=1}^{3} \beta_{1k} L_{ik} + \sum_{t=1}^{3} \beta_2 D_t + \beta_3 Z_{iq} + \sum_{q=1}^{3} \beta_{4q} D_q + \sum_{k=M}^{O} \sum_{t=1}^{3} \delta_{kt} L_{ik} D_t + \varepsilon_{iq} \qquad (14)$$

where L_{ik} is a dummy variable for hospital type $k = M,X,O$ for importers, exporters and others.

Again we test for an effect of the LPCP on LPCP hospitals of type k by using the DID coefficients (β_{3kt}).   Thus for example we test hypothesis (b) on waiting times for importing hospitals by examining ($-\delta_{Mt}$), and hypothesis (c) for exporters by using ($-\delta_{Xt}$). We test hypothesis (d) about the convergence of waiting times of exporters and importers by examining whether the improvement in exporters relative to importers ($\delta_{Mt} - \delta_{Xt}$) is positive.

The first full year of data for LPCP in ophthalmology ran from October 2002 to September 2003, and we concentrate on results for this specialty in the interests of space. (Results for other specialties are presented elsewhere, Dawson *et al* (2004).)

The waiting time measure is derived from quarterly administrative returns for ophthalmology for each hospital over a period of 4 years (16 quarters), starting from October 1999. We also have yearly hospital data (Z_{it}) on expenditure, resource use, performance, activity, capacity measures, and staffing, including vacancy rates and salaries.

Some hospitals within LPCP switched between the three (within-treatment) groups over the course of the LPCP treatment, and we take their status within LPCP as it stood in quarter 4 of the first year of LPCP (quarter 16).

We used three types of comparator hospitals to estimate the effects of LPCP on LPCP hospitals: all hospitals in the rest of England; a matched control group from the rest of England; and all hospitals in four large metropolitan areas. The rest of England control group compares LPCP hospitals to a much larger sample of hospitals. This has the advantage of reducing standard errors on coefficient estimates in the regression analysis. However, its disadvantage is that the non-LPCP hospitals in the rest of England are very varied and so may have unobserved differences in the time trends of their waiting times, thereby violating the identifying assumption of the DID method.

We therefore also matched LPCP hospitals with non-LPCP hospitals using propensity score matching in the hope that hospitals which were similar in terms of their observed characteristics would also have similar unobserved factors affecting their waiting time trends. Since the assignment of hospitals to the treatment (LPCP) and control (non-LPCP) groups is not random, the estimation of the treatment effect may be biased by the existence of confounding factors (Becker and Ichino, 2002). Propensity score matching matches treatment hospitals (LPCP) with non-treatment hospitals, chosen from the set of hospitals in the rest of England on the basis of observable characteristics, other than their waiting times, in the year before introduction of LPCP. The disadvantage of the approach is that – whilst statistically there is a strong match between LPCP and non-LPCP hospitals on their observable pre-treatment characteristics – the control group is small, and coefficient estimates may therefore be less well defined.

As a compromise between a large but unmatched comparator group and the small matched group, we also used hospitals in certain Metropolitan areas (West Yorkshire, Greater Manchester, Birmingham and the Black Country, and West Midlands South) as controls.

For each of the above control groups we estimated DID models using three estimators: pooled OLS, fixed effects, and random effects or generalised estimation equation models (Liang & Zeger, 1986). We report all three sets of results. Robust standard errors were employed throughout. We tested for multi-collinearity using variance inflation factors for the covariates specified in the fitted model. Variables were dropped if there was evidence of multi-collinearity (Fox, 1997).

4   Results

4.1   Effects of London Patient Choice Project on waiting times

Table 1 has descriptive statistics for the mean inpatient waiting times in ophthalmology for the different groups of hospitals. The mean waiting time across all treatment and control groups has fallen over the 4 periods. Exporters have higher waiting times than all other groups of hospitals, particularly in the first 3 years although there is a big decline in year 4. The 'other' group have consistently lower waiting times than any of the other groups within London over the 4 years. Waiting times for the rest of England group and the matched control group are similar. Mean waiting times in metropolitan areas are lower than for the other two control groups, and similar to the 'other' hospital group within London, particularly for the last 2 years of data.

Table 1 also shows the coefficients of variation for all groups. Across all groups (except metropolitan areas) there has been a reduction in the coefficient of variation over the four year period: mean waiting times have become more similar within the groups.

Figure 1 shows trends in average ophthalmology waiting times for (a) importing hospitals (b) exporting hospitals and (c) non-participating hospitals in London, with the start of the LPCP indicated by the vertical line in 2002. (There was hiatus in data collection for one year in 1997-98.) The graph demonstrates *prima facie* evidence of a general downward trend in waiting times, and a convergence amongst London hospitals of all types. However, in the absence of proper econometric modelling of control groups, such observational data cannot isolate the specific impact of LPCP.
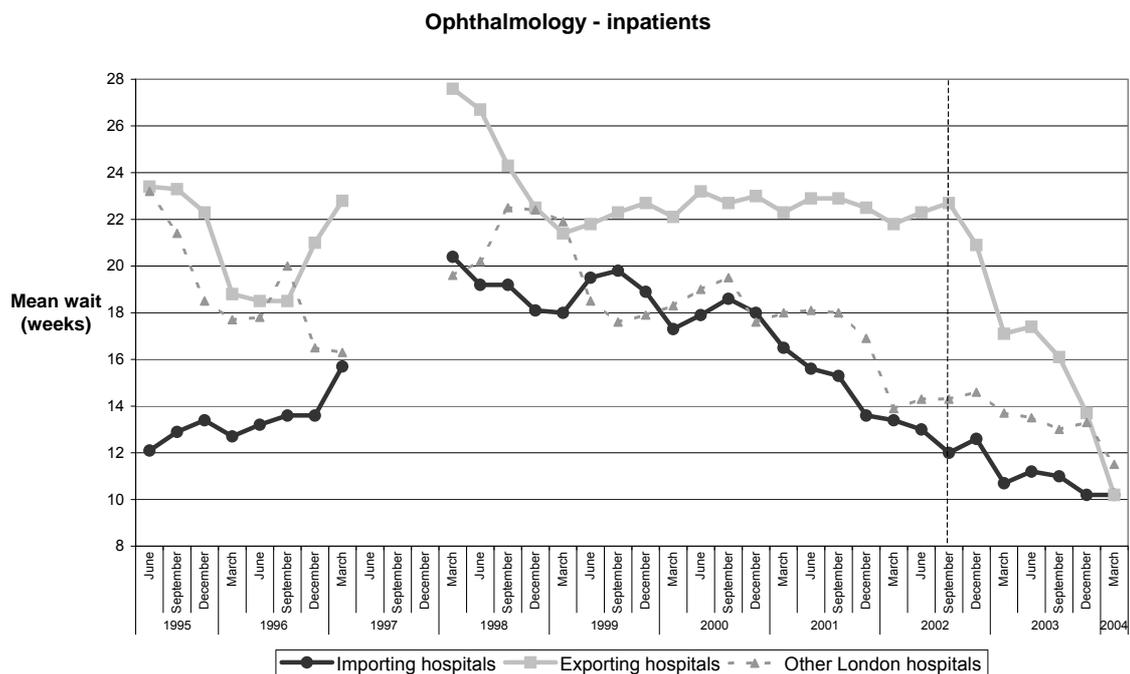
Ophthalmology - inpatients

Figure 1: Waiting time in weeks for ophthalmology inpatients, June 1995-March 2004

Table 1: Inpatient mean waiting time in weeks in ophthalmology by hospital group by year

	Number of hospitals	LPCP year	Number of observations	Mean	Std Dev	Coefficient of variation	Variance	Min	Max
Rest of England	n=163	1	515	18.332	5.56	0.303	30.91	7	35
		2	488	17.318	5.32	0.307	28.30	7	32
		3	458	16.896	5.05	0.299	25.50	7	32
		4	447	15.372	4.46	0.290	19.89	7	26
LPCP	n=20	1	72	16.982	5.84	0.344	34.11	9	27
		2	76	18.397	5.85	0.318	34.22	9	31
		3	78	17.438	5.87	0.337	34.46	7	29
		4	76	14.746	3.77	0.256	14.21	9	27
Importers	n=4	1	16	16.254	4.63	0.285	21.44	9	23
		2	16	16.082	4.31	0.268	18.58	11	24
		3	16	13.347	3.12	0.234	9.73	10	19
		4	16	11.322	2.06	0.182	4.24	9	15
Exporters	n=10	1	32	20.014	4.73	0.236	22.37	10	27
		2	36	22.087	4.71	0.213	22.18	13	31
		3	38	21.878	4.48	0.205	20.07	13	29
		4	36	17.442	3.30	0.189	10.89	12	27
Others	n=6	1	24	13.426	5.88	0.438	34.57	9	26
		2	24	14.404	4.91	0.341	24.11	9	25
		3	24	13.136	3.63	0.276	13.18	7	23
		4	24	12.983	2.07	0.159	4.28	9	17
Matched control	n=18	1	60	19.475	6.33	0.325	40.07	7	31
		2	66	18.531	6.23	0.336	38.81	7	32
		3	70	17.760	5.03	0.283	25.31	9	28
		4	70	15.796	3.67	0.232	13.47	9	24
Metropolitan areas	n=26	1	52	15.898	4.37	0.275	19.13	7	23
		2	62	15.050	4.20	0.279	17.60	8	23
		3	74	13.730	3.71	0.270	13.77	7	21
		4	80	12.144	3.48	0.287	12.09	8	24

Figure 2 plots the distribution for the mean waiting time variable over time for the LPCP group relative to each of the main comparator groups. The box shows the interquartile range from the 25th to 75th percentile, with the line in the middle of the box showing the median of the distribution of mean waiting times. The figure indicates a reduction in the median value of waiting times across all groups over time. While the median value of waiting time for metropolitan area hospitals has fallen, there has been less reduction in the distribution of mean waiting times. The most dramatic reduction in the dispersion of mean waiting times is within the LPCP group, underscoring the apparently important equity implications of the LPCP.

Table 2 shows the regression results for the DID model in which we test whether there was a significant difference in the change in mean waiting times between years 3 and 4 in the overall treatment group (LPCP) relative to the three control groups (rest of England; matched control; metropolitan areas). For each group we have run the DID model using the three estimation procedures outlined. All are run with seasonal effects although these are not reported.

The β_1 coefficients indicate the overall difference in waiting times between LPCP hospitals and the control groups. This is significant and negative relative to the rest of England and metropolitan area comparator groups when using OLS, and to the rest of England and matched control groups when using random effects. The size of the coefficients in these two control groups suggest that LPCP waiting times were between 2 and 3 weeks lower overall.

The β_t coefficients indicate the change in waiting times for the entire sample from year t to the base year. All three sets of results for all three comparator groups show significant reductions of around 3 to 5 weeks in year 4 relative to the other years.

The δ_t coefficients give the interaction effects between LPCP membership and the year t effects. We can add the δ_{kt} coefficients to the β_1 coefficients to obtain an estimate of waiting times in year t for each type of LPCP hospital. In all the models the DID estimate for year 4 against year 3 ($-\delta_3$) is modest, with estimates significant at the 10 percent level in only three of the models. The modest measured impact may be because any effect of LPCP is likely to be on the exporters and importers only, and 6 out 20 LPCP hospitals were neither exporters nor importers.

Table 3 reports the results from models that allow the differential responses for the three LPCP groups (eXporters, iMporters and Others) relative to the three comparator groups. The β_{1M} coefficients suggest importers had significantly lower waiting times overall compared to the rest of England and matched control groups. 'Others' also have significantly lower waiting times against these two comparator groups. Contrary to expectations, exporters do not have significantly higher waiting times than the control groups. As before, the positive β_{2t} coefficients suggest a decline in waiting times in the final year relative to each of the earlier years across almost all specifications.
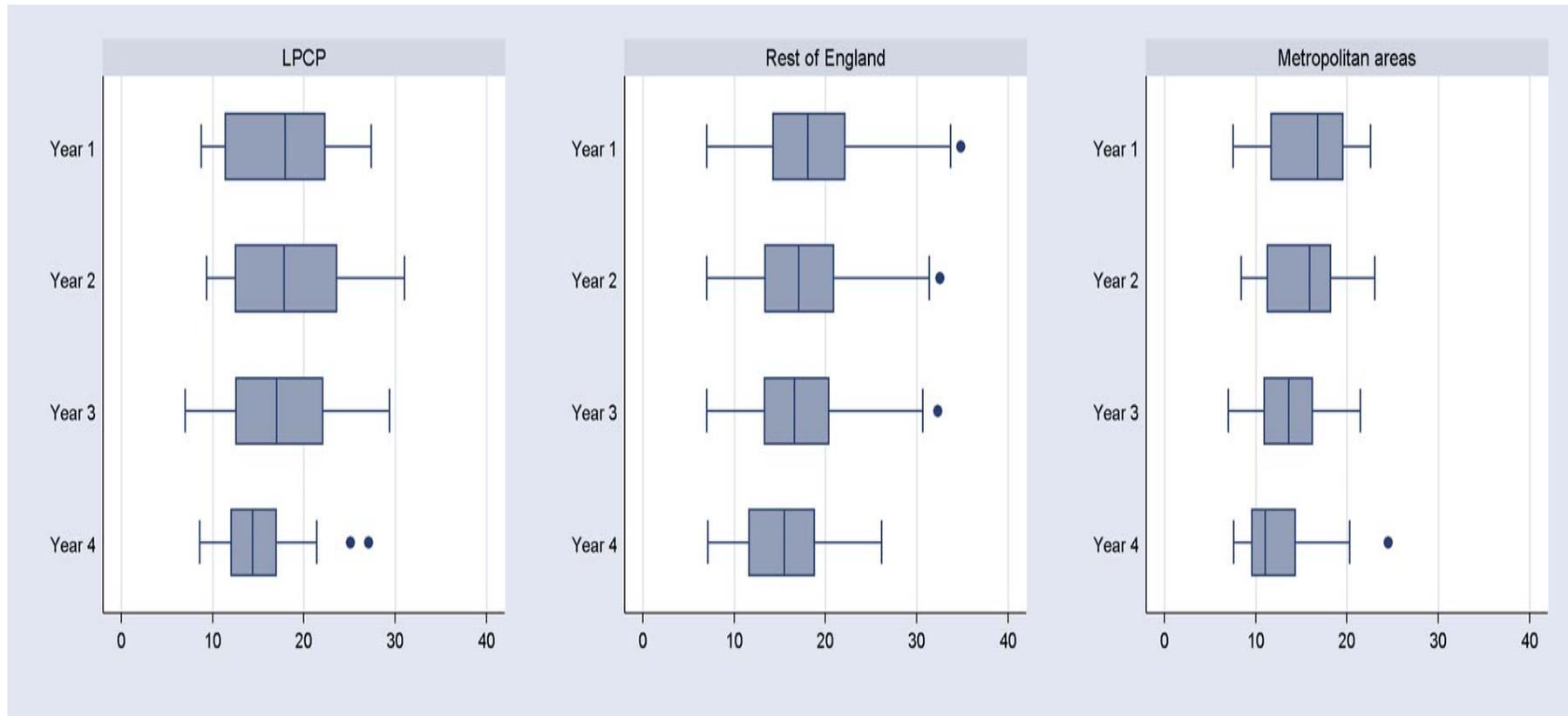
Figure 2: Distribution of mean waiting time in weeks for ophthalmology by year for LPCP Hospitals and the comparator groups Rest of England and Metropolitan areas

Table 2: Difference in difference estimates of effect of London Patient Choice Project on ophthalmology inpatient waiting times for all LPCP hospitals

	Rest of England comparator			Matched control			Metropolitan areas comparator		
	OLS	Fixed effects	Random effects	OLS	Fixed effects	Random effects	OLS	Fixed effects	Random effects
LPCP (β_1)	-1.677		-3.826	-1.038		-3.270	1.822		-0.208
	(3.24)***		(2.77)***	(1.59)		(2.38)**	(2.89)***		(0.13)
1999/00 (β_{21})	3.357	3.101	2.838	4.720	3.720	3.699	5.488	3.131	3.167
	(10.45)***	(6.88)***	(6.65)***	(5.74)***	(2.41)**	(2.81)***	(7.46)***	(2.83)***	(3.06)***
2000/01 (β_{22})	2.023	2.097	1.883	3.292	2.440	2.808	3.917	2.379	2.407
	(6.42)***	(5.80)***	(5.35)***	(3.93)***	(1.98)*	(2.41)**	(6.09)***	(2.43)**	(2.58)***
2001/02 (β_{22})	1.605	1.639	1.587	2.101	1.976	2.043	1.758	1.266	1.321
	(5.14)***	(6.45)***	(6.41)***	(2.68)***	(2.50)**	(2.76)***	(3.42)***	(2.37)**	(2.61)***
DID 2002/03 – 1999/00 $(-\delta_1)$	-1.655	0.284	0.984	-2.455	-0.391	0.034	-2.125	0.364	0.525
	(1.94)*	(0.27)	(0.98)	(2.15)**	(0.22)	(0.02)	(2.03)**	(0.26)	(0.38)
DID 2002/03 – 2000/01 $(-\delta_2)$	0.817	2.251	2.991	1.136	1.791	2.053	0.267	2.123	2.285
	(0.98)	(2.31)**	(3.17)***	(0.20)	(1.16)	(1.38)	(0.25)	(1.60)	(1.72)*
DID 2002/03 – 2001/02 $(-\delta_3)$	0.635	1.202	1.447	0.163	0.741	0.993	1.129	1.617	1.628
	(0.83)	(1.44)	(1.86)*	(0.16)	(0.67)	(0.93)	(1.31)	(1.71)*	(1.79)*
Constant (β_0)	17.456	15.169	14.714	12.848	10.360	8.426	16.207	7.888	2.848
	(10.96)***	(62.14)***	(5.02)***	(15.14)***	(3.02)***	(1.67)*	(8.77)***	(1.58)	(0.57)
Observations	2047	2210	2167	540	536	568	570	614	610
R-squared	0.14	0.79		0.22	0.75		0.31	0.77	
RESET	0.0003	0.130	0.158	0.0004	0.270	0.127	0.558	0.008	0.218

Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

LPCP	- Dummy variable for LPCP hospitals, gives main LPCP effect
1999/00 etc	- Dummy variable for 1999/00 etc year effects (1 to 3), baseline year is 2002/03
DID 2002/03 – 1999/00 etc	- Interaction of LPCP hospital dummy and year dummies

Covariates used in the models:

rci	- Reference Cost Index (Reference Cost dataset)
teaching	- Dummy variable for teaching status based on hospital type (CIPFA)
avbeds	- Average number of available beds (Department of Health hospital activity statistics)
daycase_spell	- Number of daycase admissions per elective inpatient spell or daycase rate (Hospital Episodes Statistics)
emerg_spell	- Number of emergency admissions per inpatient spell (Hospital Episodes Statistics)
daycase_theatres	- The number of available daycase theatres (Department of Health hospital activity statistics)
agnurspcx	- Proportion of non-NHS salary expenditure on agency nursing staff or bank nurses (CIPFA)
opthalmology_consultpc	- Proportion of consultants in ophthalmology from the total number of hospital consultants (NHS Workforce Survey)
bedph	- Number of available beds per head of population (Department of Health hospital activity statistics)
dtc	- Dummy variable for whether a Hospital has a Diagnostic Treatment Centre (DTC) (Department of Health)
prop_nurse	- Nursing staff WTEs as a proportion of total staff WTEs (Department of Health)

Table 3: Difference in difference estimates of effect of London Patient Choice Project on ophthalmology inpatient waiting times for Importers, Exporters and Other LPCP hospitals

	Rest of England comparator			Matched control			Metropolitan areas comparator		
	OLS	Fixed effects	Random effects	OLS	Fixed effects	Random effects	OLS	Fixed effects	Random effects
LPCP Importer (β_{1M})	-4.824		-6.915	-4.389		-6.333	-0.911		-3.208
	(7.69)***		(4.83)***	(6.32)***		(5.20)***	(1.48)		(1.90)*
LPCP Exporter (β_{1X})	0.298		-1.750	0.606		-0.900	4.258		1.714
	(0.47)		(1.01)	(0.81)		(0.56)	(6.34)***		(0.86)
LPCP Other (β_{1O})	-3.348		-4.797	-2.448		-4.043	0.199		-0.974
	(5.74)***		(4.38)***	(3.79)***		(3.97)***	(0.26)		(0.78)
1999/00 (β_{21})	3.254	2.890	2.850	4.430	3.694	3.697	-0.854	3.238	3.179
	(10.13)***	(6.40)***	(6.68)***	(5.24)***	(2.41)**	(2.80)***	(0.60)	(2.90)***	(3.14)***
2000/01 (β_{22})	1.984	1.954	1.889	3.287	2.406	2.830	-0.130	2.728	2.397
	(6.29)***	(5.37)***	(5.37)***	(3.96)***	(1.92)*	(2.42)**	(0.10)	(2.90)***	(2.58)***
2001/02 (β_{22})	1.599	1.623	1.590	2.099	1.962	2.062	0.076	1.529	1.318
	(5.13)***	(6.31)***	(6.43)***	(2.75)***	(2.48)**	(2.79)***	(0.09)	(3.03)***	(2.61)***
Importer DID 2002/03 – 1999/00 ($-\delta_{1M}$)	-0.254	2.939	2.974	-0.529	1.419	1.952	-0.854	2.408	2.387
	(0.18)	(2.05)**	(2.19)**	(0.31)	(0.65)	(1.07)	(0.60)	(1.27)	(1.36)
Importer DID 2002/03 – 2000/01 ($-\delta_{2M}$)	0.742	3.523	3.593	0.487	2.512	2.458	-0.130	2.686	2.972
	(0.58)	(2.73)***	(2.92)***	(0.28)	(1.19)	(1.45)	(0.10)	(1.62)	(1.88)*
Importer DID 2002/03 – 2001/02 ($-\delta_{3M}$)	-0.212	0.667	0.699	-0.370	0.061	0.141	0.076	0.770	0.950
	(0.24)	(0.83)	(0.91)	(0.30)	(0.05)	(0.13)	(0.09)	(0.83)	(1.04)
Exporter DID 2002/03 – 1999/00 ($-\delta_{1X}$)	-1.018	2.052	2.012	-1.840	1.048	1.004	-2.092	1.857	1.710
	(0.91)	(2.51)**	(2.57)***	(1.37)	(0.63)	(0.68)	(1.73)*	(1.38)	(1.36)
Exporter DID 2002/03 – 2000/01 ($-\delta_{2X}$)	1.860	4.436	4.403	0.849	3.596	3.379	0.241	3.785	3.820
	(1.76)*	(3.61)***	(3.71)***	(0.65)	(2.28)**	(2.07)**	(0.21)	(2.51)**	(2.59)**
Exporter DID 2002/03 – 2001/02 ($-\delta_{3X}$)	2.290	3.378	3.359	1.815	2.814	2.863	2.198	3.527	3.575
	(2.49)**	(2.98)***	(3.11)***	(1.55)	(2.09)**	(2.19)**	(2.28)**	(2.88)***	(3.08)***
Other DID 2002/03 – 1999/01 ($-\delta_{1O}$)	-3.309	-1.765	-1.731	-4.207	-3.417	-2.516	-4.414	-2.599	-2.567
	(2.77)***	(0.85)	(0.89)	(2.87)***	(1.39)	(1.06)	(3.21)***	(1.13)	(1.23)
Other DID 2002/03 – 2000/01 ($-\delta_{2O}$)	-0.645	0.497	0.561	-2.190	-1.047	-0.225	-2.747	-1.139	-0.801
	(0.58)	(0.32)	(0.38)	(1.64)	(0.54)	(0.12)	(2.17)**	(0.65)	(0.47)

Other DID 2002/03 – 2001/02 (-δ_{3O})	-1.284	-1.020	-0.978	-2.046	-1.825	-1.380	-1.624	-1.324	-1.073
	(1.37)	(1.21)	(1.22)	(1.77)*	(1.54)	(1.26)	(1.51)	(1.44)	(1.19)
Constant (β_0)	22.233	19.814	15.070	14.900	10.422	8.979	17.144	14.116	9.308
	(11.02)***	(9.84)***	(5.31)***	(24.12)***	(3.25)***	(2.54)**	(7.92)***	(23.10)***	(8.44)***
Observations	2047	2169	2167	540	536	568	572	612	612
R-squared	0.18	0.79		0.34	0.77		0.44	0.78	
RESET	0.105	0.006	0.247	0.267	0.191	0.091	0.140	0.0001	0.901
Convergence test for 2001/02	2.502	2.711	2.660	2.185	2.753	2.723	2.122	2.757	2.625
	(2.10)**	(2.02)**	(2.07)**	(1.65)*	(1.87)*	(2.10)**	(2.00)**	(2.03)**	(2.02)**
Convergence test for 2000/01	1.118	0.913	0.810	0.362	1.084	0.921	0.372	1.099	0.848
	(0.71)	(0.54)	(0.50)	(0.20)	(0.55)	(0.57)	(0.25)	(0.63)	(0.51)
Convergence test for 1999/00	-0.763	-0.887	-0.961	-1.312	-0.372	-0.948	-1.238	-0.551	-0.677
	(0.43)	(0.61)	(0.70)	(0.72)	(0.21)	(0.67)	(0.77)	(0.34)	(0.45)

Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

LPCP Importer	- Dummy variable for importing hospitals
LPCP Exporter	- Dummy variable for exporter hospitals
LPCP Other	- Dummy variable for other hospitals
1999/00 etc	- Dummy variable for 1999/00 etc year effects (1 to 3), baseline year is 2002/03
Importer DID 2002/03 –1999/00 etc.	- Interaction of importing hospital dummy and LPCP year dummies
Exporter DID 2002/03 –1999/00 etc.	- Interaction of exporting hospital dummy and LPCP year dummies
Other DID 2002/03 –1900/01 etc.	- Interaction of other Hospital dummy and LPCP year dummies
Covariates used in the models:	
rci	- Reference Cost Index (Reference Cost dataset)
teaching	- Dummy variable for teaching status based on hospital type (CIPFA)
avbeds	- Average number of available beds (Department of Health hospital activity statistics)
mortal_indx	- Standardised three-year average mortality index (Dr Foster)
daycase_spell	- Number of daycase admissions per elective inpatient spell or daycase rate (Hospital Episodes Statistics)
emerg_spell	- Number of emergency admissions per inpatient spell (Hospital Episodes Statistics)
daycase_theatres	- The number of available daycase theatres (Department of Health hospital activity statistics)
agnurspcx	- Proportion of non-NHS salary expenditure on agency nursing staff or bank nurses (CIPFA)
bedph	- Number of available beds per head of population (Department of Health hospital activity statistics)
opthalmop1pc	- Proportion of ophthalmology first outpatient attendances from total first outpatient attendances (CIPFA)
opthalmology_consultpc	- Proportion of consultants in ophthalmology from the total number of hospital consultants (NHS Workforce Survey)

We test the overall DID in waiting times in year 4 versus year *t* for the three groups of LPCP hospitals relative to the comparator groups using $(-\delta_{kt})$. For year 4 against year 3 we find a consistent positive effect for exporting hospitals, statistically significant across eight of the nine models, confirming that they have lowered their waiting times in the LPCP year relative to the previous year. These results suggest exporting hospitals lowered their waiting times in the LPCP treatment year relative to the previous year by approximately 3 weeks. In contrast, there is little evidence of any significant change amongst importers or other LPCP hospitals.

We examined whether the improvement in exporters relative to importers $\delta_{Mt} - \delta_{Xt}$ is positive in order to test hypothesis (d) that the LPCP led to a reduction in the dispersion of waiting times. This test is shown in the last three rows of Table 3, which confirms that – other things equal – exporters improved waiting times by about 2.5 weeks relative to importers in the project year. Our earlier results suggest that such a decline has not been at the expense of patients at the hospitals now taking on the additional activity (importers).

Figure 3 shows for each of the three groups of LPCP hospitals the difference between their mean waiting times in weeks and the mean for the Rest of England. It shows a downward trend in waiting times from year 2 onwards for exporters. However, in all 4 years the mean waiting times for exporting hospitals is not significantly different from the rest of England comparator group. Importers and 'others' always have significantly lower waiting times than the rest of England group over all four periods. There is some reduction for importers in year 4, and some increase for 'others' in year 4, relative to the rest of England, although neither of these changes is statistically significant.
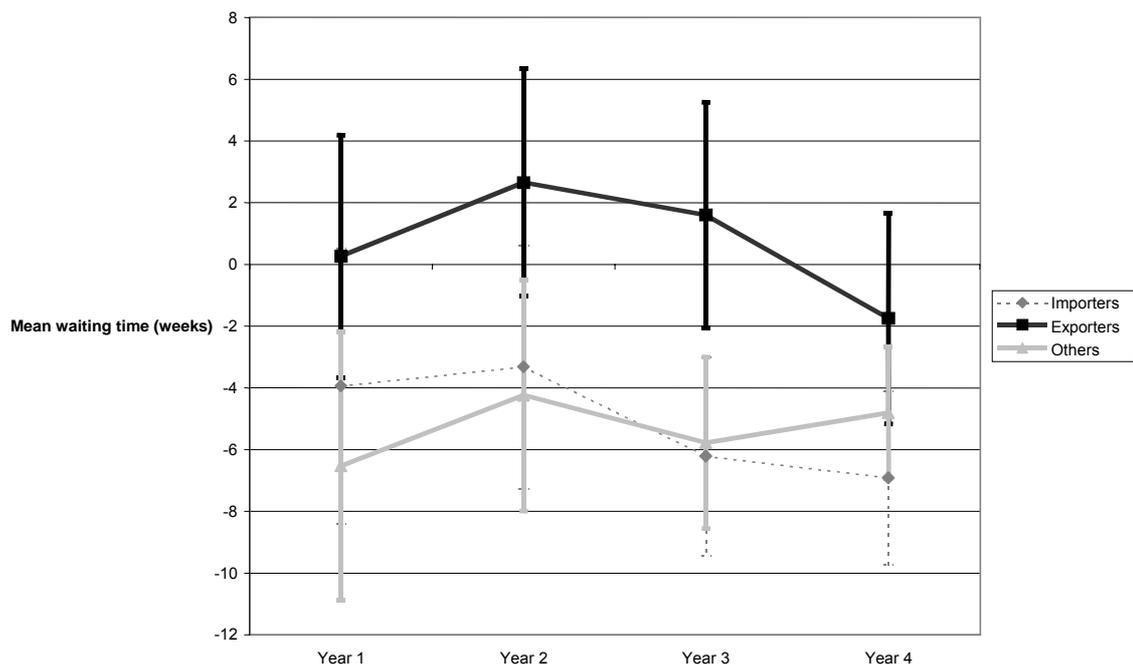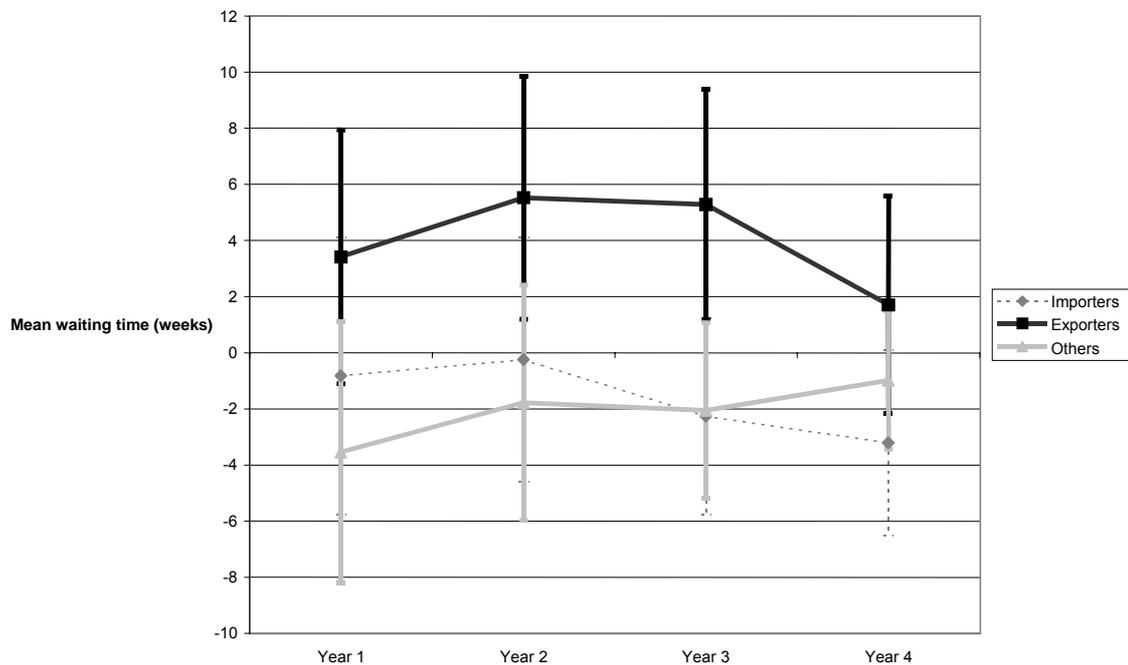

Figure 3: Mean waiting time in weeks for ophthalmology for LPCP groups relative to rest of England comparator group

The overall effect is a convergence within London of inpatient waiting time for ophthalmology, with exporters moving closer to the other two London groups. The improved equity with respect to waiting times secured amongst London hospitals is the most marked achievement of LPCP over this period.

Figure 4 shows analogous results using the Metropolitan comparator group. We again see a decline in waiting times for exporting hospitals from year 2 onwards. In years 2 and 3 mean waiting times for exporting hospitals were significantly higher than for metropolitan areas,

however in year 4 this is no longer the case and exporting hospitals are no longer significantly different. In all four years waiting times for importers and 'others' are not significantly different from waiting times for hospitals in metropolitan areas.

Figure 4: Mean waiting time in weeks for ophthalmology for LPCP groups relative to metropolitan areas control group

We searched for significant covariates variables in the database of hospital variables. In the interests of space, these are not shown in the tables. Similar sets of control variables are significant across many of the models. Of particular interest is the dummy variable for treatment centres (*dtc*) in the OLS regression for metropolitan areas, suggesting that the availability of this new capacity may have contributed to a reduction in waiting times. Other control variables show that lower waiting times are associated with teaching hospitals, smaller hospitals with fewer beds, hospitals with a higher daycase surgery rates, hospitals that spend less on agency nurses, hospitals with higher mortality rates and hospitals with a higher proportion of nurses. Hospitals with a higher proportion of consultants in ophthalmology also have lower waiting times.

We undertook a similar analysis for the specialities of orthopaedics and general surgery, but space precludes a full presentation (Dawson *et al*, 2004). The results for orthopaedics were similar to ophthalmology, indicating that, relative to control groups, LPCP succeeded in reducing mean waiting times in the treatment year. General surgery on the other hand showed no significant effect, and there may even have been an equity loss for the system, as there were increased waiting times for patients at hospitals dealing with the additional choice activity. However, these results may be attributable to the fact that LPCP procedures account for only about 25% of activity in general surgery.

5   Discussion

This study has presented evidence on the impact of an ambitious scheme to introduce increased elements of patient choice into a public hospital system that has traditionally exhibited poor levels of responsiveness to patient needs. Isolating the impact of the initiative is complicated by the plethora of other innovations being tested over the same period in order to meet the national government's waiting time targets. However, the experiment was

confined to London, and the DID methodology allows us to derive quite secure estimates of the specific LPCP effect.

In ophthalmology we find a modest reduction in waiting times associated with the LPCP, a finding replicated in orthopaedics but not in general surgery (not presented here). More striking is the reduction in variation in waiting times within London. Variations in the quality of health care received by individuals with identical needs have been a persistent policy concern in the UK, so the reduction in variations is undoubtedly a benefit of the scheme. This in itself would be considered an important improvement within the system, even if waiting times had not fallen. Thus reductions in waiting times alongside a reduction in variation are two distinct and important trends in the data, along the lines predicted by our theory.

It is infeasible to present here a full evaluation of the LPCP. To do so would require consideration of unintended side-effects of the scheme, changes in patient satisfaction and outcomes, and scrutiny of the additional resources consumed by the LPCP. Rather, in this paper we focus attention on a specific issue: the direct behavioural response of providers brought about by a scheme designed to bring down waiting times by promoting user choice. We find that providers have responded as intended and as predicted, although after adjusting econometrically for concurrent secular trends elsewhere, we find the results are perhaps not as marked as they might appear from naïve scrutiny of the data. The study therefore demonstrates the importance of deploying appropriate econometric methodology in evaluating such schemes.

The LPCP ended in 2004, and the government is in the process of introducing patient choice for secondary care throughout England. However, the new universal scheme differs markedly from the LPCP, and does not seem to have been directly informed by the experiment. Choice will now be offered throughout England at the point of first referral to hospital by a general practitioner, not after the patient has been placed on the inpatient waiting list. Moreover, there will not be a strategic purchaser of surgical capacity, the role played by the LPCP team, and hospital funding will be directly tied to the patient's choice, through a new system of case payments based on diagnosis-related groups.

This new English choice scheme therefore highlights the importance of contextual detail when seeking to evaluate innovations in health care. It was the combination of related instruments that gave rise to the specific LPCP incentives, and evaluation was made feasible by the existence of a non-London comparison group. However, policy makers rarely implement initiatives with a view to evaluation, and the effectiveness of many health care reforms remains a matter for debate. Yet if we are to learn from the massive uncontrolled experiments visited on our health systems, there is a strong case for using more experimentation such as the LPCP, or even randomization, as an intrinsic part of the implementation process.

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