Financial Penalties for Readmissions in the English NHS

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Abstract

After more than a decade of largely failed attempts of incentivising higher quality hospital care with bonuses for better quality (Pay for Performance) health care payers have recently turned to financial penalties in an attempt to increase the quality of care. Individuals are known to respond stronger to incentives framed as penalties rather than bonuses, but the effect of such schemes on organisations (Non-Payment for Performance) is unknown. This paper analyses a payment reform in the English National Health Service that stopped reimbursement for patients that were re-admitted to hospital within 30 days of discharge. Difference-in-differences estimates of a large national patient-level data set suggests a decrease in the readmission rate for patients targeted by the reform although this was in line with previous trends. The effect of the reform on treatment intensity, and gaming is mixed.

Keywords: Non-pay for performance, Health care, Quality, Provider regulation
JEL: D2, I1, H4, L5

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1. Introduction

It is an emerging trend in provider reimbursement to incentivise performance not by paying a bonus for desired behaviour, but by penalising undesired behaviour. This trend, termed non-payment for performance (NP4P) (Rosenthal, 2007) has been utilised in Medicare's Hospital Readmission Reduction Program (HRRP) under the Affordable Care Act, and in a similar scheme to reduce readmissions in the English National Health Service (NHS). Under these schemes, hospitals with higher than expected readmission rates are subject to a financial penalty.

In expected utility terms (Von Neumann and Morgenstern, 1947) bonuses and fines are indistinguishable as any bonus contract can be rewritten as an economically equivalent penalty scheme (Becker, 1968; Lazear, 1991; Aron and Olivella, 1994; Camerer, 2003). However, prospect theory (Kahneman and Tversky, 1979) and lab experiments (Luft, 1994; Dickinson, 2001; Hannan et al., 2005) suggest that individuals are not indifferent to reference point and framing of economically equivalent bonus and penalty schemes. When asked, individuals prefer bonus schemes, but the empirical evidence suggest that individuals exert more effort when faced with a penalty scheme. It is not known whether these insights applies to organisations but commentators have suggested it be used to motivate penalties as a cost effective alternative to bonuses for incentivising provider performance (Maynard, 2012).

Under the English NP4P policy, hospitals are not reimbursed for readmissions occurring within 30 days of discharge exceeding a locally set threshold. Exemptions from the policy include maternity and cancer. Hospitals are also still reimbursed for readmissions following an initial admission to a different hospital, with readmission costs being deducted from the initially admitting hospital.

NP4P for readmissions represents a profound deviation from the previous 15 years' philosophy of paying for performance to improve quality in health care and thus represents a unique opportunity to evaluate how organisations rather than individuals respond to incentive schemes framed as penalties.

The main contribution of our study is an assessment of whether the English NP4P reform had the intended effect of lowering readmission rates for the targeted conditions. Hospitals may affect patients' readmission probabilities by increasing resource use in the initial admission, and we test whether the reform was associated with changes in resource use measured as length of stay (LOS) of the initial admission. Finally we test whether hospitals responded strategically to the policy design by changing their readmission policies for patients with

an initial admission from the same hospital (not reimbursed after the reform) or a different hospital as the initially admitting hospital (still reimbursed after the reform).

As the English NHS introduced NP4P for readmission in April 2011, 1.5 years prior to the introduction of the similar US HRRP, our study brings early evidence on the likely effects of the US HRRP. In addition, our study benefits from the fact that the Enlighs NHS has close to universal care coverage unlike the multipayer setting of US hospitals where cost shifting can potentially affect effect estimates.

Our paper is related to a growing literature on pay for performance (P4P) in health care. These schemes have predominantly relied on linking bonuses to hospitals' performance on indicators of the process and outcome quality of health care. The successfulness of these schemes is mixed. The largest scheme to date, the Medicare Premier Hospital Quality Incentive Demonstration (HQID) ran for 6 years and linked payments to performance on 33 indicators at 252 hospitals in the United States (US). Evaluations of the programme found only modest improvements in process quality (Lindenauer et al., 2007; Petersen et al., 2006; Werner et al., 2011) but failed to find improvements in outcomes for patients targeted by the scheme (Jha et al., 2012). An adaptation of the scheme in one region of England known as Advancing Quality (AQ) was found to improve cost effectively improve outcomes in the short term (Sutton et al., 2012; Meacock et al., 2014a) but in the long term, relative mortality reductions in the hospitals subject to the scheme where not maintained (Kristensen et al., 2014).

There is consensus that design details of P4P schemes are critical for ensuring successful programme effects (Roland, 2012; Epstein, 2012) and that more research into how design affects effectiveness is needed (Eijkenaar, 2013) For example, the English AQ relied on bonus payments only, while the US HQID relied on a mix of bonuses for top performers and penalties for the poorest performers. In comparison, the NP4P scheme investigated in this paper relies only on financial penalties, with no bonus payments for good performance.

2. Nonpayment for readmissions in England

2.1. The institutional background

The majority of health care in England is delivered through the National Health Service (NHS). The English NHS is financed through general taxation and National Insurance contributions (compulsory contributions paid by employers, employees and self-employed on earned income) and delivers hospital care that is free to patients at the point of delivery.

When the NP4P reform studied in this paper was implemented, funding for acute hospital care was allocated from the central Government to the Department of Health who in turn distributed funding to 151 geographically defined Primary Care Trusts (PCTs) based on a capitation formula weighted for local area population needs. Each PCT was responsible for commissioning (purchasing) care for their local area populations from hospitals (NHS trusts and foundations trusts). Care at these hospitals is delivered by salaried specialist doctors, nurses and other health care professionals, and patients can only access hospital care (other than A&E) through referral from their General Practitioner (Boyle, 2011).

Until financial year[1] (FY) 2003/04, hospital were mainly reimbursed for their services through annual block contracts with limited adjustments for admissions outside agreed targets (Raftery et al., 1996). This changed in 2003/04, when the Department of Health introduced Payment by Results (PbR) as the basis of contracting between PCTs and providers. Initially PbR only covered a small group of hospitals and elective hospital services, but it has since then been extended to the majority of elective care, emergency care, A&E, and outpatient activity at all NHS hospitals (Boyle, 2011).

Under PbR, hospital reimbursement is linked to activity through a fixed price (tariff) per hospital admission. Hospital admissions are classified into a manageable number of homogenous, clinically-meaningful healthcare resource groups (HRGs) - the English equivalent of diagnosis related groups (DRGs). The price paid per HRG was set by the Department of Health as the national average cost in the two years prior to a given financial year (Farrar et al., 2007).

From 2009/10 the Department of Health began using PbR as a vehicle for financially incentivising the quality of hospital care when it introduced the Commissioning for Quality and Innovation (CQUIN) - the first national pay-for-performance scheme in England. CQUIN initially tied 0.5 % (2.5 % since 2012/13) of hospitals' income to the achievement of indicators of process and outcome quality, and innovation. The money are being withheld if the hospitals fail to achieve the agreed targets. Aside from a few national goals, the incentivised performance indicators were to be agreed locally between hospitals and PCTs (Kristensen et al., 2013).

In 2010/11 the first so-called Best Practice Tariffs (BPT) were introduced in to PbR. This was another national P4P scheme established with the intention of reducing unexplained variation in care and universalising best practice for areas that are high in volume and

[1]Financial years run from 1st April to 31 March

where good clinical evidence for what constitutes best practice exists. Under BPT, hospitals delivering care according to the Department's definition of best practice receive an additional bonus payment set above the average cost of delivering best practice care to create an incentive for performance (Meacock et al., 2014b).

Thus, from initially being introduced to create incentives for activity, since 2009/10 PbR has increasingly been refined to create financial incentives for higher quality care in the English NHS. The latest introduction of NP4P for readmissions can be seen as a further development along this path.

2.2. Nonpayment for readmissions in the English NHS

A hospital readmission occurs when a patient's initial (or index) admission is followed by another admission within a specified period of time typically measured from discharge from the index admission. Readmissions have been described as the outcome of two events: an adverse outcome of the initial admission; and a decision to subsequently readmit the patient (Milne and Clarke, 1990).

Hospital readmission rates have for a long time been proposed as indicators of hospital quality (Acheson and Barr, 1965, e.g.) and have recently regained policy makers' attention, because reductions in readmissions can in principle simultaneously improve health care quality and reduce costs (Joynt and Jha, 2012).

In England, the introduction of incentives to reduce readmission was announced in the NHS white paper, *Equity and excellence: Liberating the NHS* (Department of Health, 2010). From FY 2011–12, hospitals were no longer reimbursed for emergency readmissions occurring within 30 days of discharge following a day case, ordinary elective admission, regular day or night admission (Department of Health, 2011). For non-elective admissions, reimbursement was subject to locally agreed thresholds which should be set with the aim of reducing the readmission rate by 25% over the previous year, unless, following a clinical audit, the commissioner and provider could agree that only a lower reduction in readmission rates was possible, or that readmission rates were already as low as possible.[2]

[2]In an updated version of the policy for FY 2012-13 (Department of Health, 2012), the distinction between readmissions following elective and non-elective index admissions was abolished and providers and commissioners were to agree on a split between the proportion of the readmissions deemed unavoidable or avoidable and thus not attracting payment on the basis of clinical reviews of readmissions taking place over a sampling period taking place in the first quarter of the financial year.

The savings that PCTs would make from the non-payment policy should be placed in a post-discharge fund along with previously distributed funding for re-ablement and post discharge support. Using these funds, the PCTs must work with providers, GPs and local authorities to improve post-discharge support to patients within 30 days of discharge (Department of Health, 2011).

The policy excludes certain (re)admissions (listed in Appendix A) including readmissions for children under the age of four, maternity and childbirth patients, cancer, chemotherapy and radiotherapy patients, and patients having self-discharged against clinical advice.

2.3. Expected responses to nonpayment for readmissions

Hospital readmission rates are known to be affected by a range of factors before, during, and after the initial admission (Heggestad, 2002). Factors outside the hospital's control include patients' age, gender, race, number of previous admissions, clinical conditions, discharge destination, access to primary care, and length of stay (Billings et al., 2006; Howell et al., 2009; Lyratzopoulos et al., 2005; Weinberger et al., 1996; Holland et al., 2005; Camberg et al., 1997).

Factors under the control of the hospital include the decision to admit the patient in the first place, resource use during the initial admission, discharge procedures and contact to the patient's GP and local authorities, and the decision to readmit a patient that has previously been admitted to hospital.

The intention of the English NP4P policy for readmission was to reduce avoidable hospital readmissions. Our first outcome of interest is thus the probability of having a readmission targeted by the policy.

One potential concern with activity based reimbursement schemes such as PbR is whether the lack of incentives for hospitals to avoid readmissions could lead hospitals to discharge patients *quicker but sicker* (Kosecoff et al., 1990). The English NP4P for readmissions to some extent addresses this concern, and hospitals now potentially have an incentive to increase the resource use of the initial admission if the costs of doing so reduces the probability of a readmission within 30 days and do not exceed the cost of a non-reimbursed readmission. Our second outcome of interest is thus the effect of the new policy on hospital resource use in the index admission, and, for now, we use length of stay of the initial admission as a proxy for this policy outcome.

Hospital may also respond strategically to the reform. Specifically, readmissions where the initial admission was to a different hospital than the readmitting hospital are still fully reimbursed under the new policy, with the costs of the readmission being taken from the initially admitting hospital. If hospitals respond strategically to the reform incentives, we would expect to see a decrease in readmissions to the same provider as the initial admission (which are not reimbursed after the reform) compared to readmissions to a different provider (which are still reimbursed after the reform). Our third outcome of interest is thus the probability of being readmitted to the same provider as in the index admission, given that the patient is being readmitted.

3. Methods and data

3.1. Methods

We use a difference-in-differences (DiD) design to assess the effects of the NP4P reform on the readmission probability, LOS, and the probability of being readmitted to the same provider as in the initial admission.

In the simplest case, DiD compares the outcome for an intervention and a control group before and after the implementation of a reform. The effect of the reform is the difference in the difference between the control and intervention group before and after the reform.

In our case, the NP4P policy for readmissions was implemented simultaneously at all hospital in England, and we do not have the possibility of using one group of hospitals as controls. Instead, we utilise a feature of the policy design, which excluded certain admission from the policy. These include children under the age of 5, patients admitted for maternity and childbirth, and cancer patients (see full list in Appendix A).

The policy documents are silent about the reasons for excluding these patient groups from the policy.

The group of patients excluded from the policy constitute our potential control group. However, it is not clear that this group of patients represents a good comparison group for all patients targeted by the policy. Thus, rather than comparing all patients included in the policy to all patients excluded from the policy, we focused on assessing the outcome of the policy for 3 groups of patients that would be credible comparisons for the control groups given by the policy: Children, women and the elderly.

For children and women, we compared the outcome of patients included and excluded from the policies for patients of similar age admitted under the same specialties[3]. For children, we assessed the effect of the policy on patients admitted to the paediatric specialties aged 5-10 years, compared to the control group of patients aged 4 or younger. For women, we focused on patients admitted in obstetrics, gynaecology and midwifery, focusing on women aged 42 or younger which includes 99% of maternity patients.

For the elderly, we assessed the impact of the policy on patients in nephrology, cardiology and general medicine, using patients in clinical and medical oncology as a control.

Descriptive statistics of the patients in the specialties included in our analysis are displayed in Table 1.

Table 1: Summary statistics of patients in control and treatment specialties

Specialty	**Age**	**Males**	**White**	**Weighted Charlson score**	**Electives**	**Readmission rate**	**Included in policy**
Children							
Paediatric dentistry	8	51%	57%	0.11	100%	1%	79%
Paediatric surgery	6	70%	69%	0.27	72%	8%	49%
Paediatrics	5	55%	74%	0.44	19%	13%	33%
Paediatric neurology	8	54%	68%	0.60	89%	9%	64%
Paediatric cardiology	9	54%	64%	0.48	79%	9%	47%
Women							
Obstetrics	37	0%	73%	0.31	66%	7%	72%
Gynaecology	39	0%	76%	0.45	70%	7%	88%
Midwifery	26	5%	78%	0.13	61%	6%	3%
Elderly							
Clinical oncology	61	40%	87%	6.35	94%	12%	6%
Medical oncology	59	38%	83%	6.54	94%	14%	7%
General medicine	62	49%	85%	2.09	30%	12%	95%
Nephrology	63	58%	74%	3.92	96%	8%	99%
Cardiology	64	61%	82%	1.63	63%	8%	98%

In pre-trend analyses displayed in the Appendix Table A.1 we tested whether the readmis-

[3]When referring to specialties in the following we refer to the main specialty which is the specialty under which the consultant treating the patient is contracted. We will explore sensitivity to using treatment specialty in a future version of the paper

sion rate, LOS and same-provider readmission rate for the conditions included in the policy had a different trend to those excluded from the policy prior to the introduction of NP4P in the three groups. We used a model with a linear time trend and display the interaction of the time trend and conditions included in NP4P in the table. The results did not suggest violations of the parallel-trends assumption between the treatment and control groups, except for the readmissions overall and after elective admissions for all three groups, for readmissions for women after an initial emergency admissions, and for children and for length of stay for elective elderly patients. Further work will be undertaken to address this issue in the next version of the paper, but for now this should be kept in mind when interpreting the results.

Having identified 3 sets of treatment and control groups we estimated the difference in outcomes between patients in the control and those targeted by the NP4P policy before and after the reform, in DiD equations of the form:

$$y_{it} = \beta_0 + \beta_1 G_i + \beta_2 T_t + \beta_3 G_i \cdot T_t + \mathbf{x_{it}}\beta + \epsilon_{it} \tag{1}$$

where G_i is a dummy variable taking the value 1 when an admission or readmission is included in the NP4P policy and 0 otherwise, T_t is a dummy variable taking the value 1 for the time period after the NP4P policy was introduced, and 0 otherwise. $\mathbf{x_{it}}$ is a vector of explanatory variables including patient characteristics, admission characteristics and hospital fixed effects. We leave out the T_t main effect and include fixed quarter effects instead. Our coefficient of interest is the DiD estimate β_3.

When estimating the effect of the NP4P reform on the readmission rate, $y_{it} = \Pr(y_{it} = 1|\mathbf{x_{it}})$ where y_{it} is a dummy variable indicating whether a patient was readmitted within 30 days of discharge from the initial admission. When estimating the effects on LOS, y_{it} is the LOS measured in days and we leave out LOS from the regressors. Finally, when estimating the effect of the reform on being readmitted to the same hospital as the index admission, the sample is restricted to readmissions within 30 days only, and y_{it} is a dummy variable taking the value 1 if the readmission was to the same hospital as the initial admission and 0 otherwise.

We conduct our analysis by method of the initial admission (elective or emergency), because the NP4P policy was mandatory for all elective admissions, whereas it only applied to readmissions above a locally agreed performance threshold for initial emergency admission. All models are estimated using ordinary least squares (OLS). When estimating the probabilities of being readmitted and being readmitted to the same hospital as the initial admission we

thus use the linear probability model (LPM). The error term in the LPM is by definition heteroscedastic, and we use standard errors robust to unspecified heteroscedasticity.

3.2. Data

We analyse a 25% random sample of patients having a hospital admission between April 2008 and January 2012[4] from a large administrative patient level data set known as Hospital Episode Statistics (HES) which contains records for all patients treated in the English NHS.

In HES, each hospital admission consists of one or more episodes of care. An episode is a period of care under the responsibility of one hospital specialist. Most admission consists of just one episode. More episodes within the same provider together form a provider spell. The entire period of care within the NHS is known as a continuous inpatient spell (CIP). A CIP may consist of just one episode of care at one hospital, but may also include transfers to other hospital providers if the patient has been transferred during admission (HSCIC, 2014).

The NP4P policy targets readmissions that occur within 30 days of the end of a CIP and CIPs are thus unit of analysis. We restrict our sample to patients admitted as either elective or emergency and discharged alive from a hospital from which we have more than 5,000 observations per year, and so from the raw data of 15,445,647 episodes we create a data set of 10,466,967 CIPs from 4,087,206 individual patients admitted to 168 hospitals. The admission method of the index admission was elective for 65% of CIPs and emergency for the remaining 35% .

The data available for this version of the paper does not allow us to identify all policy exclusions precisely, including readmissions due to traffic accidents, and readmissions for chemo- and radiotherapy. However we know from previous work (Kristensen et al., 2012) that our operationalisation captures the main areas of children, maternity, and cancer patients, and are confident that we identify enough exclusion for our results to be valid. In our data, the policy included 80% of all elective admissions, and 84% of all emergency admissions.

To control for differences in case mix, we include variables for patients' age, gender, ethnicity, and the source of admission (e.g. home or nursing home) in our regression models. We also controls for admission characteristics: HRG, LOS (except in the LOS regression), discharge destination, and type (emergency, elective) of admission.

[4]This will be extended to April 2013 when the data becomes available

4. Results

4.1. Descriptive analysis of outcomes before and after NP4P

We begin by analysing simple descriptive statistics of our three outcomes of interest before and after the NP4P reform for readmissions. The raw mean 30-day readmission rate, LOS and same-provider 30-day readmission rate is displayed by method of the initial admission in Table 2.

The table shows that the readmission rate decreased for both women and children included in the policy, while there was a slight increase from before to after the reform for the elderly. In comparison, for children the overall readmission rate decreased more for elective patients excluded from the policy, and relatively less for patients with an initial emergency admission, while the readmission rate increased for women and elderly not included in the policy. The increase in readmissions for the excluded elderly was larger than that for the group included in the policy.

We would expect to find the largest effect of the policy after elective index admissions, as nonpayment was mandatory nationally for these admissions, while the policy was subject to local negotiation of thresholds for emergency readmissions, but no clear pattern was found in the data.

If the NP4P policy was intended to address the quicker but sicker concern, we would expect to see an increase in resource use measured as LOS for conditions targeted by the policy.From before to after the reform, LOS decreased for all patient groups and at relatively similar rates for those included and excluded from the reform, except for women excluded from the reform where patients with an elective index admission experienced an increase of 0.24 days compared to a decrease of .04 days for the similar group of women included in the policy.

Finally, there were only minor changes in the same-provider readmission rate, except for children and women excluded from the policy after elective admissions.

4.2. Difference-in-differences estimates of the effect of NP4P for readmissions

The descriptive analysis suggested that the NP4P reform for readmissions had the expected impact of reducing the readmission rate for patients targeted by the policy, except for children with an elective index admission for whom the decrease in the readmission rate was larger for those excluded from the policy. This difference did not appear to be associated

Table 2: Unconditional mean of 30-day readmission rate, same-provider readmission rate and LOS before and after the NP4P reform for conditions included and excluded from the refom

	Included in NP4P			Excluded from NP4P		
	Pre-reform	Post-reform	Difference	Pre-reform	Post-reform	Difference
Children						
Readmission rate (%)						
Overall	8.40	7.16	−1.25	13.13	12.16	−0.96
Elective	5.26	4.30	−0.97	14.97	13.20	−1.77
Emergency	10.14	8.91	−1.23	12.72	11.92	−0.80
Resource use (length of stay (days))						
Overall	0.91	0.82	−0.09	1.01	0.94	−0.07
Elective	0.56	0.45	−0.11	0.58	0.51	−0.07
Emergency	1.10	1.04	−0.06	1.11	1.04	−0.07
Same-provider readmission rate (%)						
Overall	90.34	90.30	−0.04	88.10	86.97	−1.13
Elective	76.71	77.37	0.66	66.28	62.27	−4.01
Emergency	94.26	94.13	−0.13	93.82	93.43	−0.38
Women						
Readmission rate (%)						
Overall	6.61	6.23	−0.38	15.45	17.78	2.33
Elective	3.22	3.14	−0.08	4.80	7.78	2.97
Emergency	12.77	11.49	−1.29	21.22	21.27	0.06
Resource use (length of stay (days))						
Overall	0.53	0.51	−0.03	0.89	0.92	0.03
Elective	0.35	0.31	−0.04	0.60	0.84	0.24
Emergency	0.86	0.84	−0.02	1.05	0.95	−0.10
Same-provider readmission rate (%)						
Overall	93.11	92.48	−0.64	93.18	94.34	1.16
Elective	88.91	88.24	−0.67	81.33	89.41	8.08
Emergency	95.04	94.45	−0.59	94.63	94.97	0.34
Elderly						
Readmission rate (%)						
Overall	9.96	10.17	0.21	14.90	15.30	0.40
Elective	6.32	6.38	0.07	12.35	12.87	0.51
Emergency	14.40	14.76	0.36	32.59	33.28	0.68
Resource use (length of stay (days))						
Overall	0.72	0.60	−0.12	0.44	0.35	−0.10
Elective	0.13	0.10	−0.03	0.19	0.13	−0.06
Emergency	1.44	1.19	−0.25	2.21	1.94	−0.27
Same-provider readmission rate (%)						
Overall	85.40	85.00	−0.41	83.99	84.05	0.06
Elective	73.68	72.69	−0.99	83.16	82.80	−0.36
Emergency	91.67	91.44	−0.24	86.16	87.62	1.46

Note: **Children** are children treated in a paediatric speciality. The treatment group is children aged 5-10, the control group is children aged 0-4. **Women** are women treated in midwifery, obstetrics or gynaecology aged 42 or younger. The treatment group is all women treated in this specialty except those the maternity patients constituting the control group. **Elderly** are patients treated in Nephrology, cardiology or general medicine (treatment group) or clinical or medical oncology (control group).

with a relative increase in LOS for patients targeted by the reform. Changes in the same-provider readmission rate was mixed, with higher decreases for children excluded from the reform, than for those included in the reform, while the opposite is true for women and the elderly.

Table 3 shows our difference-in-differences (DiD) regression estimates of the effect of the first three monhts of the NP4P reform from. The results suggests a statistically significant reduction in the overall readmission rate for patients targeted by the reform for both children, women and the elderly. While this confirms the findings from the descriptive analysis, it should be kept in mind that the decrease is in line with pre-reform trends for the targeted conditions.

The DiD estimate of the effect of the reform on resource use in the index admission suggests no overall change in LOS for children admitted to the paediatric specialties targeted by the reform. The results suggests that LOS increased for women admitted in obstetrics and gynaecology targeted by the reform, especially following an elective index admission. Compared to a pre-reform LOS of .86 days, this is approximately equal to a 8% increase in length of stay for emergency admissions after the reform was implemented.

[Further inspection of the results is needed to explain estimated overall decrease in LOS for the elderly when the individual changes in LOS are positive.]

Finally, the results do not suggest that hospitals responded strategically to the financial incentives to reduce same-hospital readmissions for children, while we do find statistically significant decreases in the same-provider readmission rate for women after an elective index admission and for elderly after an emergency index admission.

5. Discussion and concluding remarks

A recent trend in provider reimbursement uses financial penalties rather than bonuses to incentivise desired provider behaviour. In this paper we have analysed the early effect of such NP4P for readmissions introduced in the English NHS.

We examine the effect of the policy on children, women and the elderly, and find general decreases in readmissions targeted by the policy, although this was in line with previous trends. There is some evidence to suggest that hospitals responded to the policy by increasing LOS for women targeted by the policy, and mixed evidence on whether hospitals responded strategically to the reform by decreasing same-provider readmissions.

Table 3: Difference in differences estimates of the effect of the NP4P policy on the readmission probability, LOS of the index admission, and the probability of being readmitted to the same hospital as the index admission

		Index admission type	
	Overall	Elective	Emergency
Children			
30-day readmission rate	-0.0053^{*}	0.0024	-0.0055
	(-2.22)	(0.60)	(-1.76)
Length of stay	-0.0089	0.0027	0.0052
	(-0.47)	(0.07)	(0.24)
Same-provider readmission rate	0.0194^{*}	0.0820^{***}	0.0018
	(2.38)	(3.63)	(0.22)
Women			
30-day readmission rate	-0.0212^{***}	-0.0244^{***}	-0.0157^{**}
	(-5.43)	(-4.62)	(-2.92)
Length of stay	0.0731^{***}	0.0456	0.0659^{**}
	(4.11)	(1.36)	(2.83)
Same-provider readmission rate	-0.0145	-0.0628^{**}	-0.0060
	(-1.94)	(-2.63)	(-0.77)
Elderly			
30-day readmission rate	-0.0031^{**}	-0.0047^{***}	-0.0023
	(-2.67)	(-3.90)	(-0.57)
Length of stay	-0.0516^{***}	0.0273^{***}	0.0106
	(-7.36)	(6.30)	(0.28)
Same-provider readmission rate	-0.0022	0.0016	-0.0137^{**}
	(-0.71)	(0.34)	(-2.60)
Children			
$N_{30\ day\ readmissions\ and\ LOS}$	476,591	106,633	369,958
$N_{Same-provider\ readmissions}$	56,519	11,882	44,637
Women			
$N_{30\ day\ readmissions\ and\ LOS}$	354,853	207,745	147,108
$N_{Same-provider\ readmissions}$	29,311	7,107	22,204
Elderly			
$N_{30\ day\ readmissions\ and\ LOS}$	2,991,179	1,846,307	1,144,872
$N_{Same-provider\ readmissions}$	330,518	150,423	180,095

Note: See Table 2 for group definitions. The results for 30-day readmissions and same-provider readmissions were estimated using linear probability models. All models include controls for patient's age, gender and ethnicity, the source of admission, HRG, LOS, discharge destination, type of the initial admission and hospital and quarter fixed effects. LOS is not a regressor in the LOS regression. t-values in parentheses. All models estimated with standard errors robust to unspecified heteroscedasticity. * $p < 0.05$, ** $p < 0.01$, ***

As mentioned in the introduction, England is not alone in penalising readmissions. The HRRP– the NP4P reform for readmissions for US hospitals reimbursed under Medicare and Medicaid was effective from October 2012, and creates financial incentives to reduce readmissions within 30 days for patients with acute myocardial infarction, heart failure, and pneumonia.

Rather than incentivising reductions in all-cause readmissions, the HRRP thus clearly focuses on three well defined clinical conditions. This policy design might make it easier for hospitals to focus their efforts on reducing readmissions for the clinical areas targeted by the reform. It may also make it easier to identify relevant clinical guidance on how to reduce readmissions for these patient groups. On this background, we might expect the HRRP to lead to larger reductions in readmission rates than the English NP4P scheme.

The design of the financial penalty is also different between the English policy and the HRRP. In the English scheme, hospital admissions are evaluated on a per admission basis, and hospitals are not being reimbursed for the individual readmissions targeted by the policy. Under the HRRP, hospitals with higher than expected risk adjusted readmission rates are penalised by a percentage reduction of up to 3% (increased from 1% in the first year) of the hospital's DRG base operating amount for patients admitted for any reason. The penalty increases with the extent of worse than expected performance (PPACA, 2010).

It is noteworthy that the English policy does not make formal risk adjustments, but targets all readmissions within the policy criteria. The focus on risk adjusted readmission rates in HRRP might make the marginal cost of readmitting an additional patient less tangible than under the English NP4P scheme. On the other hand, the magnitude of the financial penalty is potentially larger than under the English scheme, and the tournament design of the HRRP may also crate stronger incentives for reducing readmission rates for the targeted conditions, at least for hospitals that fear they have higher than average readmission rates. Again, this could suggest a stronger effect of the US HRRP reform on readmission rates.

Early evidence of the effect of the US HRRP suggests the scheme might have been successful in reducing readmissions. In the last quarter of 2012 (the first quarter after the reform) the all-cause readmission rate fell from 19% to 17.8% $\approx$ 6% , and Centers for Medicare and Medicaid Services (CMS) has reported that the reduction was greater for the conditions targeted by the policy than for all causes (James, 2013). However, the size of the effect for these conditions, and effects on resource use and other outcomes has yet to be robustly evaluated.

There are important questions regarding the impact of the policy that we have not yet considered. The focus on readmissions occurring within 30-days means that hospitals can avoid the negative financial consequences of admitting patients by postponing readmissions to the 31st day or later after discharge, and this question will be analysed in future work.

Another important question not considered so far is the effect of the readmission NP4P on mortality. Previous research (Laudicella et al., 2013) has shown that, due to unobserved patient severity, ignoring the correlation between mortality and readmission rates can lead to biased estimates of hospital performance on readmission rates. This can result in the underestimation of hospital performance (in terms of readmissions) for hospitals with low mortality rates. A policy adjustment to the HRRP for FY 2014 will penalise hospitals that reduces readmissions at the cost of an increase in 30-day mortality, although commentators warn that this micro management approach may lead hospitals to loose sight of more important population level goals (Brown JR et al., 2014).

This paper has taken a first step in assessing the effect of NP4P for readmissions. NP4P is not only being used for incentivising lower readmission rates. Both in England and the US, payers have implemented NP4P for so-called 'Never Events' or Hospital Acquired Conditions, withholding payment for hospitalisations leading to undesired patient outcomes such as pressure ulcers during hospitalisation and wrong site surgery. More applications are likely to follow of an instrument that is potentially a cost effective alternative to pay for performance, but further research is needed to comprehensively ascertain the effects of NP4P on organisational performance.

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Appendix A. Policy Exemptions

Readmissions that are exempted from the policy are defined as readmissions where the readmission includes children under the age of four (measured at the readmission), maternity and childbirth patients (defined as having admission or readmission in HRG subchapter NZ (Obstetric medicine) in HRG v. 4), Cancer, chemotherapy and radiotherapy patients, (defined as patients with an index or readmission with a primary diagnosis in ICD-10 codes C00-C97 and D37-D48 or an unbundled HRG in subchapter SB (chemotherapy) or SC (radiotherapy)), patients who are readmitted having self-discharged against clinical advice and patients where the readmission is due to a road traffic accident (defined as readmissions with a primary or secondary diagnosis in ICD-10 codes beginning with a V), multiple trauma patients (with a readmission in with a HRG root code of VA14 or VA15) or readmissions without a national tariff. From FYI 2012-13 patients receiving renal dialysis and patients readmitted subsequent to a transplant are also excluded from the policy (Department of Health, 2012)

Table A.1: Analysis of pre-reform equivalence of linear trends between treatment and control groups

		Index admission type	
	Overall	Elective	Emergency
Children			
30-day readmission rate	-0.0017^{***}	-0.0015^{**}	-0.0015^{***}
	(-5.46)	(-2.71)	(-3.64)
Length of stay	-0.0040	-0.0056	0.0013
	(-0.99)	(-0.52)	(0.42)
Same-provider readmission rate	-0.0001	0.0024	-0.0009
	(-0.13)	(0.77)	(-0.94)
Women			
30-day readmission rate	-0.0016^{***}	-0.0013^{**}	-0.0010
	(-3.57)	(-2.59)	(-1.46)
Length of stay	0.0029	0.0040	0.0025
	(1.19)	(1.38)	(0.67)
Same-provider readmission rate	0.0009	0.0008	0.0003
	(0.92)	(0.21)	(0.36)
Elderly			
30-day readmission rate	-0.0005^{**}	-0.0006^{***}	0.0002
	(-3.01)	(-3.96)	(0.38)
Length of stay	-0.0067^{***}	0.0029^{***}	-0.0029
	(-6.20)	(3.87)	(-0.55)
Same-provider readmission rate	0.0006	-0.0002	0.0005
	(1.39)	(-0.28)	(0.68)

Note: The displayed coefficient is the interaction of a linear time trend and an indicator for conditions to be included in the NP4P. Only pre-reform data is used. See Table 2 for group definitions. All models include controls for patient's age, gender and ethnicity, the source of admission, HRG, LOS, discharge destination, type of the initial admission and hospital and quarter fixed effects. t-values in parentheses. All models estimated with standard errors robust to unspecified heteroscedasticity. * $p < 0.05$, ** $p < 0.01$, ***