Hospital Funding and Efficiency: Evidence on DRG-based Reimbursement

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Abstract

Aims This paper reviews the theoretical and empirical literature on how prospective reimbursement systems, based on diagnosis-related groups (DRGs), affect hospital efficiency.

Methods A comprehensive review of theoretical literature and recent empirical evidence from industrialised countries.

Results Microeconomic theory predicts that prospective funding offers moderate incentives for increasing activity, controlling expenditure and improving quality. However, the strength of incentives for efficiency depends on how prices are set. Incentives for efficiency are maximised if price is partly or entirely independent of a provider's own costs. Prices, therefore, can be used as a policy instrument to signal what the health care system should be doing and to reward good practice.

Empirical evidence of the impact of prospective funding on hospital efficiency is mixed. Where efficiency improved following the introduction of prospective funding, establishing causation is complicated by confounding factors. Elsewhere potential efficiency gains may have been somewhat offset by other aspects of the national health care system, such as limitations on activity. There is general consensus that prospective funding is associated with increased activity and reduced length of stay, although the same caveats apply.

Prospective funding can have unintended consequences, such as quality skimping, cost-shifting, adverse selection (where hospitals 'cherry pick' lower-cost patients) or upcoding to higher-priced DRGs. To guard against such behaviour, prospective funding must be supplemented by appropriate regulatory mechanisms, such as activity ceilings and data audit.

Conclusions Prospective DRG-based reimbursement offers the potential for increased efficiency, but appropriate regulatory mechanisms are essential for the potential to be realised.

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1 Introduction

The first use of prospective funding based on diagnosis-related groups (henceforth prospective funding) was in 1983, when the US adopted it to pay hospitals for treating Medicare patients. Since then it has been widely adopted internationally, principally because of its three overarching strengths:

1. Payments are patient-based. Fundamental to effective prospective funding is an accurate description of the type of patients treated (casemix). Most countries that have adopted prospective funding use some form of diagnosis-related groups (DRGs) to classify patients. This is because DRGs offer an efficient and clinically sound approach for describing and managing hospital activity, more so than the alternatives of treating each patient separately or using specialty groupings.
2. Prospective funding is a form of 'yardstick competition', designed to encourage greater efficiency in the absence of free-market competition. To be effective, prices must reflect the costs of efficient providers.
3. Prospective funding offers greater transparency in the financing of health care, relating provider revenue directly to their workload.

The remainder of this section describes the purpose of DRG systems and the role of yardstick competition. Different funding models are then outlined in Section 2 and the empirical evidence on the impact of prospective funding on hospital efficiency is reviewed in Section 3. Section 4 details the potential unintended consequences associated with the use of DRGs in prospective funding and Section 5 briefly concludes.

1.1 Purpose of the DRG System

There have been various reasons for the introduction and development of DRG systems (Table 1). In the US, the hospital funding mechanism switched from fee-for-service, which was considered inherently inefficient and increasingly expensive, to prospective funding using DRGs. In most European countries, DRGs were mainly used to engender a more equitable allocation of hospital budgets (Scheller-Kreinsen *et al.*, 2009). In others, DRGs were principally a cost containment instrument (for example, Estonia). The historical use of block contracts was considered unsustainable, and a prospective payment system offered the potential to reduce length of stay and to encourage efficiency.

More recently, DRGs were used in Europe as the payment unit for prospective funding. Portugal was the first European country with a national health system to incorporate DRG casemix adjustment to formulate hospital budgets on a nationwide basis (Bentes *et al.*, 1999). DRGs have subsequently been adopted as the main instrument in hospital reimbursement in many European countries (for example, Germany, England and France). However, in Sweden and Finland DRGs are primarily used to aid transparency in the planning and management of hospital services (Table 1).

Table 1: Overview of the DRG system in 11 European countries

	Year of DRG introduction	**Original purpose**	**Principal purpose(s) in 2010**
Austria	1997	Cost containment tool	Reimbursement and also used as a planning and steering instrument
England	1992	Patient classification	Patient classification, reimbursement
Estonia	2003	Grouping tool	Reimbursement
Finland	1995	To provide benchmarking data at a national level to better describe hospital activities	Used as a billing instrument and also as a patient classification system and for planning and management/ hospital benchmarking
France	1991	Description of hospital activity	Reimbursement
Germany	2003	Budgetary allocation	Reimbursement
Ireland	1993	Budgetary allocation	Budgetary allocation
Poland	2008	Reimbursement	Reimbursement
Spain/Catalonia	1997	Reimbursement	Hospital reimbursement/efficiency benchmarking
Sweden	1991	Used as a prospective payment system and also to describe performance, to increase transparency of hospital activities, and to increase productivity	Benchmarking and measuring performance
The Netherlands	2005	Finance primary care chain based on the quality of the delivered care	Hospital reimbursement

DRGs have also helped to foster an environment of competition among hospitals and, in the Netherlands, among health insurers. Linking DRG costs to hospital budgets has encouraged hospitals to become more efficient and productive. Cost differences between similar specialties have been reduced while the relationship between activity and costs has become more transparent.

1.2 Yardstick Competition

Prospective funding is a form of 'yardstick competition', designed to encourage providers to reduce their costs in contexts where they face limited competitive pressure (Schleifer, 1985). If providers outperform others they benefit directly by retaining the generated surplus; if they

under-perform they generate deficits and, ultimately, risk bankruptcy. All providers, including the most efficient, have an incentive to continually reduce costs.

Yardstick competition is effective when regulated prices are virtually independent of an individual provider's costs, since they are based on costs observed in all providers within the same industry. Ideally, prices should reflect the supply costs of efficient providers. However, it is not straightforward to identify efficient providers, especially if the regulator is poorly informed about the provider's costs, the exogenous influences on these costs and the level of effort expended by the provider (i.e. their efficiency). This asymmetry of information is particularly problematic in the health care sector. Schleifer (1985) argues that inferences are more robust if based on analysis of the costs of a sufficiently large number of firms.

2 Funding Models

To understand the role of DRGs in enhancing efficiency, we compare (simplified versions of) the three main forms of provider funding models used in hospital financing: cost-based reimbursement, global budgeting, and prospective financing. The three funding models are summarised in Table 2, together with the different incentives associated with each for achieving objectives relating to activity levels, expenditure control, quality of care and efficiency.

Table 2: Summary of hospital payment systems and their associated incentives

	Cost-based	**Global budget**	**Prospective**
Description of patients	Individual	Specialty	DRG
Amount of activity	Unrestricted	Target/historical	Unrestricted
Price per unit of activity	Item of service	Locally agreed	Fixed prospectively
Basic formulation of revenue function	$R^C = Q_i \times c_i$	$R^G = \sum_{s=1}^{S} B_s = \sum_{s=1}^{S} \left[\bar{Q}_s \times p_s \right]$	$R^A = Q_j \times \hat{p}_j$
Incentives			
Increase activity	Strong	Weak	Moderate
Expenditure control	Weak	Strong	Moderate
Quality	Strong	Moderate	Moderate
Efficiency	Weak	Moderate	Strong

Note: See Glossary for a description of terms.

Each funding model is explained in detail in the following subsections.

2.1 Cost-based or Insurance-based Reimbursement

Under cost-based reimbursement, payments to hospitals are based on the cost incurred by each individual patient. The main method of cost control is to specify a price list that details the unit payment for each 'item of service' (for example, medication). Hospitals must therefore provide itemised bills for every patient treated, but they have no incentive to limit what they do per insured patient – the more diagnostic tests they perform, the more they get paid.

Stated formally, under cost-based reimbursement, hospital revenue (R^C) amounts to the number of patients treated (Q_i) multiplied by the unit cost of treatment (c_i), where *i* indicates a particular patient:

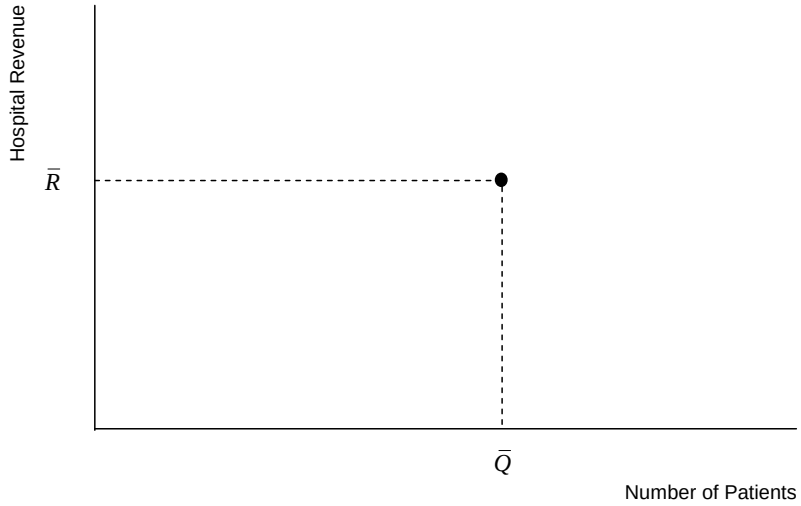
$$R^C = \left[Q_i \times c_i\right] + \mathbf{Z}^C \tag{1}$$

$\mathbf{Z}^C$ captures all other forms of revenue that hospitals receive, such as for teaching and research. Cost-based reimbursement operated in the US during the 1960s and 1970s. This fuelled escalation in health care costs as hospitals engaged in a 'medical arms race', spending ever more on technologies and facilities to attract patients. Hospitals knew that they could reclaim the costs from health insurance companies and Medicare and Medicaid, the public insurance programmes for older people and those on low incomes.

2.2 Global Budgets

Cost control is one of the key advantages of global budget arrangements, which have been common in countries with socialised (as opposed to insurance-based) health systems. A fixed payment is agreed in advance for a target level of activity – often specified at specialty-level. Figure 1 illustrates the case where a hospital receives a fixed payment $(\bar{R})$ for treating a pre-specified volume of activity $(\bar{Q})$.

Figure 1: Hospital revenue under global budgets



Difficulties arise if there are deviations from the pre-specified volume. Some form of penalty must be imposed if the volume is not achieved. If the pre-specified volume is exceeded ('over-performance'), the funder must either provide extra money or the hospital will refuse to do extra work, thereby creating waiting lists ('cost & volume' contracts were developed to deal with these problems, and we return to a prospective funding form of these below).

Often global budgets specify activity by specialty. Negotiations between the funder and hospital revolve around the monetary value of each specialty-level contract (B_s) and how much activity $(\bar{Q}_s)$ will be provided under this contract. The local specialty-level price (p_s) is the by-product of negotiations about total contract value and the volume of activity. In formal terms, hospital revenue under global budget arrangements is the sum of its contracts across specialties (B_s):

$$R^G = \sum_{s=1}^{S} B_s + \mathbf{Z}^G = \sum_{s=1}^{S} \left[\bar{Q}_s \times p_s \right] + \mathbf{Z}^G \tag{2}$$

Where $\mathbf{Z}^G$ captures all other forms of revenue that hospitals receive under these funding arrangements.

2.3 Prospective Funding

There are two key features of prospective funding. First, activity is described using DRGs rather than specialty. For instance, payment is made for a patient having a hip replacement rather than a patient treated in trauma and orthopaedics. Second, the price per DRG is fixed in advance (i.e. prospectively) and is wholly or partially independent of an individual provider's costs. In many jurisdictions, this fixed price is set nationally rather than locally.

The relationship between the unit price and amount of activity can take a number of forms. The main ones discussed here are:

1. Linear payments, where the total payment equals price times quantity;
2. Mixed payments, where hospitals receive additional payments (often in the form of lump sums) that are unrelated to activity levels;
3. Marginal payments, where different prices are payable for the same type of activity depending on the quantity provided; and,
4. Mixed and marginal payments, which are a combination of (2) and (3).

To understand the differences between these payment arrangements, we consider how the total revenue received by a particular hospital is calculated.

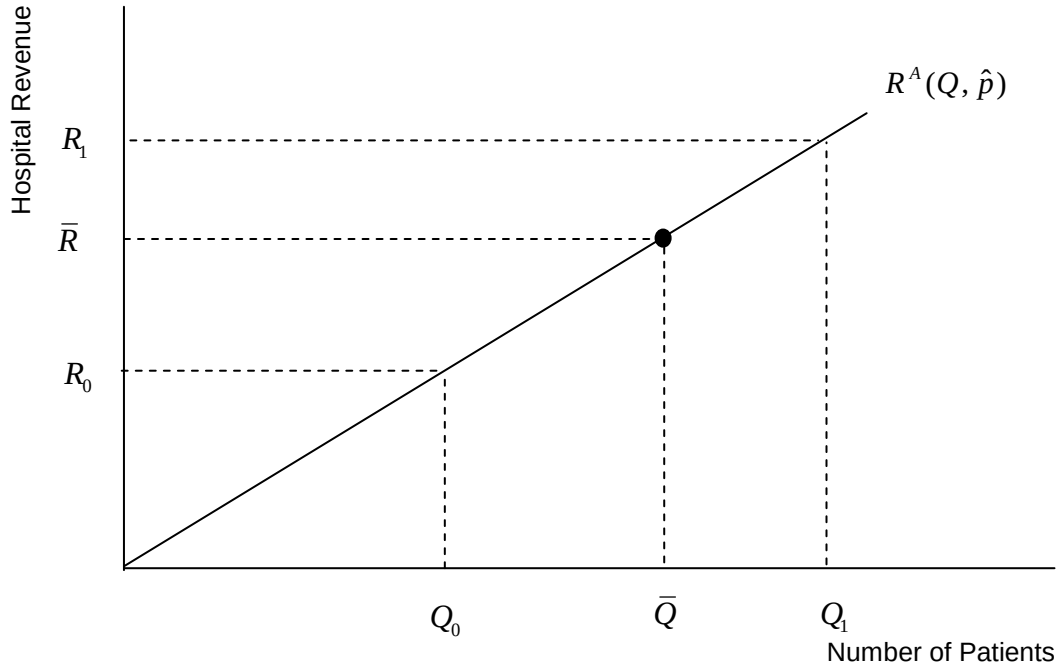
2.3.1 Linear Payments

Under the most straightforward prospective payment system of linear payments, hospital revenue is determined simply by multiplying activity in each DRG (Q_j) by the fixed price per DRG $(\hat{p}_j)$, where *j* indicates a DRG:

$$R^A = \left[Q_j \times \hat{p}_j \right] \tag{3}$$

Under this formulation, hospital revenue increases linearly with activity, as illustrated in Figure 2. If the hospital treats Q_0 patients it receives revenue amounting to only R_0; if Q_1 patients are treated, revenue increases to R_1. Clearly, then, the revenue consequences of changes in activity are much more transparent than under global budget arrangements.

Figure 2: Hospital revenue under 'pure' prospective funding



2.3.2 Mixed Payments

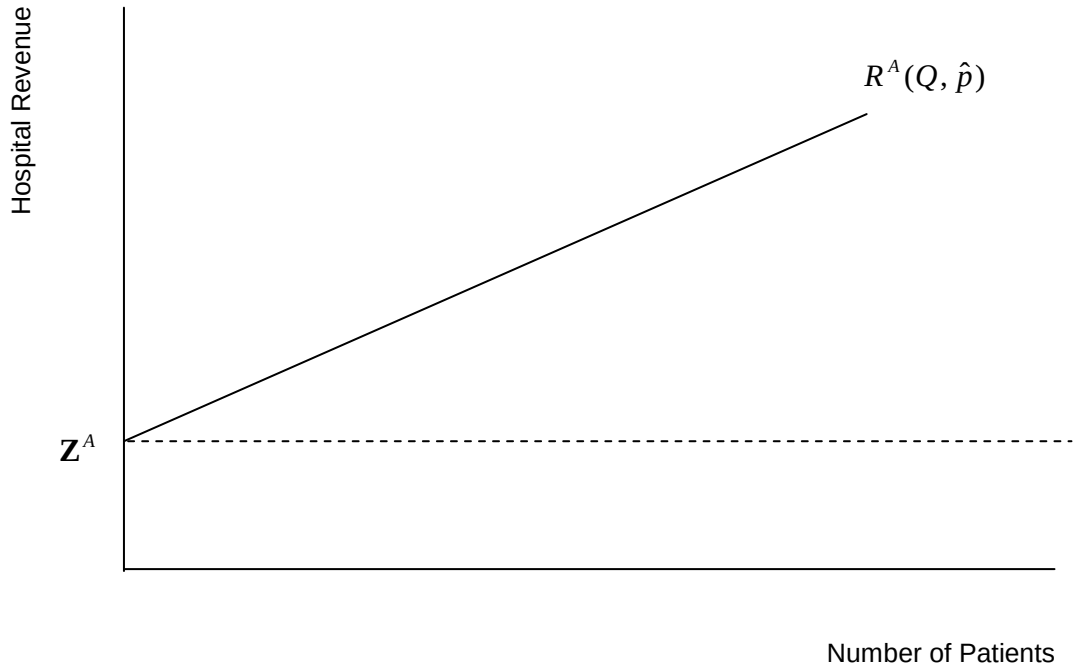
In almost all countries that have introduced prospective funding, hospital revenue is not determined solely by the number of patients treated. Hospitals also receive revenue in other forms – for instance, for teaching and research, to compensate for different geographical costs, or to cover some element of the fixed costs of providing services. It has been formally demonstrated that this 'mixed' funding system creates better incentives than a system of 'pure' activity-based funding (Ellis and McGuire, 1986). The composition of these other revenue forms is a matter of negotiation between the funder and the hospital sector, and may vary between hospitals, between countries and over time. We define $\mathbf{Z}^A$ as capturing all these non-activity related sources of revenue under prospective funding. Then the revenue function becomes:

$$R^A = \left[Q_j \times \hat{p}_j \right] + \mathbf{Z}^A \tag{4}$$

Figure 3 shows how this arrangement changes the relationship between revenue and activity. Hospitals receive a fixed amount $\mathbf{Z}^A$ irrespective of the number of patients treated. On top of

this, hospitals receive revenue in line with activity – but the unit price ($\hat{p}_j$) will be lower under this 'mixed' arrangement than under a 'pure' prospective system.

Figure 3: Hospital revenue under 'mixed' prospective funding



2.3.3 Marginal Payments

Prospective funding can be modified to allow incentives to vary with supply. Quite often, prospective funding is introduced to stimulate activity beyond existing levels. But unconstrained growth in activity may be undesirable. First, it undermines control over global expenditure – under the simple formulation (equation 3), expenditure may simply keep rising in line with activity. Second, hospitals may be able to expand activity at low marginal cost – perhaps because they have under-utilised resources available – and, thus, this differential pricing may be used to exploit economies of scale. If so, there is an argument for reducing the unit price for additional activity.

The resulting arrangements are akin to 'cost & volume' contracts. Two policy decisions are required. First, a 'target' level of activity $(\overline{Q}_j)$ needs to be defined for each hospital. In some countries, this is based on historical activity. Agreeing a target is more difficult where there is decentralised purchasing, such as in England, because the target has to be agreed between each

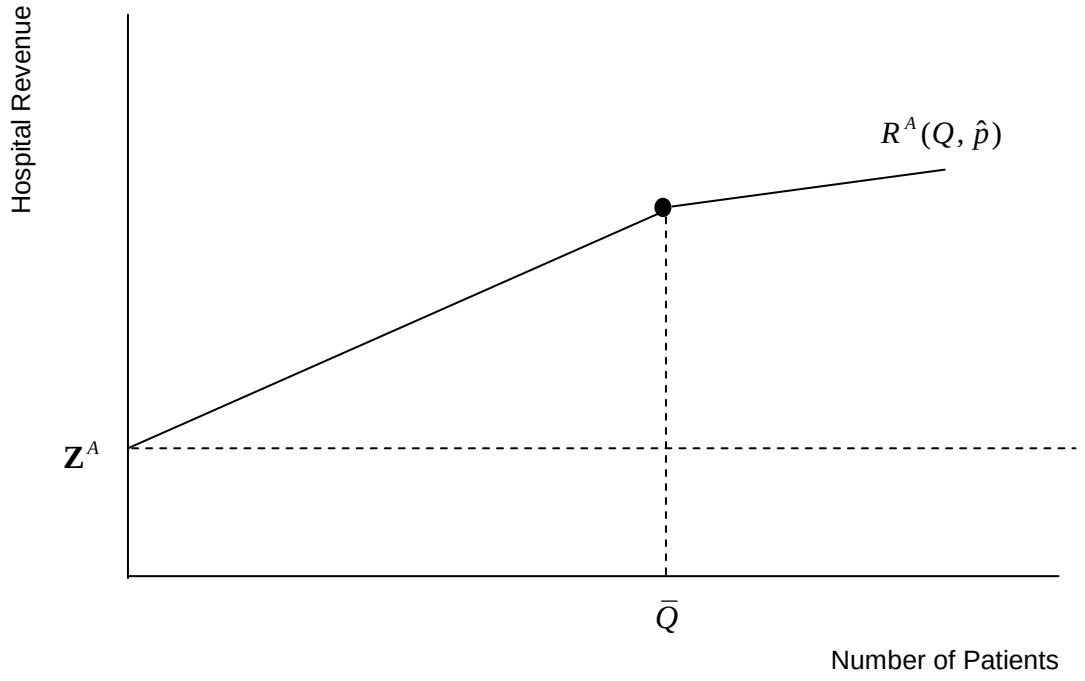
purchaser and provider. Second, the price that should be paid for activity above the target level must be agreed – this is usually defined as some proportion (α) of the price up to the target level. Formally the revenue function can be expressed as:

$$R^A = \left[\bar{Q}_j \times \hat{p}_j\right] + \left[\left(Q_j - \bar{Q}_j\right) \times \alpha \hat{p}_j\right] + \mathbf{Z}^A \quad (5)$$

Where $\left(Q_j - \bar{Q}_j\right)$ is non-negative and represents activity above the target and $\alpha \hat{p}_j$ is the price paid per unit of additional activity. If $\alpha = 0.5$, the price for additional activity is 50% of that paid for activity up to the target; if $\alpha = 1$, the same price is paid (in which case equations 4 and 5 are equivalent); if $\alpha = 0$, the marginal price is zero, so there is no incentive for hospitals to undertake more activity; and if $\alpha > 1$ additional payments are higher than the base price, which creates very strong incentives to undertake additional work. This may be justified if marginal costs are high, as expansions in activity require additional investment.

Figure 4 shows how revenue changes under this arrangement, when the marginal price for additional activity is below the price for activity up to the target i.e. $0 < \alpha < 1$. This results in a 'kinked' revenue function.

Figure 4: Hospital revenue under 'mixed' prospective funding with marginal pricing



3 Review of Empirical Evidence on DRGs and Efficiency

The theoretical framework indicates that prospective funding may enhance hospital efficiency, either by changing the focus of cost-based reimbursement from being retrospective to prospective or by linking payment to activity, unlike in global budgets. This section reviews the recent empirical evidence from industrialised countries. Although improving hospital efficiency is generally a key motivation for introducing casemix-adjusted prospective funding, relatively few studies have explicitly identified and quantified its impact. Rather, most research has concentrated on components of efficiency – such as activity and costs – which are more easily measured. The evidence on these components is also considered.

3.1 Prospective Funding and Efficiency

Studies of the impact of prospective funding on hospital-level efficiency typically focus on technical efficiency and/or productivity, not cost efficiency. Data envelopment analysis, a well-established non-parametric method, is the most commonly applied approach, although some studies use regression-based stochastic frontier analysis. Both methods have advantages and disadvantages (*inter alia*, Jacobs *et al.*, 2006), yet reassuringly studies that applied both techniques produce broadly consistent results (Gerdtham *et al.*, 1999a; Gerdtham *et al.*, 1999b; Dismuke and Sena, 1999).

Given the obvious difficulties in undertaking cross-sectional international efficiency comparisons, all but one of the studies summarised in Table 3 adopted a longitudinal perspective, comparing hospital efficiency before and after the reimbursement reform. However the length of follow-up periods vary, complicating interpretation: where the time horizon is short, changes may not be sustained; conversely a longer timeframe may fail to establish a causal relationship particularly if other reforms are implemented in the interim. Several studies explicitly highlight the difficulty in attributing changes in efficiency, or any of its components, to the introduction of prospective funding (Farrar *et al.*, 2007; Audit Commission, 2008). Moreover, few studies assess the quality of care, despite the potential trade-off between quality and efficiency.

Table 3: Summary of recent studies examining impact of prospective funding on hospital efficiency

Country, Year of change to prospective funding	Study	Methodology	Variables	Results/Conclusions
US, 1983	Borden, 1988[a]	*Method:* DEA, ratio and regression analysis *Sample:* 52 hospitals in New Jersey *Study period:* 1979-1984	*Outputs:* (1) Cases treated in each of the eight highest-volume DRG categories; (2) Cases treated in remaining DRG categories *Inputs*: (1) Total FTEs; (2) Nursing FTEs; (3) Other nonpayroll expenses; (4) Beds *Quality*: Not included.	The funding reform did not have a positive effect on technical efficiency.
	Chern and Wan, 2000	*Method*: DEA *Sample*: 80 hospitals in Virginia *Study period*: 1984 & 1993	*Outputs*: (1) Casemix-adjusted inpatient discharges; (2) Visits to the Emergency Room and outpatient facilities *Inputs*: (1) Beds and service complexity; (2) Non-physician FTEs and weighted number of part-time personnel; (3) Operating expenses excluding payroll, capital and depreciation *Quality*: Not included.	There was no statistically significant difference in technical efficiency between 1984 and 1993, but the percentage of efficient hospitals was higher in 1993.
Sweden, early 1990s	Gerdtham *et al.*, 1999a	*Method*: Multiple-output stochastic ray frontier model *Sample*: 26 county councils *Study period*: 1989-1995	*Dependent variables*: (1) Operations; (2) Discharges; (3) Physician visits *Independent variables*: (1) Cost; (2) Available beds; (3) Year; (4) Variables to capture the lead-effects of reform; (5) Variables for the new reimbursement system; (6) Political majority; (7) Age; (8) Proportion of private visits; (9) University hospital *Quality*: Not included.	Move to prospective funding increased technical efficiency by 9.7% on average.
	Gerdtham *et al.*, 1999b	*Method*: Two stages: (1) Modified DEA; (2) Regression *Sample*: 26 county councils *Study period*: 1993 & 1994	*Outputs*: (1) Surgical discharges; (2) Short-term internal medicine discharges; (3) Surgical operations in short-term care; (4) Physician visits in short-term surgical care; (5) Physician visits in internal medicine *Inputs*: (1) Total cost for short-term care; (2) Beds *Quality*: Not included.	Hospital services were more efficient in county councils with internal markets and output-based (prospective) reimbursement, compared to those with budget reimbursement. Potential cost savings of approximately 13% by switching from budget to prospective reimbursement.

Table 3: Summary of recent studies examining impact of prospective funding on hospital efficiency (contd.)

Country, Year of change to prospective funding	Study	Methodology	Variables	Results/Conclusions
Portugal, 1990	Dismuke and Sena, 1999	*Method*: Two stages: (1) Parametric and non-parametric methods; (2) Regression *Sample*: 2 DRGs *Study period*: 1992-1994	*Outputs*: (1) Live discharges; (2) Dead discharges *Inputs*: Utilisation of: (1) Computerised axial tomography scanner; (2) Electrocardiogram; (3) Echocardiogram *Quality*: Distinguishes between desirable outputs (live discharges) and undesirable outputs (dead discharges).	Percentage of hospitals' budgets paid through DRG had a positive impact on their productivity.
	Dismuke and Sena, 2001	*Method*: Malmquist-Luenberger index *Sample*: 2 DRGs *Study period*: 1992-1994	*Outputs*: (1) Number of live discharges; (2) Number of dead discharges *Inputs*: Utilisation of: (1) Computerised axial tomography scanner; (2) Electrocardiogram; (3) Echocardiogram *Quality*: As per Dismuke and Sena, 1999.	Prospective payment improved productivity.
Austria, 1997	Sommersguter-Reichmann, 2000	*Method*: DEA/ Malmquist *Sample*: 22 hospitals *Study period*: 1994-1998	*Outputs*: (1) Patients treated in the outpatient care unit; (2) Credit points reported by each hospital, multiplied by a steering factor (to differentiate between hospital types) *Inputs*: (1) Labour FTEs; (2) Hospital beds; (3) Expenses for external medical services *Quality*: Not included.	There was a positive shift in technology between 1996 and 1998, but there was no improvement in technical efficiency.
Norway, 1997	Biørn *et al.*, 2003	*Method*: Two stages: (1) DEA; (2) Regression *Sample*: 48 hospitals *Study period*: 1992-2000	*Outputs*: (1) Casemix-adjusted discharges (including day care); (2) Outpatient visits weighted by the fee paid by the state for each visit *Inputs*: (1) Physician FTEs; (2) Other labour FTEs; (3) Medical expenses; (4) Total running expenses (for analysis of cost efficiency) *Quality*: Not included.	The introduction of prospective funding improved technical efficiency, but the results on the impact on cost efficiency are varied.
	Hagen *et al.*, 2006	*Method*: Two stages: (1) DEA; (2) Regression *Sample*: 48 hospitals *Study period*: 1992-2003	*Outputs*: (1) Casemix-adjusted discharges; (2) Outpatient visits weighted by government's reimbursement per visit *Inputs*: (1) Physician FTEs; (2) Other labour FTEs; (3) Medical expenses; (4) Total operating costs (for analysis of cost efficiency) *Quality*: Not included.	Technical efficiency increased after the reimbursement reform, but the effect on cost efficiency was statistically insignificant.
Norway, 1997 and Finland	Linna *et al.*, 2006	*Method*: DEA *Sample*: Finland – 47 hospitals and Norway – 51 hospitals *Study period*: 1999	*Outputs*: (1) DRG-weighted admissions; (2) Weighted outpatient visits; (3) Weighted day care; (4) Inpatient days *Inputs*: (1) Net operating costs *Quality*: Not included.	The average level of cost efficiency was lower in Norwegian hospitals.

Notes: FTE, full-time equivalent. DEA, data envelopment analysis. DRGs, diagnosis-related groups.

[a] Studies hospitals in New Jersey, where prospective payments were introduced for all payers in 1980.

Methodological caveats aside, findings on the impact of prospective funding on hospital efficiency are mixed. The reformed funding system was associated with improved technical efficiency in Sweden (Gerdtham *et al.*, 1999a; Gerdtham *et al.*, 1999b), Portugal (Dismuke and Sena, 1999, 2001) and Norway (Biørn *et al.*, 2003; Hagen *et al.*, 2006). By contrast, no positive impact was observed in the US (Borden, 1988; Chern and Wan, 2000) and there were technological improvements, but no technical efficiency gains, in Austria (Sommersguter-Reichmann, 2000). The limited evidence on time-series changes to cost efficiency, confined to Norwegian data, is also mixed (Biørn *et al.*, 2003; Hagen *et al.*, 2006). These divergent results may be explained by the country-specific contexts in which the funding reforms were implemented, including different incumbent reimbursement mechanisms, the specification of prospective funding, and/or the simultaneous introduction of other health care reforms.

Taking the first of these, the potential for efficiency gains may depend on the pre-existing funding system. Thus, where global budgets preceded prospective funding, as in socialised systems such as Sweden, Portugal and Norway, hospitals' technical efficiency apparently improved (although Linna *et al.*, 2006, found lower cost efficiency in Norwegian hospitals compared to their Finnish counterparts, despite the latter being regarded as operating within a global budget framework). Conversely, prospective payment did not improve technical efficiency when it replaced retrospective, cost-based reimbursement (as in insurance-based systems, such as the US and Austria).

This apparent greater potential for efficiency gains when moving from global budgets cannot be regarded as definitive, because the operation of the national prospective funding system may itself act as a constraint. Hence initial efficiency improvements in Sweden were subsequently negated when ceilings were imposed on hospital activity levels (Gerdtham *et al.*, 1999a; Gerdtham *et al.*, 1999b; Anell, 2005; Kastberg and Siverbo, 2007), and analogous restrictions may also help to explain the lack of improvements in the US and Austria (Sommersguter-Reichmann, 2000; Böcking *et al.*, 2005). Finally, it is difficult to isolate the impact of prospective funding when it is introduced as part of a wider health care reform programme, as in Sweden when an internal market was also established (Gerdtham *et al.*, 1999a, Gerdtham *et al.*, 1999b).

3.2 Prospective Funding and Efficiency Components: Activity, Length of Stay and Costs

Table 4 summarises studies that examined changes in efficiency components. Following the introduction of prospective funding, hospital admissions increased in Australia (Ettelt *et al.*, 2006; Street *et al.*, 2007), Denmark (Street *et al.*, 2007), England (Farrar *et al.*, 2007; Audit Commission, 2008; Farrar *et al.*, 2009), France (Or, 2009), Germany (Böcking *et al.*, 2005; Hensen *et al.*, 2008), Norway (Biørn *et al.*, 2003; Kjerstad, 2003; Hagen *et al.*, 2006; Magnussen *et al.*, 2007), Spain (Ellis and Vidal-Fernández, 2007) and, at least initially, in Sweden (Anell, 2005; Kastberg and Siverbo, 2007). However, activity did not increase in the US (US Congress Office of Technology Assessment, 1985; Guterman *et al.*, 1988; Davis and Rhodes, 1988; Manton *et al.*, 1993; Muller, 1993; Rosenberg and Browne, 2001) and there are conflicting results for Italy (Louis *et al.*, 1999; Ettelt *et al.*, 2006). Of course, the aforementioned points regarding country-specific contexts also apply here.

The financial incentive to minimise costs under prospective funding has contributed to a shift from inpatient to daycase and/or outpatient settings (Rosenberg and Browne, 2001; Farrar *et al.*, 2009) – this may also improve the quality of care, as well as efficiency, *ceteris paribus*. Indeed, prospective tariffs have been used to explicitly incentivise hospitals to increase daycase activity, as for example in England, where until recently a common national tariff applied to elective activity across inpatient and daycase settings (Epstein and Mason, 2006; Street and Maynard, 2007). In the US, the shift towards outpatient care may also be explained by the operation (until 2000) of a parallel retrospective cost-based reimbursement system for such treatment (Rosenberg and Browne, 2001).

Average length of stay generally declined following the move to prospective funding (for example, Kahn *et al.*, 1990; Böcking *et al.*, 2005), although some argue that this was merely consistent with a general trend (Rosenberg and Browne, 2001; Schreyögg *et al.*, 2005). Discharge rates to post-acute institutions (typically less costly than acute facilities) usually increased. On average, the recorded severity of patients remaining in acute settings increased (Böcking *et al.*, 2005), which, assuming this was not simply changed coding practice, suggests limited potential for further reductions in length of stay *ceteris paribus* (Guterman *et al.*, 1988; Rosenberg and Browne, 2001).

Table 4: Summary of recent studies examining changes in the components of hospital efficiency following the introduction of prospective funding

Country, Year of change to prospective funding	Study	Study period	Hospital activity	Average length of stay	Costs	
					Unit/ Average	Total
US, 1983	US Congress Office of Technology Assessment, 1985	1983-1984/ Review	–	–		
	Guterman *et al.*, 1988	1983-1986	–	–		+[c]
	Davis and Rhodes, 1988	Review	–	–		
	Kahn *et al.*, 1990	1981/2 & 1985/6		–		
	Manton *et al.*, 1993	1982/3-1984/5	–	–		
	Muller, 1993	1970-1992	–	–		
	Rosenberg and Browne, 2001	Review	–	–		
Australia, 1993[a]	Ettelt *et al.*, 2006	Review	+		–	–
	Street *et al.*, 2007	Review	+			
Sweden, early 1990s	Anell, 2005	Review	+	–		+
	Kastberg and Siverbo, 2007	Review	+	–		+
Italy, 1995	Louis *et al.*, 1999	1993-1996	–	–		
	Ettelt *et al.*, 2006	Review	+			
Spain, 1996	Ellis and Vidal-Fernández, 2007	Review	+		+[c]	
Norway, 1997	Biørn *et al.*, 2003	1992-2000	+			
	Kjerstad, 2003	1995-1998	+			
	Hagen *et al.*, 2006	1992-2000	+			
	Magnussen *et al.*, 2007	Review	+			
Austria, 1997	Theurl and Winner, 2007	1989-2003		–		
Denmark, 2002	Street *et al.*, 2007	Review	+			
Germany, 2003	Böcking *et al.*, 2005	Review	+	–		
	Schreyögg *et al.*, 2005	Review		–		
	Hensen *et al.*, 2008[b]	2003-2006	+	–		
England, 2003/4	Farrar *et al.*, 2007	2002/3-2005/6	+	–	–	
	Audit Commission, 2008	2003/4-2006/7	+	–	?	
	Farrar *et al.*, 2009	2003/4-2005/6	+	–	–	
France, 2004/5	Or, 2009	Review	+			

Notes: The changes following the introduction of prospective funding are denoted by + for an increase, – for a decrease, and ? for mixed effects.

[a] Prospective funding was introduced in Victoria in 1993.

[b] Relates to dermatology.

[c] Increased, but at a slower rate.

Finally, in the majority of cases, the introduction of prospective funding was associated with higher total costs (Forgione and D'Annunzio, 1999; Anell, 2005; Kastberg and Siverbo, 2007), whereas unit costs appear to have declined (Böcking *et al.*, 2005; Farrar *et*

al., 2009). In the US the overall impact was reduced inflation in aggregate costs (Guterman *et al.*, 1988).

In short, in some cases hospital-level efficiency has improved following the introduction of prospective funding, but establishing causation is difficult due to confounding factors. Elsewhere its theoretically-beneficial effects may have been somewhat offset by other features of the national health care system, such as limitations on activity or the pre-existing reimbursement system, leading to mixed results.

4 What are the Key Issues, Problems and Challenges?

4.1 Unintended Consequences of Prospective Funding

Prospective funding can have adverse effects. For instance, incentives to reduce unit costs may lead hospitals to compromise quality, a practice known as 'skimping'. Alternatively, hospitals may attempt to shift costs onto other parts of the care pathway, such as primary care, social services or the patient's family ('cost shifting'). 'Adverse selection' means that hospitals deliberately select patients with lower costs. Although hospitals in socialised systems have limited control over referrals, they retain discretion over the number of attendances and procedures they provide for existing patients. In addition, there is potential for misuse of the classification codes ('upcoding'). For example, hospitals may assign additional diagnostic codes to increase measures of complexity and therefore revenue.

Table 5 qualifies commonly stated aims of prospective funding with caveats that recognise that expectations might not be realised. To guard against such behaviour, prospective funding must be accompanied by additional regulatory mechanisms, such as activity ceilings, marginal pricing, data audit, monitoring of the care process and measurement of patient satisfaction and health outcomes (Street and Maynard, 2007).

Table 5: Caveats to stated aims and benefits of prospective funding

Aims	Qualification
Increase efficiency in the provision of existing levels of activity	Prices based on average costs may dampen incentives for low cost providers to improve. Rather than efficiency, may encourage specialisation and selection of patients with low expected costs.
Encourage expansion of activity	Cost-based prices provide 'neutral' signals about what is needed – additional incentives are required to signal what is most desirable.
Enhance patient choice	Yes, compared to global budgets, as no price differentials across hospitals.
Reduce waiting lists	Yes, especially if incentives are structured so that activity increases are focused on waiting list conditions.
Improve quality	Quality in danger of being compromised, especially if hospitals engage in risk selection or cost-shifting. Additional regulatory safeguards required.
Keep costs under control	Not compared to global budgeting. Need to introduce additional mechanisms to control overall expenditure.
Channel funding where it is needed	Within the acute sector, cost-based prices provide neutral signals. Ability to channel funding away from acute sector depends on relative 'power' of hospital and funder.
Shift patterns of service provision away from historical patterns	Ability to channel funding away from acute sector depends on relative 'power' of hospital and funder – hospitals might be able to generate activity which may be more appropriately undertaken in other settings.
Encourage the development of new, cost-effective treatment pathways	Yes, in the acute sector. For pathways spanning different settings, prospective funding might entrench isolated, rather than partnership, working practices.
Introduce fairness and transparency in funding providers	Yes, prospective funding is perceived to be fair (equal pay for equal work) and transparent – even if the specific formulation might be complex.
Encourage providers to be responsive to patients and funder	Yes, but depends on relative 'power' of hospitals and funder.

Source: Adapted from Street and Maynard, 2007

Some of these issues are covered in more detail below.

4.2 Categorisation Problems may lead to Unfair Reimbursement or Patient Selection

Like any categorisation system, DRGs cannot group patients perfectly on the basis of their expected resource requirements. Much health care is highly individualised so defining a 'standardised package of care' is not straightforward. This would not create funding problems if differences across providers were random, but if the differences across providers are systematic, then the reimbursement system becomes potentially unfair.

4.3 Independence of Price Setting

In some countries, the number of hospitals may be insufficient to ensure that prices are independent of each hospital's costs. This has two implications. First, the regulator may be unable to determine whether costs are contaminated by inefficient behaviour, especially if provision is concentrated in only one or two hospitals. Prospective funding is then in danger of reducing to cost-based reimbursement – which embodies no incentives to improve efficiency. Second, this form of reimbursement may encourage collusion between providers in their reporting behaviour or in their efforts to reduce their costs. The likelihood for such behaviour increases if there are few providers who are well informed about each other's behaviour. Collusion will limit the scope for prospective funding to deliver efficiency improvements.

4.4 Control of Expenditure

Prospective funding that adopts a simple price-per-unit-of-activity approach offers direct incentives to suppliers to increase activity levels. If marginal cost is lower than marginal revenue, the more providers do, the larger their profit. Increases in activity levels may therefore place severe pressure on funders' budgets.

5 Conclusions

Prospective funding systems have the potential to enhance efficiency in the delivery of hospital services and the form by which payments are made can be tailored and fine-tuned to the pursuit of specific objectives, such as activity increases, cost control or reduction of waiting lists. Empirical evidence is mixed, and it appears that if the potential benefits for efficient production are to be realised then payment systems must be carefully designed and monitored.

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Glossary

Summary of terms used in the equations

Symbol	Description
R^C, R^G, R^A	Hospital revenue under, respectively, cost-based reimbursement (*C*), global budgets (*G*) and activity-funding (*A*)
$\mathbf{Z}^C$, $\mathbf{Z}^G$, $\mathbf{Z}^A$	All sources of non-activity related revenue under cost-based reimbursement, global budgets and activity-funding (respectively)
Q	Activity
$\overline{Q}$	Target activity
i	Individual patient
s	Specialty
j	DRG
c	Unit cost
B_s	Specialty contract value
p_s	Locally agreed specialty-level price
$\hat{p}_j$	Prospectively fixed DRG-price
α	Proportion of fixed DRG-price paid for additional activity