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Activity-based funding based on diagnosis-related groups. The end of an era?

A review of payment reforms in the inpatient sector in ten high-income countries.

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ABSTRACT

Background: Across the member countries of the Organisation for Economic Co-Operation and Development, policy makers are searching for new ways to pay hospitals for inpatient care. At present, the dominant payment system for inpatient services is activity-based funding based on diagnosis-related groups. Its focus on activity, however, does not support the transition from volume to value that most OECD countries are seeking to achieve.

Methods: We reviewed reforms to payment systems in ten high-income countries (Australia, Austria, Canada (Ontario), Denmark, France, Germany, Norway, Poland, the United Kingdom (England), and the United States).

Results: We identified four reform trends among the observed countries. First, they are reducing the overall share of inpatient payments based on DRGs. Second, they are implementing add-on payments for rural hospitals or excluding these hospitals from the DRG system entirely. Third, they are experimenting with episode-based payments, which use one joint price to pay providers for all services delivered along a patient pathway. Fourth, they are operating with financial incentives to shift the delivery of care to less costly setting. Some countries have combined some or all of these measures with financial adjustments for quality of care.

Discussion: Countries are experimenting with new ways to pay hospitals for inpatient services. These reforms demonstrate a shift away from activity and efficiency towards a diversified set of targets, and mirror efforts being undertaken more broadly to slow the rise in health expenditures while improving quality of care. Very few of the reforms have been evaluated, and those that have are almost exclusively from the United States. Where available, the evidence points to mixed results.

Conclusion: Countries are moving away from DRG systems. The degree to which they are reforming their payment systems within existing structures or are moving to alternative payment systems altogether reflects the underlying values of each health system. We strongly encourage countries to follow the example of the United States and to pilot and evaluate reforms in selected areas, and to make evaluations a mandatory part of payment reform initiatives.

1. INTRODUCTION

High-income countries are searching for new ways to pay hospitals [1, 2]. Hospital expenditures generally represent the largest or second largest share of total health spending in OECD countries. The way hospitals are paid has a direct effect on how they provide care. At present, most OECD countries use some form of activity-based funding based on diagnosis-related groups (DRGs) [3]. Such payment systems reward hospitals for the activity they perform. They set clear incentive to increase the volume of care that hospitals provide, as well as their productivity and efficiency, but may come at the expense of poor cost control, oversupply of care, wasteful spending, lower quality of care, and a lack of integration with other services [4, 5]. In recent decades, policy makers have tried to counterbalance the negative side-effects of DRG payment systems with additional policies, but with mixed success. At the turn of this decade, countries have begun experimenting with more comprehensive changes to the way they pay hospitals to align the incentives of payment systems with a move towards value-based purchasing [6, 7].

To date, there is no comprehensive overview of changes in inpatient payment systems and their effects on the delivery of care across OECD countries. In this paper, we provide an overview of the latest reform trends in ten of these. Our aim was twofold. First, we wanted to map reforms in several countries to inform policy makers about the range of designs and intervention points they have at their disposal when considering such reforms. Second, we reviewed evaluations of these reforms, where available, to discuss experiences and lessons learned from their implementation and to distil recommendations for policy makers.

This paper is organized as follows: We first revisit the incentive structure of DRGs and review the strategies that countries have had in place to date. Next, we map reform trends and investigate the effects of these reforms on the delivery of care. We conclude with a discussion of the reforms and derive recommendations to help policy makers refine, redesign, or replace their inpatient payment systems.

1. DRGS AT A GLANCE

DRG payment systems set clear incentives for hospitals on how to provide care [8]. They allocate each patient to a group based on their main diagnosis, which translates into a payment that should reflect the cost intensity of treating the patient and cover all services related to the treatment. The payment is adjusted by additional factors, such as age, gender, co-morbidities, procedures, birth weight, and ventilation hours, to reflect differences in costs and resource intensity [9]. Under this type of payment system, more patients translate into higher revenues. Hospitals therefore have a strong incentive to increase the number of patients they treat, which can reduce waiting times. It also incentivizes hospitals to shorten the length of stay to free capacities for new patients.

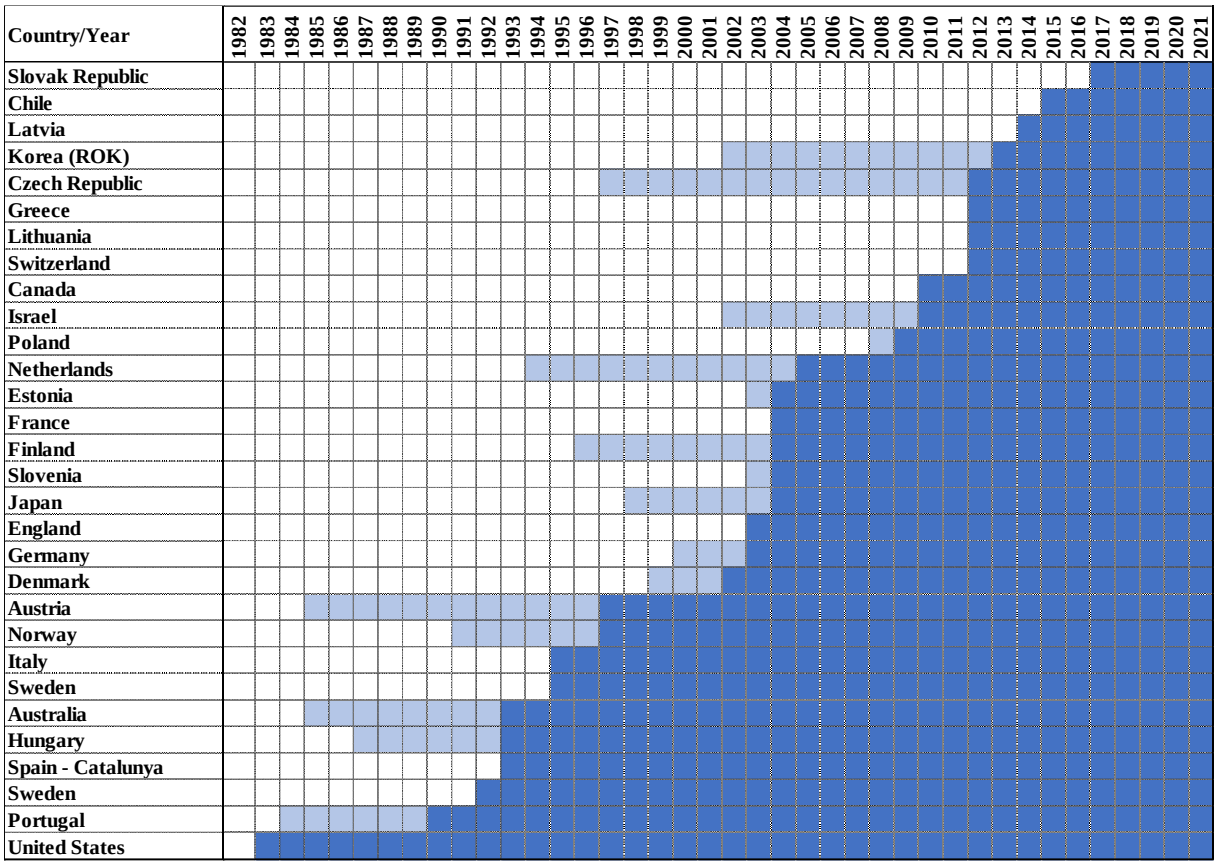
This mechanism is supported by the so-called *yardstick-competition* [10]. In most DRG systems, payments per DRG are based on average market costs of treating all patients in a given DRG derived from actual costs from a sample of hospitals, or all hospitals in a country. Hospitals with costs above the benchmark incur losses, whereas hospitals below the benchmark generate profits. Hospitals can reduce costs by reducing the length of their patients' stays, increasing efficiency, and developing innovative, less costly ways to deliver care. In addition, DRGs can increase transparency because hospitals have to record patient information to claim their payments [10].

Countries have sought to use the incentive structure of DRG payments to overcome deficiencies in their former payment systems. DRGs were developed in Yale in 1967 [11], introduced in selected hospitals in Connecticut and Pennsylvania in the late 1970s [12–14], and became the core payment system for Medicare in 1983, with Medicaid and other plans, such as Blue Shield Blue Cross, soon following suit [15–17]. In the United States (US), they replaced the fee-for-service system and were supposed to reduce costs and increase activity without compromising quality of care. The initial results from the US seemed successful: DRG systems appeared to lead to lower costs, shorter lengths of stay, and greater efficiency

without compromising quality [18–21]. This invited other nations to follow, including most OECD countries (see figure 1), albeit from different starting points.

Similar to the US, Japan replaced its fee-for-service system with DRGs to contain costs without lowering their inpatient activity or reducing the quality of care [22]. In contrast, European countries moved from global budget, capitation, or per-diem systems to DRGs to increase transparency, efficiency, and volume of care in their inpatient systems while reducing waiting times and length of stay.

Figure 1: Introduction of DRG systems for payment purposes across OECD countries



Note: Light blue: Pilot phase. The following OECD countries do not use DRG payment systems: Belgium, Colombia, Iceland, Ireland, Luxembourg, Mexico, New Zealand, Northern Ireland, Scotland, Spain, Wales, Turkey. In Japan, hospitals can choose between the DRG-style DPC-system and fee-for-system. Israel and Japan use a procedure-based system. For sources, see Supplement 1.

More recent evaluations of DRG payment systems and several decades of experience, however, have started to unveil negative side-effects. Hospitals have responded strategically to the incentives of the DRG system, exploring means to maximize their profits. This can lead to unintended consequences. First, DRG payment systems can lead to supplier-induced

demand and increase volume beyond what is medically necessary [8, 23]. Second, they can incentivize hospitals to give preference to financially profitable patients over those with medical need (*cream-skimming*), to compromise on quality of care along the treatment pathway, and to discharge patients earlier then medically appropriate (*bloody discharges*) [24–27]. Third, DRG payment systems can lead to wasteful spending due to upcoding, which occurs when hospitals code patients as sicker than they actually are to receive larger payments [28–31].

Past efforts to address the deficiencies of DRG payment systems by additional policies while maintaining the existing payment system have largely performed below potential, and also come with negative side-effects. First, countries responded to increases in expenditures and volume by introducing expenditure caps and price deductions. For example, France defines annual expenditure targets and adjusts prices accordingly. This has slowed expenditure increases but has been met with criticism that price adjustments do not reflect changes in healthcare costs [32, 33]. Germany has imposed price reductions of 35% on volume increases from 2017 onwards to reduce these, but the effects of doing so are still unknown. England, in turn, planned to introduce a 50% price cap but abandoned this in the face of increasing waiting times, which worsened over the course of the COVID-19 pandemic. Second, DRG payment systems ignore quality of care. As a result, various OECD countries have introduced pay-for-performance programs to link a portion of their payments to quality performance. However, evaluations indicate that many programs have failed to lead to significant improvements, increased the administrative burden for hospitals, systematically discriminated against safety-net providers, and increased racial disparities [34, 35]. It remains unclear whether the programs' benefits outweigh their negative consequences. Third, countries have introduced and strengthened additional means of competition, such as hospital choice and quality and price transparency, to improve quality of care while containing costs. The results, however, have been mixed and inconclusive, with evidence from the US and England being more favorable than that from other OECD countries [36–39]. In addition, competition is highly vulnerable to mergers and might be difficult to uphold in

rural areas that have experienced waves of hospital closures [39–42]. More recently, several countries have been looking for more comprehensive strategies, beginning to move away from DRG systems as the dominant mechanism for payment and revisiting their inpatient payment systems as a whole [1, 6, 43, 44].

2. METHODS

For this paper, we reviewed reforms to inpatient payment systems in ten OECD countries (Australia, Austria, Canada (Ontario), Denmark, France, Germany, Norway, Poland, UK (England), and US), which employ different applications of DRG payment systems and offer a diverse spectrum on how to reform DRG payment systems We performed desk-based research of documents from ministries, other government agencies, and statutory bodies at the federal, state, and regional levels. We considered documents in Danish, English, French, German, Polish, and Norwegian to be eligible for inclusion. We chose not to limit our search to a specific time period to be able to include programs that had already ended. In several cases, we contacted experts in the respective countries to add information and to validate our results. In addition, we reviewed the relevant academic literature based on a structured PubMed search that included the phrases “inpatient payment reform”, “DRG reform”, “episode-based payment”, “bundled payment” and corresponding variants. Moreover, we actively searched for evaluations of the payment reforms that had been identified in the preceding steps. We performed our search from September 2021 to June 2022. The results can be found in the supplement to this paper. We limited our search to reforms of inpatient payment systems, thus excluding systems that reformed both the inpatient and outpatient sectors (e.g., population-based affordable care organizations) and reforms that targeted a different sector but might have an effect on the delivery of care of the inpatient sector (e.g., increases in payments to outpatient physicians).

3. RESULTS

We found that all ten OECD countries are actively reforming their inpatient payment systems to change the delivery of inpatient care. We identified four trends (see Table 1). First, some countries are moving away from DRGs as their *overall* inpatient payment system, and in doing so are aiming to shift the underlying incentive structure of their overall inpatient payment system from activity and efficiency to other aims. Second, countries have introduced add-on payments or are using alternative payment systems for *specific types* of hospitals, such as rural hospitals, for which DRGs are deemed unfit as the (dominant) inpatient payment system. Third, countries are using episode-based payments to foster cooperation between the inpatient sector and other sectors and to streamline the delivery of care along a patient's care pathway. Fourth, they are offering financial incentives to shift the delivery of care from the inpatient sector to less costly settings. In addition, they are often combining their reforms with new ways to enhance the quality of care by adjusting payments upwards or downwards based on a hospital's quality performance. The subsequent sections present the results along these four categories in greater detail.

Table 1: Overview of reforms by category and country

Country	Total DRG reduction	Rural hospitals	Episode-based payments	Shifting care
Australia		**X**		
Austria				**X**
Canada (Ontario)			**X^{Q}**	
Denmark	**X**			**X**
France	**X**	**X**	**X^{Q}**	**X**
Germany		**X**		
Norway			**X**	**X**
Poland	**X**			**X**
United Kingdom (England)	**X**	**X**	**X**	**X**
United States	**X^{Q}**	**X^{Q}**	**X^{Q}**	
Sum	**5**	**5**	**5**	**6**

Note: ^{Q}=Quality-adjusted.

3.1. Searching for new combinations of payment systems

In our sample, we identified five out of ten countries that are moving away from DRGs as their dominant payment system towards combinations of global budgets and DRGs. The countries differ in the extent to which total hospital payments are based on DRGs, and the extent to which they are planning to reduce the DRG share. In our sample, the share of total inpatient payments that are made using DRGs ranges from 30% in Ontario to roughly 90% in Germany. Countries with a share above 50% are discussing, are in the process of introducing, or have introduced reforms to reduce the share, albeit to different extends. Denmark and England have announced that they are largely abandoning their DRG as for payment purposes. Denmark abolished activity-based funding based on DRGs (*takststyring*, or tariff management) in 2019 and replaced it with value-based payments (*værdibaseret styring*, value-based management) [45, 46]. Until 2019, DRGs were the dominant hospital financing system in Denmark, representing approximately 40 to 55% of hospital reimbursement depending on the region [47]. Denmark also operated with a 2% activity target, meaning that hospitals had to increase their activity by 2% annually. This target was scrapped in 2019. As of 2022, Denmark's five regions are in the process of transforming their payment systems into a combination of global budgets and targets. Central Jutland (*Region Midtjylland*) already piloted a reform in 2013. England announced a deviation from DRGs in its NHS Long Term Plan in 2019 [6], returned to global budgets ("block funding") in response to the COVID-19 pandemic [6, 48], and as of 2022 is moving towards a payment system that consists of three components: a fixed payment, a variable component largely based on DRGs, and a quality-related component. It will be up to each of the 42 newly introduced Integrated Care Systems to decide which combination is appropriate for its region. Other OECD countries are also in the process of reducing the share of DRG payments but to a lesser amount than Denmark or England. As of 2022, France is moving towards a combination of global budgets and activity-based funding [43]. The aim is to reduce the share of DRG payments from roughly 80% to 50% in the next few years [43]. Similarly, Poland moved a portion of its hospital payments to global budget systems in 2017 [49]. Other

countries are not modifying their share of DRG payments, but they also originate from different starting points and have experimented with different shares in search of the optimal combination of incentive structures. After years of experimentation, Norway, for example, has settled on system comprising 50% DRG payments and 50% global budgets in an attempt to balance cost containment with sufficient activity levels [50]. The country started with a DRG share of 35% in 1997, increased this to 60% in 2003, and then reduced it to 40% in 2006 before increasing it again in 2014 to today's 50% [51, 52]. In Canada (Ontario), the share of DRG payments ranges below that in Norway, comprising 30% as of 2022, whereas the remaining seven countries have shares around 50% and greater. As of 2022, Australia allows its states and Canada its provinces to define their own shares. In addition, several US states have replaced their fee-for-service payment systems with global budgets to reduce spending and improve quality of care [53, 54].

3.2. Choosing different payment programs for specific hospital types

We identified four out of ten countries (Australia, France, Germany and UK (England)) that have implemented specific payment policies for rural hospitals. As of 2022, they either offer add-on payments or use an entirely different payment system. The payments are intended to provide financial security in areas with lower population density in which hospitals have difficulty attracting a sufficient number of patients to generate enough income to cover costs and are thus deemed unsuitable for DRG payment systems. Rural hospitals are generally defined based on a minimum distance to the nearest provider (ranging from 15 miles in the US to 60 minutes in France) and additional factors, such as low population density, status as the main provider in a given region, a low case-mix index, or difficulties in accessibility due to geography or weather (see Supplement 2 for a more detailed overview of criteria).

The payment policies for rural hospitals in the four countries differ in their design, complexity, and the size of payments. Germany uses the simplest approach, granting all hospitals that meet pre-defined eligibility criteria a fixed add-on payment ranging from approximately US$402,000 (€400,000) to US$804,000 (€800,000) [55]. England adjusts its lump-sum

payments for unavoidable cost differences resulting from their rural location. For example, in 2018/19, it awarded a total of US$39.3 million (£34 million) in add-on payments to eight hospital sites , with payments ranging from approximately US$3,313,000 (£2,864,000) in Scarborough to almost US$7,270,000 (£6,281,000) in Furness [56]. The US and France use add-on payments that are dependent on hospital volume or case-mix. The US offers an add-on payment of up to 25% per hospital discharge for hospitals with 3,800 or fewer cases per year. The exact amount of the payment depends on the number of cases, with fewer cases resulting in higher payments. Hospitals with up to 500 cases per year receive 25%, and the add-on payment decreases as the number of cases increases. France uses a similar approach but pays fixed add-on payments instead of a percentage. Similar to the US, the add-on payment increases as the number of cases increases, and ranges from roughly US$35,200 (€35,000) to US$1,407,000 (€1,400,000) per hospital per year. In Australia, rural hospitals with a case-mix lower than or equal to 3,500 are financed through a combination of DRGs and global budgets, with a lower case-mix translating into a higher share of global budgets[57].

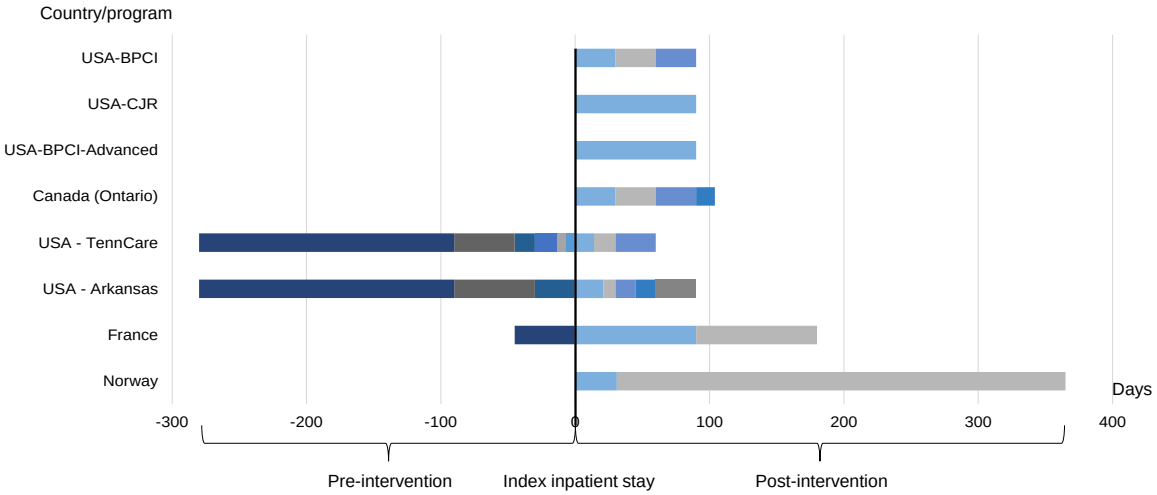
Some states in the US have decided to replace DRG payments entirely with global budgets. Maryland introduced global budgets for rural hospitals in 2010 and rolled these out to all hospitals four years later [58]. As of 2022, it is expanding global budgets to outpatient providers. Global budgets are largely based on historic expenditures and hospitals deviate from them it by up to 10%. Hospitals that spend less than the budget receive a share of the savings, whereas hospitals that spend more than the budget must pay the losses themselves in full. Pennsylvania introduced prospective, all-payer global budgets, which are largely based on each hospital's historic budget, for 18 rural hospitals in 2017 [59]. In addition, the Centers for Medicare and Medicaid introduced the Community Health Access and Rural Transformation (CHART) Model in 2021 [60]. Under this system, participating hospitals in four states (Alabama, South Dakota, Texas, and Washington) will receive bi-weekly prospective payments to offer financial stability and security to providers in rural areas [61].

To date, few of these programs have been evaluated, and most of those that have been implemented in the state of Maryland in the US. So far, the results have been mixed. We identified a total of 15 evaluations of the Maryland Global Budget Program (see Supplement 4). These failed to detect consistent improvements in quality of care, or a decrease in, or lower increase in expenditures [58, 62, 63], but were limited by short time horizons, such as 18 months or three years after the introduction.

3.3. Bridging providers via episode-based payments

We identified a total of eight programs in five OECD countries (Canada (Ontario), France, Norway, United Kingdom (England), United States) that have introduced episode-based payment programs in their inpatient sectors. Episode-based payments, also referred to as bundled payments, aim to integrate inpatient services with services provided by other sectors by making one all-inclusive payment to all health care providers that deliver services along a patient's pathway during one episode of care. In their implementation to date, episode-based payments have been heterogeneous in design and the number of conditions they cover. Most programs outside the US cover only a few conditions, whereas programs in the US cover up to a few dozen (for a list of all conditions see Supplement 3). There is little overlap among the selected conditions except for hip and knee replacements, which are covered by all programs in all countries except the United Kingdom (England). The programs also vary in how they define an episode (See figure 2). In three programs, the episode starts 30 to 45 days before hospital admission. The end of an episode varies between 30, 60, 90, 180 and 365 days after discharge, depending on the program and the condition, with the majority of programs using 90 days.

Figure 2: Days covered per episode-based payment



Sources: [64–75]. Note: Some programs varied the length of the period covered by the episode-based payment by condition. Colors of the bars vary accordingly.

In all of the programs, costs are based on the average costs of a bundle, and provider expenditures are benchmarked against these costs. The programs differ in the degree to which prices are adjusted. All of the programs involve some type of risk-adjustment to account for cost differences due to patient characteristics, with prices generally being adjusted based on age and case-mix [75]. Some programs use additional factors. For example, the Comprehensive Care for Joint Replacement (CJR) and Bundled Payments for Care Improvement (BPCI) Advanced initiatives adjust prices by dual-eligibility for Medicare and Medicaid, which serves as a proxy for socio-economic status. France uses a similar approach to BPCI Advanced. Payments consist of one of four base tariffs, depending on where a surgical procedure takes place, and nine to 12 adjustment parameters, including age, co-morbidities, and socio-economic parameters [72–74].

The programs have different regulations in place if providers spend less or more than the target price. In Arkansas and TennCare, providers pay 50% or gain 50% of the savings. Providers that join the BPCI or CJR initiatives can decide between two types of risk sharing. Under the one-sided system, they are eligible for gains but do not have to pay any losses if costs are above the target price. Under the two-sided system, they can be subject to paying for losses

but can also enjoy higher gains. For the BPCI Advanced, only the two-sided risk bearing is available. In France, profits have to be shared among providers, whereas losses are borne entirely by the leading provider, generally a hospital.

Some programs adjust payments based on quality of care. These programs differ in the choice of indicators and the financial amount by which payments are adjusted. They use either an episode-specific set of two to five indicators per condition, or a combination of general and episode-specific conditions. All of the programs include some type of process and outcome indicators. Countries also differ in the design and amount by which payments are adjusted. In two programs in the US, TennCare and CJR, hospitals must reach a pre-defined quality threshold in order to benefit from financial savings. Programs differ in the financial amount that is related to quality criteria. In the BPCI Advanced model, prices are adjusted upwards or downwards by as much as 10%, whereas in France, providers can receive a penalty of up to3% and a bonus of up to 10%.

Programs in the US have been thoroughly evaluated, but most of those outside the US have not. Among the former, the results point to modest cost reductions of 1-2% per total episode [76–79], which resulted for the most part from significantly lower spending on institutional post-acute care (approx. 6% lower), for example due to fewer discharges and to reductions in length of stay [76, 78] (see Supplement 4). However, these savings disappeared once reconciliations were applied [80]. Studies have largely failed to find a significant effect on volume, patient composition, or quality of care [78, 81–83].

3.4. Shifting care to less costly settings

We identified five out of ten countries (Austria, Denmark, France, Norway, Poland, United Kingdom (England)) that use financial incentives to shift inpatient care to the day care and outpatient settings to reduce expenditures, increase efficiency, and reduce waiting times [84, 85]. To date, England does not differentiate payments based on setting or length of stay. Denmark, France, and Norway have rolled out their DRG payment systems to the daycase and outpatient sectors, and pay one price for a set of services, regardless of the setting in

which these are delivered. From the inception of their DRG systems, Denmark and Norway included a share of DRGs that are paid independently of the setting and of the intervention. Denmark has continuously expanded this share from 29 of 495 so-called “grey zone tariffs” (*gråzonetaksten*) in 2002 to 205 of 743 DRGs in 2017 [86]. In 2018, it followed the English approach and merged its pricing systems, and since then no longer distinguishes among sectors [87]. Norway has tried to balance financial incentives designed to shift the delivery of care away from the inpatient sector on the one hand with the attempt to appropriately reflect cost differences between inpatient care and outpatient, or daycare, on the other. It already offered financial incentives in 1988 and integrated day surgeries into its DRG system in 1999 by paying the same price irrespective of the setting. In 2002, the list of procedures, for which the price was independent from the setting, covered 123 procedures and was continuously expanded to all surgical interventions. In the late 2000s, following concerns about cream-skimming, bloody discharges, and wasteful spending due to an overpayment of providers for daycase surgeries [88], Norway removed the incentive by differentiating prices between inpatient and daycases to reflect cost differences. This resulted in a reduction in the share of daycase surgeries. As a result, Norway returned to offering incentives for daycases by with an add-on of 10% in 2016 on the price for daycase surgeries, and of 15% in 2017 before these were aligned with inpatient prices again in 2018 [51]. France followed Denmark and Norway in 2009 with the introduction of the so-called “uniform price” (*tarification unique*) [89], and continuously expanded this list from 18 conditions in 2009 with the “ambulatory shift” (*virage ambulatoire*) to 147 conditions as of 2020 [90, 91]. France operates with four prices with different incentives depending on the degree to which the delivery of care has been shifted to the outpatient sector (see Table 2) [91]. In addition, for 55 conditions covering 240 procedures, providers, whose share of services performed on an ambulatory basis is below that of the national average, have to ask the patient’s statutory health insurer for approval if they want to perform a service in the inpatient setting (*Mise sous accord préalable*). This policy was introduced in 2008 in combination with the uniform price.

Table 2: Pricing of ambulatory care services in France

Category	Price calculation 2014/15	Price calculation since 2016
Mature "ambulantization" *Share of ambulatory services >80%*	Price equals average costs of inpatient services and prospective share of ambulatory services	Price equals ambulatory costs
Advanced "ambulantization" *Share ambulatory services of >50-80%*	Price equals average costs of inpatient services and prospective share of ambulatory services	Price equals average costs of inpatient services and prospective share of ambulatory services
Commencing "ambulantization" *Share of ambulatory services of 10-50%*	Price equals average costs of inpatient and ambulatory services	Price equals average costs of inpatient and ambulatory services
Weak "ambulantization" *Share of ambulatory services <10%*	Price equals inpatient costs	Price equals inpatient costs

Sources: [91–93]

Of the five countries, the UK (England) is the only one that used to pay a higher price for services provided on a daycase or outpatient basis instead of in the inpatient setting, with the former amounting to roughly 10% more than the latter. These *Best Practice Tariffs* for daycase and outpatient services were introduced in 2010 and withdrawn in 2022 [86]. Conditions were selected based on their potential to be treated in a non-inpatient setting and the degree of regional variation [94]. Poland pays a portion of hospital services with global budgets. These budgets can be adjusted upwards for hospitals that shift the delivery of services to ambulatory care [49].

To date, there have been few formal evaluations of the effects of these initiatives, but those that have been conducted indicate that there has been a significant shift in the delivery of care from the inpatient to the daycase and outpatient settings. English *Best Practice Tariffs* showed a successful shift for 14 of the 32 incentivized conditions [95]. Evaluations from France, which offers a lower financial incentive than the English *Best Practice Tariffs*, also indicate that there has been a significant shift to non-inpatient care, but the findings are less straightforward than those in England. Evaluations found a casual effect from 2009 to 2012 in public hospitals, but not in private ones [96].

4. DISCUSSION

Across the OECD, policy makers are searching for ways to shift their inpatient payment systems away from a focus on volume to one on value using value-based purchasing arrangements. In this paper, we investigated ten countries that are actively using payment reforms to align this and other health system goals with the way they incentivize hospitals. We were able to identify four broad trends. First, out of all countries we have investigated, five countries are moving away from DRGs towards combinations of global budgets and DRGs, but to a different extend. Some are combining different systems in search for the optimal balance of different incentive structures, such as Norway, which uses a 50-50 mixture of a global budget and DRG payment system, whereas others have moved from a system that was based mostly on DRGs to one that is based mostly on global budgets while using targets to prevent negative side-effects, such as underprovision of care, low productivity, low efficiency, and longer waiting times. Among the latter are Denmark, England, and some US states. This form of payment system entails risks for England and Denmark, for example, which have struggled with long waiting lists in the past. Whether targets will have their intended effects remains to be seen. In the past, efforts to reduce the negative side-effects of DRG payment systems with additional policies, such as pay-for-performance and price caps, have performed below potential. It remains to be seen be seen whether targets can actively prevent negative side-effects of global budgets. Other countries, such as France, are taking more blended approaches and following Norway in combining both global budgets and DRG systems, and are attempting to balance the different incentive structures of payment systems to align the delivery of care with their overall goals. It is likely that this has a more direct effect on the delivery of care and helps preserve the positive incentives of DRGs, such as low waiting times and length of stay, high activity and efficiency, compared to the combination of global budgets and targets.

Second, four of the ten countries are introducing add-on payments or using entirely different payment systems to pay specific types of hospitals, predominantly rural hospitals, to reflect

that the incentive structure of DRG payment systems might not be appropriate for certain types of hospitals. Across the OECD, hospitals in rural areas are often disadvantaged because of the lower population densities of their catchment areas, which makes it more difficult for them to provide the volume of services needed to cover their costs [59, 97]. Some rural hospitals have responded by admitting patients whose treatment is beyond their capabilities, by expanding patients' length of stay beyond what is medically necessary, by reducing services, or by closing their facilities altogether. This can have negative consequences for the areas that are affected, resulting in poorer access to care, worse outcomes, and subsequent closures of other healthcare providers [98–102]. Some OECD countries have responded by introducing dedicated policies to support rural hospitals, offering add-on payments per patient treated or annual lump-sum payments, or introducing different payment systems entirely [59, 97]. Evaluations of those policies, however, remain scarce and inconclusive. Add-on payments per patient are unlikely to offset negative consequences and achieve health equity between urban and rural areas because they essentially remain tied to hospital volume. This means that rural hospitals can generate additional revenue only if they treat a sufficient number of patients – and [103, 104]. Add-on payments, as offered by France and Germany, are meant to disentangle financial support from hospital volumes, and offer financial security independently of the number of cases treated. However, these add-on payments are very low compared to the average annual budget of a rural hospital and probably amount to only a few percentage points of total hospital expenditure in both countries. It is unlikely that this amount will be sufficient to provide financial security to rural hospitals. Australia and some US states, such as Maryland and Pennsylvania, have decided to rely on an entirely different payment system for rural hospitals and are using global budgets. However, while this offers these hospitals financial security [97], it also completely removes the incentive to uphold volumes, potentially leading to the underprovision of care and long waiting times. In Maryland, global budgets have not been associated with reduced spending or improved quality of care [58, 62]. It is contested,

however, whether policies to sustain rural hospitals should be expected to yield improvements over simply maintaining provider structures.

Third, four countries in our sample are using episode-based payments to facilitate the integration of care across sectors and to improve the efficiency and quality of care. There is a high degree of heterogeneity in the amount and design of episode-based payments, unveiling different understandings of what should be considered an episode and for which conditions they should be used. Evaluations from the US have yielded mixed results on quality of care, ranging from no changes to modest improvements. In addition, they have shown only modest savings, which generally stemmed from reductions in post-acute care spending. The results were largely positive for joint replacements but not for other conditions [105, 106], suggesting that episode-based payments work better for conditions with well-established care pathways. Policy makers in a given country might want to consider starting with episode-based payments for lower extremity joint replacements and expand the number of conditions if such payments are found to yield successful results.

Fourth, five countries in our selection are using payment systems as a policy instrument to shift care from the inpatient to the outpatient sector to reduce expenditures, free capacities, and improve the efficiency of their health systems. They pay the same rate for services regardless of the sector in which these are performed, but the types of services that are subject to these arrangements differ from country to country. In France and Norway, providers receive the same payments for services irrespective of the setting. In Denmark and England, all services can theoretically be performed on an outpatient or daycase basis, but in Denmark, the exact list of services is subject to regional agreements. From 2010 to 2021, England paid a higher rate for services provided in the outpatient setting, leading to a significant shift in volume for 14 of 32 incentivized conditions, but the magnitude varied by condition. [95] France's strategy also led to a substantial shift from the inpatient to the outpatient sector, but depended on the setting [96]. In general, financial incentives are understood to be successful at shifting care from the inpatient sector to less costly settings,

but do come at the expense of overcompensating providers that deliver care on an outpatient or daycase basis. In France, for example, providers were found to be overcompensated by 30% [107]. Policy makers should take into account that shifting inpatient care to a less costly setting might take several years and require additional financial resources for the transition phase, and that savings will probably materialize only in the medium to long term [107].

Fifth, countries are linking payments to quality of care, for example by making possibilities for savings conditional on a hospital having reached quality thresholds, or by adjusting prices outright based on whether a hospital has met certain quality of care indicators. Among the programs we identified that had incorporated quality of care in their payment system, we noted a substantial deviation from more traditional pay-for-performance (P4P) programs in two aspects. First, traditional P4P programs separately apply penalties or grant bonus payments at the end of each fiscal year by means of a dedicated program [34]. They suffer from poor feedback and traceability due to the long time period between patient treatment and the application of a penalty or bonus payment. The quality adjustments we identified in this paper, however, allow for greater transparency and feedback that is more direct, e.g., by adjusting payments per case. Second, traditional P4P programs mostly use process measures, and if they use outcome indicators, almost exclusively rely on 30-day readmission and 30-day mortality [34]. The programs we identified in this category, however, used a more diverse set of indicators, such as patient-reported experience and outcome measures. Using outcome indicators that are tailored to the specificities of different indications might capture quality of care more accurately, but of course also adds complexity to the system.

In summary, our review found that all ten countries are actively looking for ways beyond DRG payments, and it identified four broad trends in how they are doing so. When interpreting our findings, however, some important limitations of our approach should be considered. First, we focused only on the inpatient sector. Countries are also reconsidering how to pay other health providers and goods, such as general practitioners, outpatient specialist care, and pharmaceuticals. These reforms can interact with the inpatient sector.

For example, increases in the payment of general practitioners and overarching reforms, such as integrated care programs and the introduction of population-based payments, can lead to a shift in volume from the inpatient to the outpatient sector. Second, we limited our search to a selection of ten high-income countries to facilitate the comparison of results. In doing so, however, we might have missed interesting reforms and trends in other countries; future researchers may therefore wish to expand upon our review. Third, several countries are discussing or are in the process of introducing payment reforms. For some countries, such as England, reforms are ongoing. Germany is discussing shifting away from its DRG system, but the reforms have not yet been defined. We therefore expect payments to undergo further changes in the future. Fourth, few of the reforms have been evaluated, and most of those that have are from the US. We strongly recommend that countries introduce mandatory evaluations to be able to detect potential negative side-effects, adjust their payment systems if necessary, and gather information to inform future payment reforms both at home and internationally.

5. CONCLUSION

In this paper, we have shown that countries are moving away from DRGs as their dominant payment system for hospitals, towards more diversified approaches. We have identified four trends. First, some countries are choosing approaches to pay hospitals that involve replacing their DRG system almost *entirely*. Denmark and England, for example, are moving back to global budgets and are using targets, such as waiting times and quality outcomes, to avoid potential negative side-effects. Other countries are combining DRGs and global budgets in the hope that the potential negative side-effects of each payment system neutralize one another. Second, countries are using different payment approaches for subsets of hospitals, such as those in rural areas, for which DRG payments are no longer seen as appropriate. Third, countries are creating new financial incentives by rolling out their DRG system to daycase and outpatient procedures. Fourth, countries are using episode-based payments to support the

integration of care across sectors by reimbursing providers for all services delivered along a patient pathway with one joint payment. We noticed a lack of evaluations of payment programs and reforms, particularly outside of the United States. We encourage policy makers to make evaluations a mandatory part of reform initiatives so that the lessons learned can be used to make better informed policy choices in the future. When doing so, it would be of great importance to pilot policies in select areas and define control groups (e.g., hospitals, provider networks, or regions) for each reform initiative to be able to draw more robust conclusions which allow for evidence-based policy making.

SUPPLEMENT

Supplement 1: Sources of DRG introduction (corresponding to Figure 1)

Country	Year of introduction	Source (original)	Source (translation)	Additional information
Australia				
National	2012	Council of Australian Government meeting (2008). Communique. 29 November 2008. Canberra. Council of Australian Governments (2011). National Health Reform Agreement. Canberra. *See also* Senate Standing Committee on Community Affairs (2000). Inquiry into Public Hospital Funding. Commonwealth of Australia. Canberra.	*Not applicable*	
Queensland	1996	Queensland Health (1998) Hospital funding model for Queensland public hospitals: policy and technical papers 1997/98. Brisbane: Queensland Health *See also* Senate Standing Committee on Community Affairs (2000). Inquiry into Public Hospital Funding. Commonwealth of Australia. Canberra.	*Not applicable*	
South Australia	July 1994	Senate Standing Committee on Community Affairs (2000). Inquiry into Public Hospital Funding. Commonwealth of Australia. Canberra.	*Not applicable*	
Tasmania	July 1997	Department of Community and Health Services (1997) Case mix: managing resources for care (policy paper). Hobart: Artemis *See also* Senate Standing Committee on Community Affairs (2000). Inquiry into Public Hospital Funding. Commonwealth of Australia. Canberra.	*Not applicable*	
Victoria	July 1993	Department of Human Services (1997). Victoria -public hospitals: policy and funding guidelines 1997-98. Melbourne: Department of Human Services Senate Standing Committee on Community Affairs (2000). Inquiry into Public Hospital Funding. Commonwealth of Australia. Canberra.	*Not applicable*	
Western Australia	1995	Health Department of Western Australia (1997). Western Australian government health system funding 1997/1998: Budget reform. Perth: Health Department of Western Australia *See also*	*Not applicable*	

		Senate Standing Committee on Community Affairs (2000). Inquiry into Public Hospital Funding. Commonwealth of Australia. Canberra.		
Austria	1997	Vereinbarung gemäß Art. 15a B-VG über die Reform des Gesundheitswesens und der Krankenanstaltenfinanzierung für die Jahre 1997 bis 2000 (Stück 9, Nr. 9/1997) Vereinbarung gemäß Art. 15 a B-VG über die Krankenanstaltenfinanzierung und die Dotierung des Umwelt- und Wasserwirtschaftsfonds (BGBl. Nr. 214/1985; BGBl. Nr 619/1988; BGBl., Nr. 863/1992	Agreement in accordance with Art. 15a B-VG on the reform of the health care system and the financing of hospitals for the years 1997 to 2000 (Article 9, No. 9/1997) Agreement in accordance with Art. 15 a B-VG on hospital financing and the endowment of the environmental and water management fund (Federal Law Gazette No. 214/1985; Federal Law Gazette No. 619/1988; Federal Law Gazette No. 863/1992	Pilot phase from 1985 to 1997.
Canada				
British Columbia	2010 – 2013	Sutherland JM, Liu G, Crump RT and Law M (2016). Paying for volume: British Columbia's experiment with funding hospitals based on activity. *Health Policy* 120(11): 1322-1328. Sutherland, JM, McGrail KM, Law MR, Barer ML, Crump RT (2011). British Columbia Hospitals: examination and assessment of payment reform (B-CHeaPR). BMC Health Services Research 11(1): 150.	*Not applicable.*	
Ontario	2012	Ontario (2011). Backgrounder. Patient-Based Funding For Hospitals. https://news.ontario.ca/en/backgrounder/20500/patient-based-funding-for-hospitals	*Not applicable.*	
Chile	2020	Ministerio de Salud (2014). Glosa 09. Informe ejectuvio implementación Sistema Grupos Relacionados por el Diagnóstico Internactionales y Refinados GRD IR). Gobierno de Chile. Santiago. *See also* Águilar AR, Munoz AD, Sepúlvedas VS (2019). Experiencia en el desarrollo e implementación de la metodología de grupos relacinados por diagnóstico en un hospital universitario chileno. Evaluación a diez anos de funcionamiento. Rev Med Chile 147:1518-1526.	Ministry of Health (2014). Gloss 09. Executive report on the implementation of the International Diagnosis-Related Groups System and Refined DRG IR). Government of Chile. Santiago. *See also* Águilar AR, Munoz AD, Sepúlvedas VS (2019). Experience in the development and implementation of the methodology of diagnosis-related groups in a Chilean university hospital. Evaluation after ten years. Rev Med Chile 147:1518-1526.	Introduction in selected hospitals in 2002 (pilot phase)
Czech Republic	2012	Zákon c. 592/1992 Sb., o pojistném na vseobecné zdravotní pojistení, ve znení pozdejsích predpisu. Zákon č. 48/1997 Sb.	Act No. 592/1992 on General Health Insurance Premiums [as amended] Act No. 48/1997 on Public Health Insurance [as amended and supplemented]	Pilot phase from 1997 – 2012 Since 2007, payment via a combination of DRGs, individual contracts and global budgets Payments were reversed in 2012
Denmark	2000	Finansloven for 1998: Forhandlingsresultater. Finansministeriet, december 1997. Aftale om FINANSLOVEN for 1999, Finansministeriet, november 1998. *See also*		2018: Merger of inpatient (DkDRG), outpatient (DAGS), and greyzone tariffs (grazone) to one joint DRG tariff scheme

		Statsrevisorerne (2010). Beretning om DRG-systemet, Beretning nr. 11, *København*		
England	2003	Department of Health Payment by Results team (2010). A simple guide to Payment by Results. Department of Health. Leeds. *See also* Dixon J. (2004). Payment by results – new financial flows in the NHS. *BMJ* 328(7446): 969-970.	*Not applicable.*	2003: Phase-in with 6 surgical specialties/15 Health Resource Groups (HRGs, English DRGs). 2004/5: 48 HRGs; 2005/6: NHS foundation trusts move to full system, and NHS trusts in 2006/7 with Payment by Results representing > 50% of acute provider income.
Estonia	2004	*Not applicable.*	Estonian Health Insurance Fund (2009). Overview of Estonian experiences with DRG system. Department of Health Economics. Tallin.	Pilot phase from 2003 to 2004. Stepwise roll-out: 10 % in 2003, 50 % in 2005, 70 % in 2009.
Finland	2004	Mikkola H, Keskimäki I, Häkkinen U (2002). DRG-related prices applied in a public health care system – can Finland learn from Norway and Sweden? *Health Policy* 59(1):37-51.		Pilot phase from 1996-2004
France	2004	Loi n° 2003-1199 du 18 décembre 2003 de financement de la sécurité sociale pour 2004 *See also* LOI n° 99-641 du 27 juillet 1999 portant création d'une couverture maladie universelle Or, Z. (2014). Implementation of DRG Payment in France: Issues and recent developments. Health Policy 117(2): 146–150.	Law no. 2003-1199 from December 18, 2003 on the financing of social security in 2004 Law no. 99-641 from 27 July 1999 on the introduction of Universal Health Care	Pilot phase starting 2000 for originally up to 5 years Stepwise introduction in public hospitals (2004: 10%, 2005: 25%, 2006: 35%, 2007: 50%, 2008: 100%)
Germany	2003	Gesetz zur Einführung eines diagnose-orientierten Fallpauschalensystems für Krankenhäuser (Fallpauschalengesetz – FPG) vom 23. April 2002 (BGBl. I 27).	Act on the introduction of a DRG system for hospitals from 23 April 2002.	
Greece	2012	*See also* Panagiotopoulos, P., Maniadakis N, Papatheodoridis G, and Pektasidis D (2020). "An Evaluation of Diagnosis-Related Group (DRG) Implementation Focused on Cancer DRGs in Greek Public Hospitals. PharmacoEconomics - Open 4(1): 61-69. Polyzos N, Karanikas H, Thireos E, Kastanioti C, Kontodimopoulos N (2013). Reforming reimbursement of public hospitals in Greece during the economic crisis: Implementation of a DRG system. Health Policy 109(1): 14-22.		
Hungary	1993	1992. évi LXXXIV törvény a társadalombiztosítás pénzügyi alapjairól és azok 1993, évi költségvetéséről *See also* Kroneman M. and Nagy J (2001). Introducing DRG-based financing in Hungary: a study into the relationship between supply of hospital beds and	Act LXXXIV of 1992 on the financial funds of social security and the budget of 1993	Pilot phase from 1987 to 1993

		use of these beds under changing institutional circumstances. Health Policy 55(1): 19-36. Gaal P, Stefka N and J. Nagy J (2006). Cost accounting methodologies in price setting of acute inpatient services in Hungary. Health Care Management Science 9(3): 243-250.		
Israel	2010	Brammli-Greenberg S, Waitzberg R, Perman V and Gamzu R (2016). "Why and how did Israel adopt activity-based hospital payment? The Procedure-Related Group incremental reform." Health Policy 120(10): 1171-1176. Waitzberg R., Quentin W, Daniels E, Perman V, S. Brammli-Greenberg S, Busse R, Greenberg D (2019). "The 2010 expansion of activity-based hospital payment in Israel: an evaluation of effects at the ward level." BMC Health Services Research 19(1): 292.		
Italy	1995	Decreto legislativo 30 dicembre 1992 n. 502 e 7 dicembre 1993 n. 517 *See also* Fattore G and Torbica A (2006). Inpatient reimbursement system in Italy: How do tariffs relate to costs? Health Care Management Science 9(3): 251-258. Louis DZ., Yuen EJ, Braga M, Cicchetti A, Rabinowitz C, Laine C and Gonnella JS(1999). Impact of a DRG-based hospital financing system on quality and outcomes of care in Italy. Health Services Research 34(1 Pt 2): 405-415.	Legislative decree of 30 December 1992 no. 502 and 7 december 1993 no. 517.	
Japan	2003	**厚生労働省 (2010).** DPC 制度の概要と基本的な考え方. 東京. **健康保険法等の一部を改正する法律附則第 2 条第 2 項の規定に基づく基本方針（平成 15 年 3 月 28 日閣議決定）.** Available at: https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/kenkou_iryou/iryouhoken/hoken-kaisei/index.html (Last accessed 11 September 2022). *See also* Hamada H., Sekimoto M, and Imanaka Y (2012). Effects of the per diem prospective payment system with DRG-like grouping system (DPC/PDPS) on resource usage and healthcare quality in Japan. Health Policy 107(2): 194–201.	Ministry of Health, Labour, and Welfare (2010). Overview and basic concept of the DPF system. Tokyo. Basic Policy Based on the Provisions of Article 2, Paragraph 2 of the Supplementary Provisions of the Law Revising a Portion of the Health Insurance Law, etc. (Cabinet decision from March 28, 2003). Available at: https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/kenkou_iryou/iryouhoken/hoken-kaisei/index.html (Last accessed 11 September 2022).	Pilot phase from 1998 to 2004 in 10 national hospitals. Initially introduced on a trial basis in 82 major Japanese hospitals in 2003.
Korea (ROK)	2013	보건복지부 (2013) 다음달부터 7 개질병군 포괄수가제 종합병원 이상으로 확대 적용. 보도자료. Available	Ministry of Health and Welfare (2013). From next month on, the comprehensive fee system for 7 disease groups applies beyond general hospitals. Available	3 pilots (1997 for 8 disease groups, 1998 for 8 disease groups, 1999 for 15 disease groups)

		at: https://www.mohw.go.kr/react/al/sal0301vw.jsp?PAR_MENU_ID=04&MENU_ID=0403&page=1&CONT_SEQ=287062&SEARCHKEY=CONTENT&SEARCHVALUE=7%EA%B0%9C%EC%A7%88%EB%B3%91%EA%B5%B0 (Last accessed 11 September 2022). *See also* 보건복지부 (1999) 질병군(DRG)별 포괄수가제 3 차 시범사업 실시. 보도자료. https://www.mohw.go.kr/react/al/sal0301vw.jsp?PAR_MENU_ID=04&MENU_ID=0403&page=1308&CONT_SEQ=18317&SEARCHKEY=TITLE (Last accessed 11 September 2022). 건강보험심사평가원(2013) 7 개 질병군 포괄수가제. Choi JW, Kim S-J, Park H-K, Jang S-I, T. H. Kim TH and Park E-C (2019). Effects of a mandatory DRG payment system in South Korea: Analysis of multi-year nationwide hospital claims data. BMC Health Services Research 19(1): 776.	at: https://www.mohw.go.kr/react/al/sal0301vw.jsp?PAR_MENU_ID=04&MENU_ID=0403&page=1&CONT_SEQ=287062&SEARCHKEY=CONTENT&SEARCHVALUE=7%EA%B0%9C%EC%A7%88%EB%B3%91%EA%B5%B0 (Last accessed 11 September 2022). *See also* Ministry of Health and Welfare (1999). Implementation of the 3rd pilot project of comprehensive fee system by disease group (DRG). https://www.mohw.go.kr/react/al/sal0301vw.jsp?PAR_MENU_ID=04&MENU_ID=0403&page=1308&CONT_SEQ=18317&SEARCHKEY=TITLE (Last accessed 11 September 2022). Health Insurance Review and Assessment Service (2013). Comprehensive fee system for 7 disease groups. Presentation. September.	Voluntary phase from 2002 to 2013. Substantial revision of DRG system in 2010-12
Latvia	2014	Latvijas Vestnesis. 2018. Cabinet Regulation No. 555 of 28 August 2018, Procedures for the Organisation and Payment of Health Services. *Latvijas Vēstnesis*, Nr.176 (6262), 05.09.2018. Available at: https://likumi.lv/ta/id/301399	Latvijas Vestnesis. 2018. Cabinet Regulation No. 555 of 28 August 2018, Procedures for the Organisation and Payment of Health Services. Latvijas Vēstnesis, Nr.176 (6262), 05.09.2018. Available at: https://likumi.lv/ta/id/301399	
Lithuania	2012	Lietuvos Respublikos sveikatos apsaugos ministerija (2011). Dėl Aktyviojo gydymo paslaugų teikimo sąnaudų, apmokamų Privalomojo sveikatos draudimo fondo biudžeto lėšomis, priskyrimo sąnaudų grupėms pagal gimininingų diagnozių grupių metodą tvarkos aprašo patvirtinimo. *Valstybės žinios*, 2011-08-20, Nr. 104-4881	Ministry of Health of the Republic of Lithuania (2011). Regarding the approval of the description of the procedure for assigning the costs of providing active treatment services, paid from the budget of the Compulsory Health Insurance Fund, to cost groups according to the method of groups of related diagnoses. *State Gazette*, 20/08/2011, No. 104-4881	Preparation phase from 2009 to 2012, delay to 2014 due to coding issues
Norway	1997	Helse- g omsorgsdepartementet (1996), St meld nr 44 (1995-1996). Ventetidsgarantien – kriterier og finansiering, Oslo. Sosial- og helsedepartementet Helse- g omsorgsdepartementet (1994). St. Meld. Nr. 50 (1993-94). Samarbeid og styring. Mål og virkemidler for en bedre helsetjeneste. Oslo.	Ministry of health and care (1996). Report to Parliament No. 44 (1995-1996). The waiting time guarantee – criteria and financing. Oslo. Ministry of social affairs and health (1994). Report to Parliament No. 50 (1993-94). Cooperation and management. Objectives and meaures for a better health service. Oslo. *See also:* Biørn, E., T. P. Hagen, T. Iversen and J. Magnussen (2003). "The Effect of Activity-Based Financing on Hospital Efficiency: A Panel Data Analysis of DEA Efficiency Scores 1992–2000. Health Care Management Science 6(4): 271–283.	

			Magnussen, J. and K. Solstad (1994). Case-based hospital financing: the case of Norway. Health Policy 28(1): 23-36.	
Poland	2009	Zarządzenie Prezesa Narodowego Funduszu Zdrowia nr 32/2008/DSOZ z dnia 11 czerwca 2008 r. w sprawie określenia warunków zawierania i realizacji umów w rodzaju leczenie szpitalne.	Order No. 32/2008/DSOZ of the President of NFZ (National Health Fund) of 11 June 2008 on specifying terms and conditions of conclusion and execution of contracts pertinent to hospital treatment.	Phase-in from 2008-2009
Portugal	1990	Assembleia da República (1990). Lei 48/90: Lei de Bases da Saúde. Diário República, 195:3452–9.	Republic Assembly (1990). Law 48/90: Basic Law on Health.	Pilot-phase from 1984-1990
Slovak Republic	2017	Zákon č. 363/2011 Z. z. o rozsahu a odmienkach úhrady liekov, zdravotníckych pomôcok a dietetických potravín na základe verejného zdravotného poistenia a o zmene a doplnení niektorých zákonov v znení zákona č. 460/2012 Z. z., zákona č. 265/2015 Z. z., zákona č. 306/2016 Z. z. a zákona č. .../2017 Z. z. (tlač 706) https://www.nrsr.sk/web/Default.aspx?sid=zakony/cpt&ZakZborID=13&CisObdobia=7&ID=706 (Last accessed November 5, 2021). *See also* Všeobecná zdravotná poisťovňa (2022). DRG - Diagnoses Related Groups (skupiny súvisiacich diagnóz). https://www.vszp.sk/poskytovatelia/drg/ (Last accessed 11 September 2022).	Act no. 363/2011 Coll. on the scope and terms of payment of medicinal products, medical aids and dietetic foods on the basis of public health insurance and on the amendment and supplementation of some laws, as amended by Act No. 460/2012 Coll., Act no. 265/2015 Coll., Act no. 306/2016 Z. z. and Act no. ... / 2017 Coll. (printing 706)] https://www.nrsr.sk/web/Default.aspx?sid=zakony/cpt&ZakZborID=13&CisObdobia=7&ID=706 . (Last accessed November 5, 2021) General Health Insurance Fund (2022). DRG – Diagnosis-related groups. https://www.vszp.sk/poskytovatelia/drg/ (Last accessed 11 September 2022).	
Slovenia	2004	Ministrstvo za zdravje Republike Slovenije (2003). Zdravstvena reforma: pravinost, dostopnost, kakovost, uinkovitost. Ljubljana: Ministrstvo za zdravje.	Ministry of Health of the Republic of Slovenia (2003). Health reform: equity, accessibility, quality, efficiency. Ljubljana: Ministry of Health.	
Spain (Catalunya)	1997	Generalitat de Catalunya. Departament de Sanitat i Seguretat Social. Modalitat de pagament que regeixen la contractació de serveis sanitaris en l'àmbit del Servei Català de la Salut. DOGC: decret 179/1997. Barcelona, 1997:8720–21.	Government of Catalonia. Department of Health and Social Security (1997). Mode of paymnt that governs the contracting of health services in the Catalan Health Service. DOGC: decree 179/1997. Barcelona, 1997:8720-21-	
Sweden	1992	Serdén L, Lindqvist R, Rosén M (2003). Have DRG-based prospective payment systems influenced the number of secondary diagnoses in health care administrative data? Health Policy 65(2):101-107.	*Not applicable*	First started in Stockholm ("Stockholm model", Stockholmsmodellen) Adoption of DRG payment system depends on region
Switzerland	2012	Bundesgesetz über die Krankenversicherung (KVG) (Spitalfinanzierung). Änderung vom 21. Dezember 2007 (AS 2008 2049)	Federal law on health insurance (KVG) (hospital financing). Amendment from December 21, 2007 (AS 2008 2049)	
The Netherlands	2005	Staten-Generaal;, T. K. d. (2003). Kamerstuk. Invoering Diagnose Behandeling Combinaties (DBCs). Brief van de Minister van Volksgesondheid, Welzijn en Sport. 29248 nr. 1. Den Haag. Staten-Generaal;, T. K. d. (2004). Kamerstuk. Invoering Diagnose Behandeling Combiaties (DBCs). Brief	Parliament of the Netherlands (2003). Parliamentary paper. Introduction of Diagnosis Treatment Combinations (DBCs). Letter from the Minister of Health, Welfare and Sport. 29248 no. 1. The Hague.	

		van de Minister van Volksgezondheid, Welzijn en Sport. 29248 nr. 10.	Parliament of the Netherlands (2004). "Parliamentary paper. Introduction of Diagnosis Treatment Combinations (DBCs). Letter from the Minister of Health, Welfare and Sport." 29248 No. 10.	
United States	1983	Federal Register: Medicare Program prospective payments for Medicare inpatient hospital services. 1983 Sept.48(No. 171).	*Not applicable*	

Supplement 2: Eligibility criteria of rural hospitals for different funding mechanism (corresponding to section 4.2)

Country	Definition	Source
Australia	1. Hospitals has been nominated by a jurisdiction 2. Less than or equal to 3,500 NWAU per annum for rural hospitals 3. Less than or equal to 1,800 admitted patient NWAU per annum for city hospitals.	Clauses A52 to A55 of the Addendum to the National Health Reform Agreement 2020−25 International Health Pricing Authority (2021). National Pricing Model Technical Specification 2021-22. Sydney. International Health Pricing Authority (2021). National Efficient Cost Determination 2012-22. Sydney.
England	Remoteness adjustment for hospitals providing Tier 1 A&E services as defined by: 1. Catchment area with 200,000 inhabitants or less within one-hour travel time of the site 2. The next nearest provider with tier 1 A&E servies is one hour or more away for at least 10 % of the population served 3. 24/7 emergency department	NHS England and Improvement (2019). NHS Technical Guide to Allocation Formulae and Pace of Change. For 2019/20 to 2023/24 revenue allocations.
France	1. Population density of 10 inhabitants or less per $km^{2/}$/20 women aged 15 to 49 $km^{2/}$/22 inhabitants aged below 18 per $km^{2/}$ 2. Distance to next provider: 30 min to next emergency department/45 min to next maternal department/60 minutes to next 3. Population density is 45 inhabitants per $km^{2/}$ or less 4. Hospitals are main provider in a given region	Décret no 2015-186 du 17 février 2015 relatif aux modalités dérogatoires de financement des activités de soins des établissements de la sante répondant à des critères d'isolement géographique
Germany	1. Distance of 30 min to next nearest hospital for at least 5,000 inhabitants for internal medicine, general surgical care, and basic emergency department 2. Distance of 40 min to next nearest hospital for at least 950 women aged 15 to 49 for gynaecology/delivery 3. Distance of 40 min to next nearest hospital for at least 800 inhabitants aged below 18 for paediatrics Departments require a medical specialist that can reach the hospital within 30 min 24/7, a midwife that can reach the hospital within 30 min 24/7 for gynaecology/delivery, and must have closed a contract with the state	Gemeinsamer Bundesausschuss (2020). Regelungen für die Vereinbarung von Sicherstellungszuschlägen gemäß § 136c Absatz 3 SGB V. In der Fassung vom 24.11.2016 BAnz AT 21.12.2016 B3. Geändert am 01.01.2020 BAnz AT 08.12.2020 B3 Berlin.
United States	*Sole Community Hospital (introduced in 1983)* • The hospital is at least 35 miles from other like hospitals. • The hospital is rural, located between 25 and 35 miles from other like hospitals, and meets 1 of these criteria: ○ No more than 25% of hospitalized inpatient residents, or no more than 25% of hospitalized inpatient Medicare patients in the hospital's	42 CFR Section 412.92

	service area, are admitted to other like hospitals within a 35-mile radius of the hospital or, if larger, within its service area. ○ The hospital has fewer than 50 beds and would meet the 25% criterion except some patients get specialized care unavailable in the hospital service area. ○ The hospital is rural, and between 15 and 25 miles from other like hospitals but inaccessible because of local topography or periods of prolonged severe weather conditions for at least 30 days in each of 2 out of 3 years. ○ The hospital is rural and because of distance, posted speed limits, and predictable weather conditions, travel time between the hospital and the nearest like hospital is at least 45 minutes.	
	Low-volume hospital (introduced in 2005) • Medicare makes add-on payments to qualifying low-volume hospitals more than 15 road miles from the nearest "subsection (d)" hospital if the hospital discharges less than 3,800 total patients based on the hospital's most recently submitted cost report. • Qualifying hospitals get an adjustment up to 25% for each patient discharge. Medicare bases a qualifying hospital's low-volume payment adjustment on the following: • The low-volume hospital payment adjustment is an additional 25% for each Medicare low-volume hospital with less than 500 total discharges during the fiscal year. The adjustment for each Medicare discharge is an additional percentage calculated using the formula [(95/330) minus (number of total discharges/13,200)] for low-volume hospitals with more than 500 and fewer than 3,800 total discharges during the fiscal year.	42 CFR Section 412.101

Supplement 3: Overview of inpatient bundled payments across several OECD countries

	Canada (Ontario)	England	France	Norway	USA –Arkansas	USA – Tennessee	USA – CJR	USA – BPCI	USA – BPCI Adv.
Orthopedics									
Amputation								X	
Colonoscopy					X	X[2]			
Double Joint Replacement of the Lower Extremity								X	X
Fractures of the Femur and Hip or Pelvis						X[7]		X	X
Hernia Repair						X[8]			
Knee Arthroscopy						X[7]			
Lower Extremity/Humerus Procedure except Hip, Foot, Femur								X	X
Major Joint Replacement of the Lower Extremity							X	X	X[i,o,]
Major Joint Replacement of the Upper Extremity								X	X
Major non-infectious orthopaedic procedure								X	
Hip replacement	X		X	X	X	X[1]			
Knee replacement	X		X	X					
Other knee procedures								X	
Removal of orthopaedic devices								X	
Revision of hip/knee replacement								X	
Shoulder (reverse) arthroplasty	X								
Cardiac Care & Procedures									
Acute Myocardial Infarction (AMI)								X	X
Atherosclerosis								X	
Cardiac Arrythmia									X
Cardiac Defibrillator – *inpatient*								X	X
Cardiac Defibrillator – *outpatient*									X
Cardiac Valve						X[4]		X	X
Cardiac Surgery**	X								
Congestive Heart Failure	X				X	X[4,a]		X	X
Coronary Artery Bypass Graft (CABG)						X[4]		X	X
(Endovascular) Cardiac Valve Replacement									X
Medical peripheral vascular disorders								X	
Pacemaker								X	X
Percutaneous Coronary Intervention (PCI)						X[a]		X	X[i]
Percutaneous Coronary Intervention (PCI)						X[n]			X[o]
Other vascular surgery								X	
Syncope / collapse						X[8]		X	
Transient ischemia								X	
Gastrointestinal Surgery									
Bariatric surgery						X[4]			X
Major bowel procedure								X	X
Colon Cancer			X						
Gastrointestinal Care & Procedures									
Acute gastroenteritis						X[8]			
Appendectomy						X[8]			
Colposcopy						X[8]			
Disorders of the Liver Except Malignancy, Cirrhosis, or Alcoholic Hepatitis									X
Esophagogastroduodenoscopy						X[3]			
Esophagitis, gastroenteritis, and other digestive disorders								X	
Gastrointestinal Hemorrhage						X[3]		X	X
Gastrointestinal Obstruction						X[8]		X	X
Inflammatory Bowel Disease									X
Neurological Care									

Seizures						X[8]			X
Stroke	X							X	X
Spinal Procedures									
Back and Neck Except Spinal Fusion – inpatient								X	X
Back and Neck Except Spinal Fusion– outpatient									X
Combined anterior posterior spinal fusion								X	
Complex non-cervical spinal fusion								X	
Spinal Decompression (without spinal fusion)						X[7]			
Spinal Fusion						X[7]		X	X
Other / Medical and Critical Care									
Acute Kidney and Ureter Stones						X[9]			
Asthma					X	X[1,a]		X	
Attention Deficit Hyperactivity Disorder (ADHD)					X	X[4]			
Oppositional Defiance Disorder (ODD)						X[4]			
ADHD/ODD Comorbidity									
Back//Neck pain						X[7]			
Brest Biopsy						X[5]			
Bronchitis								X	
Cellulitis	X								X
Chest pain								X	
Chronic Obstructive Pulmonary Disease (COPD)	X				X	X[2,a]		X	X
Cholecystectomy					X	X[2,o,n]			
Cystic Fibrosis		X							
Cystourethroscopy						X[9]			
Diabetes						X[6,a]		X	
Dialysis				X					
HIV						X[6]			
Hysterectomy						X[8]			
Maternity care		X							
Maternity care – Perinatal					X	X[1]			
Non-operative injuries – ankle						X[7]			
Non-operative injuries – wrist						X[7]			
Non-operative injuries – shoulder						X[7]			
Non-operative injuries – knee						X[7]			
Nutritional and metabolic disorders								X	
Other respiratory								X	
Pancreatitis						X[6]			
Otitis media						X[5]			
Red blood cell disorders								X	
Renal Failure								X	X
Sepsis								X	X
Respiratory Infections						X[3]			X
Pneumonia						X[3]		X	
Paediatric Pneumonia						X[8]			
Bronchiolitis						X[8]			
Skin and Soft Tissue Infection						X[6]			
Tonsillectomy					X	X[5]			
Upper Respiratory Infection					X				
Urinary Tract Infection – inpatient	X					X[3]		X	X
Urinary Tract Infection – outpatient						X[3]			
SUM	**9**	**2**	**3**	**3**	**10**	**48**	**1**	**43**	**33**

Note: Norway offers additional annual bundles for drug costs for skin conditions, rheumatological conditions, gastrointestinal disorders, and neurological conditions. Tennessee rolled out its bundled payments programme in 9 waves. The superscript number indicates the wave in which the bundled payment was first introduced. Arkansas has phased out its episode-based payment program over the course of 2020/21. BPCI ended in 2018. "BPCI" refers to Model 2-4. Cardiac surgery in Ontario includes, among others, coronary artery bypass grafts (CABG), valve replacements, and aortic repairs (elective and urgent/emergent). Sums might differ slightly from official program descriptions due to different levels of aggregation. ^{o}= outpatient, ^{i}=inpatient, ^{a}=acutre, ^{n}=non-acute.

Sources: Canada (Ontario): 64, 108. England: 109. France: 72–74. Norway: 51, 70. Alaska: 75. Tennessee: 69. USA – BPCI: 110. USA – BPCI Advanced: 67. USA – CJR: 65

Supplement 4: Evaluations of payment programmes

Authors	Area	Indication	Outcome(s)	Data	Methods	Quality	Costs	Other	Add. information
Global Budget Schemes									
Aliu et al. 2021 [111]	USA /MD	7 surgical procedures	1. Hospital acquired conditions incidence rate 2. Index hospital costs	01/2008 – 12/2016 2,983,411 patients (525,262 patients in MD, 2,458,149 in control group)	Difference-in-difference analysis	1. Significantly lower rate of hospital-acquired conditions in MD (<1% - 11% depending on procedure)	1. Lower increases in index hospital costs	1. Reduction in case-mix severity in MD	
Dávila Castrodad et al. 2020 [112]	USA /MD	Total hip arthroplasty	1. Patient composition 2. LOS 3. 30-day readmission 4. Mean inpatient costs and charges	2010 – 2016 20,838 procedures before, 22,414 post programme introduction	Descriptive, chi-square and t-test	1. Lower length of stay of 0.5 days*** 2. Lower 30-day readmission of -0.9%***	1. Lower mean inpatient costs (-US$1417.44***) and mean inpatient charges (-US$2196.50***)	1. No changes in proportion of minorities 2. Increased number of patients with Medicare insurance (+4.0%***) 3. Higher rate of home discharge post implementation	
Done et al. 2019 [113]	USA /MD	All conditions	1. Hospital utilisation (inpatient & outpatient)	2008 – 2013 125 Zip Code Tabulation Areas and two control areas (66 and 327 Zip Code Tabulation Areas)	Difference-in-differences analysis	1. No statistically significant changes in readmission	*Not applicable*	1. No statistically significant changes in admission and ED visits 2. 8.9%**-reduction in outpatient visits 3. 1.48%***-reductions in non-ED utilisation utilisation	
Offodile et al. 2022 [114]	USA /MD	Cancer surgery	1. 30-day spending 2. 30-day readmission 3. ED visits 4. Mortality	2011 – 2018 35 Maryland hospitals (20,320 patients) and 101 non-Maryland hospitals (4,737 patients)	Difference-in-differences analysis	1. 2.2 p.p.-decrease in 30-day readmission 2. No statistically significant changes in ED visits or all-cause mortality	1. No statistically significant changes in spending	*Not applicable*	1. No significant results in subgroup analysis among patients undergoing major cancer surgery
Gallarraga et al. 2020 [115]	USA /MD	ED admissions	1. Overall ED admission rates 2. ED admission rates for (non-)ambulatory-care sensitive conditions & clinical conditions that commonly lead to admission	01/2012 – 12/2015 790,542 ED visits in 10 global budget revenue hospitals (348,140), 10 non-Maryland hospitals (369,810), 5 Maryland total patient revenue hospitals (72,592)	Difference-in-differences analysis	*Not applicable*	*Not applicable*	1. Total admissions decreased more among global budget hospitals compared to non-Maryland hospitals (-3%) and total patient revenue hospitals (-1.9%) 2. Relative decline was similar for (non-)ambulatory care conditions	1. Only 2 years after introduction studied

								3. Admission rate declines varied across clinical conditions *No p-values given*	
Galarraga et al. 2022 [116]	USA /MD, NY & NJ	ED visits	1. ED visits 2. ED returns 72h/9 days after discharge 3. Morbidity and mortality in ED returns	01/2012 – 12/2015 From MD (4,190,394 visits), NJ (6,849,553 visits), NY (16,029,948 visits)	Interrupted time-series analysis with difference-in-difference analysis	1. ED returns declined by -1.8%* for 72h/-1.5%* for 9 days. 2. No statistically significant change in ICU utilisation and in-hospital mortality among readmissions	*Not applicable*	1. ED visits decreased by 5.8%* compared to NJ and 4.6%* compared to NY 2. ED admissions decreased by 1.8%* compared to NJ/ 0.6%* compared to NY	1. Returns declined among non-Hispanic Whites and Blacks, but unchanged among Hispanics/Latinos
Morrison et al. 2020 [117]	USA /MD	All conditions	1. Hospital utilization (inpatient admission, outpatient ED visits, admission for ambulatory care sensitive conditions), 30-day readmission 2. Total spending and section spending	*Unclear data. To be revisited.*	Difference-in-differences analysis, propensity score matching and weighting	*Not applicable*	1. Slower growth (2.8%***) in Medicare spending compared to commercial plans, and in Maryland compared to comparison group (4.1%***) 2. Decline in outpatient ED spending & slower growth in other outpatient spending compared to control group 3. No statistically significant difference in inpatient spending	1. Greater decline (7.2%***) in Medicare admissions then among commercial admissions	
Mortensen et al. 2014 [118]	USA /MD	All conditions	1. 30-day readmission	2009-2011 374,353 patient discharges from 8 participating hospitals, 3 rural control hospitals, all Maryland hospitals with readmissions (1,997,164)	Difference-in-differences analysis, linear probability models	*Not applicable*	1. No statistically significant changes in predicted probability of readmissions	1. Patient characteristics differed. Patients in participating hospitals were older and more likely to be white, and Medicare insured 2. Participating hospitals had fewer staffed hospitals and fewer discharges, but no differences in average gross patient revenue	1. Evaluations after first 18 months of the programme

Pines et al. 2019 [119]	USA /MD	All conditions	1. ED visits and admission rates 2. Inpatient (non-ED) admissions & transfers to other hospitals 3. Inpatient length of stay 4. Ambulatory surgery center and outpatient clinic visits 5. Case-mix and procedures	01/2007 – 12/2013 (01/2007 – 06/2010: baseline period, 07/2010 – 12/2013: treatment period) 5.0 million ED visits, 1.3 hospital admissions, 0.6 million outpatient surgery visits, 3.5 outpatient clinic visits/services	Difference-in-differences analysis	1. Reduction in number of services	1. Statistically significant increase in spending per Medicare beneficiary	1. No statistically significant decline in ED visits 2. No statistically significant reduction in length of stay	1. Participating hospitals were in counties with lower incomes, older adults, and fewer black residents
Roberts et al. 2018a [58]	USA /MD	All conditions	1. Acute care use (inpatient admissions, observation stays, ED visits without subsequent admission) 2. Price-standardised hospital spending 3. Price-standardised outpatient spending	2007 – 2013 77,756 Medicare beneficiaries in intervention group, 68,117 Medicare beneficiaries in control group	Difference-in-differences analysis, propensity score weighting	1. No statistically significant change in 30-day readmission between both groups	1. No statistically significant change in hospital spending 2. Potentially significant reduction in outpatient department spending, but not clearly attributable	1. No statistically significant reduction in hospital stays	Maryland has altered parts of its programme after 2013
Roberts et al. 2018b [62]	USA /MD	All conditions	1. Inpatient stays 2. 30-day readmission 3. ED visits without subsequent admission 4. Outpatient department utilization 5. Visits with Primary Care physician	2009 – 2013 & 2014 – 2015 94,967 beneficiaries vs. 206,389 beneficiaries	Difference-in-differences analysis	1. No consistent effect on readmission rates	*Not applicable*	1. No consistent changes in outcome parameters of access 2. Reduction in hospital stays and Primary Care visits dependent on trend assumption	
Viganego et al. 2021 [120]	USA /MD	3 cardiovascular conditions	1. Hospitalisation 2. Length of stay 3. 30-day readmission & mortality 3. Procedure volumes	2013 – 2018 1,701,179 admissions	Interrupted time series analysis	1. Decreased hospitalisation for ischemic stroke 2. Lower length of stay for congestive heart failure 3. Decrease in readmission for AMI 4. No changes in mortality	1. Increase in charges for ischemic stroke, decrease for AMI	*Not applicable*	
Arkansas Payment Improvement Initiative Episodes of Care									
Carroll et al. 2018	USA – AR	1 procedure:	1. Total and per-sector spending per episode	2009 – 2014 2,454 patients vs. 20,824 pre-	Difference-in-difference analysis	1. Limited improvement in quality of care (stafitically significant	1. Statistically significant decrease in spending by	1. Reduced spending in interpartum facility (-6.6%**), which results	

[121]		Perinatal care	2. Procedures of care	intervention (Control states Alabama, Kentucky, Louisiana, Oklahoma) and 1,737 vs. 15,291 patients post intervention; Commercial payer data (Truven Health MarketScan)		increase in chlamydia screening, but no improvement in other areas)	3.8%* ($396) compared to control group	largely from a price effect	
Chen et al. 2020 [122]	USA - AR	4 procedures: Colonoscopy, total joint replacement, cholecystectomy, tonsillectomy	1. Annual rate of procedures 2. Probability of beneficiary undergoing procedure in given quarter	2011 – 2016 134,797 patients vs. 2,917,534 patients in control group (Missouri, Alabama, Mississippi, Lousiana, Texas) pre-intervention, 91,430 vs. 3,010,568 patients post-intervention; Commercial payer data (Truven Health MarketScan)	Difference-in-difference analysis	*Not applicable*	*Not applicable*	1. Probability of undergoing colonoscopy increased by 17.2%***, no significant effect for other procedures	
Toth et al. 2020 [123]	USA – AR, MS, MO	Upper respiratory infection, Perinatal episodes of care	1. Antibiotic use, preventive screening 2. ED and physician visits 3. Hospitalisation 4. Readmission	2011 – 2014, 804 559 weighted upper respiratory infection, episodes of care, 58 381 weighted perinatal episodes, data from Arkansas (intervention), Mississippi, and Missouri (control group)	Difference-in-difference analysis, propensity score weighting	1. Upper respiratory infection: Reduced probability of antibiotic use and physician visits, higher probability of tests 2. Perinatal care: Higher probability of screening 3. Higher probability of ED visit for upper respiratory infection, lower for perinatal episodes of care	*Not applicable*	*Not applicable*	1. Authors point at potential side-effects, such as code shifting and increased hospitalization for perinatal episodes of care
Bundled Payments for Care Initiative									
Chen et al. 2018 [82]	USA	Cardiac and orthopaedic surgery (hip/knee replacement/revision)	1. Medicare expenditures 2. Quality of care (30-day mortality, postsurgical complications, 30-day readmission)	2007 – 2012 5,017 cardiac surgery patients & 10,462 orthopedic patients in intervention group vs. 9,617 cardiac surgeries & 42,312 orthopedic patients in control group	Difference-in-difference analysis	1. No statistically significant differences in quality of care	1. No statistically significant reduction in 30-day Medicare payments 2. Decrease in 30-day post-acute care payments	*Not applicable*	1. Cost reduction primarily due to reduced institutional care 2. Voluntary programme participation

Dummit et al. 2016 [81]	USA	Lower extremity joint replacement	1. Total payment 2. Utilization 3. Quality of care (unplanned readmission, emergency department visits, mortality)	10/2011 – 06/2015 29,441 procedures in baseline period & 31,700 in intervention period in participating hospitals vs. 29,440 & 31,696 in non-participating hospitals	Difference-in-difference analysis	1. No statistically significant differences in quality of care	1. Greater decline in expenditures in intervention group y US$ 1,166*** compared to baseline	1. Greater decline in post-acute care use among patients in participating hospitals	1. Cost reduction primarily due to reduced institutional care
Joynt Maddox et al. 2018 [83]	USA	5 conditions (AMI, congestive heart failure, COPD, pneumonia, sepsis)	1. Change in standardised Medicare payments per episode 2. Changes in volume and patient composition 3. Changes in quality of care (LOS, emergency department, readmission, mortality)	01/2013 – 09/2015 492 participating hospitals (73 hospitals for AMI, 125 for congestive heart failure, 101 for COPD, 88 for sepsis, 105 for pneumonia) vs. 898 matched control hospitals (3,681 non-participating hispitals)	Difference-in-differences analysis	1. No statistically significant changes in quality of care between baseline and intervention period for treatment and control group 2. Greater decease in 90-day mortality for AMI and COPD, and for 30-day readmission for COPD in treatment group compared to control group	1. No statistically significant change in payments	1. BPCI hospitals more likely to be large, non-profit, urban, teaching hospitals 2. No statistically significant changes in patients between treatment and control group	
Joynt Maddox et al. 2021 [124]	USA	Joint replacement	1. 90-day Medicare payments 2. Patient selection (volume, comorbidities) 3. Clinical outcomes (30-/90-day emergency department visits, readmission, morality, healthy days at home)	2013 – 2017 91 orthopaedic groups, 169 control groups (baseline: 74,343 patients in intervention group vs. 88,147 patients in control group, treatment: 102,790 in intervention vs. 120,253 in control group)	Propensity score matching	1. No differential changes in volume or comorbidities 2. Higher share of patients discharged home in participating practices compared to control group 3. 30-day and 90-day-readmission rats decreased more among participating practices than controls	*Not applicable*	1. Savings driven by decrease in postacute spending	
Jubelt et al. 2016 [125]	USA /NY	3 surgeries (cardiac valve, major joint replacement in the lower extremities, spinal fusion)	1. Discharge to post-acute care institution 2. Readmission rates 3. Length of stay	06/2009 – 12/2014 3,070 patients in baseline period, 1,594 patients in intervention period	*Method unclear. Descriptive investigation ?*	1. Decrease in readmission for joint replacement by 3 p.p.**, but not for other conditions	*Not applicable*	1. Decline in discharges to post-acute institution by 49% for cardiac valve, and 34% for major joint replacement, but not for spinal fusion. *P-values missing*. 2. Reduced length of stay for all conditions	1. Statistically significant decline in age, but no change to gender composition

Jubelt et al. 2017 [126]	USA /NY	3 orthopaedic surgeries, 5 conditions in control group	1. Total costs per episode 2. Costs per service category	2,940 intervention episodes, 1,474 control episodes 04/2011 – 06/2012; 10/2013 – 12/2014	Difference-in-difference analysis	*Not applicable*	1. Costs for joint TEP decreased by US$ 3,017 2. Costs for cardiac procedures decreased by US$ 2,999 3. Costs for spinal fusion increased by US$ 8,291	*Not applicable*	1. Savings largely due to earlier shift from inpatient rehabilitation facilities to home 2. Spinal fusion costs increased due to changes in surgical technique
Liao et al. 2019 [127]	USA	Lower extremity joint replacement surgery	1. Clinical outcomes 2. Total episode spending	01/2011 – 09/2016 (baseline: 01/2012 – 09/2013, intervention: 10/2013 – 09/2016), 483,008 patients in 212 hospitals with bundled payment participation, 105 hospitals with ACO and episode-based payment participation (coparticipation), and 1,413 nonparticipation hospitals	Difference-in-differences analysis, instrumental variable	1. Coparticipants had 1.5%** more unplanned readmissions than bundled payment participants 2. Greater reductions in length of stay of coparticipants and bundled payment participants compared to nonparticipants	1. Episode spending decreased more among coparticiopants (-3.0%***) and bundled payment participants (-3.4%***) compared with nonparticipants. No statistically significant differences between both groups	1. Coparticipants were larger, with greater market share, more likely to be urban, not-for-profit teaching hospitals 2. Patient characteristics varied, but meaningful differential trend detected according to authors	
Martin et al. 2018 [128]	USA	Lumbar fusion for patients over age 65	1. Differences in patient and hospital characteristics 2. Procedure volume 3. 90-day reoperation, readmission and surgical complications	2012 – 2013 671 preparatory hospitals (19,265 patients), 102 risk-bearing hospitals (3,843 patients), 1,277 non-participant hospitals (29,221 patients)	Generalized estimating equation regression	1. Increase in readmissions in risk-bearing hospitals compared to other hospitals Increase in 90-day readmission rate (+2.7* vs. -10.7%*) 2. Increased repeat surgery rate (+30.6 % vs. +7.1%*)	1. No statistically significant reduction in costs	1. No statistically significant changes in patient composition and volume after BPCI introduction 2. Participating hospitals were larger, had greater volume than non-participating hospitals	
Navathe et al. 2018 [129]	USA	Lower extremity joint replacement surgery	1. Market volume 2. Patient characteristics (Demographics, race, socio-economic status, medical severity, health care facility use in past 12 months)	01/2011 – 12/2015 (baseline: 01/2011 – 09/2013, treatment. 10/2013 – 12/2015) 1,717,243 surgeries	Difference-in-differences, propensity score matching	*Not applicable*	*Not applicable*	1. Participating hospitals more likely to be larger, urban, not-for-profit, and teaching	

Navathe et al. 2021 [77]	USA	48 episodes (24 medical/24 surgical)	1. 90-day readmission 2. Total spending	7,108,146 Medicare beneficiaries, 01/2011 – 09/2016	Difference-in-differences analysis, OLS	1. Lower readmissions for medical (-0.98 pp) and surgical (-0.84 pp) conditions	1. Lower spending in postacute care for medical (-$323), but not surgical spending		
Rolnick et al. 2020 [76]	USA	4 episodes (AMI, congestive heart failure, COPD, pneumonia)	1. Total spending per episode 2. 90-day mortality 3. Use and spending of post-acute care 4. Market characteristics of hospitals	01/2011 – 12/2016 (Baseline: 01/2011 – 09/013, treatment: 10/2013 – 12/2016), 261,163 episodes in baseline and 93,562 episodes in treatment period in participating hospitals, 211,208 and 78,643 episodes in not-participating hospitals	Difference-in-difference analysis, propensity-score matching	1. No significant change in 90-day mortality	1. -1.2%* decrease in total costs per episode 2. -6.3%*** decrease in spending in skilled nursing facilities due to reduced length of stay of -6.2 %*** 3. Increase in home health spending by 4.4 %**	1. Reduction in mean age by 0.3 years*** in participating hospitals 2. Participating hospitals were larger, more likely to be non-profit, teaching, and urban, lower share of low-income patients	
Tsai et al. 2015 [130]	USA	All episodes	1. Hospital descriptives 2. Types of enrolled clinical conditions 3. Spending (components and variation in spending))	2011 332 hospitals (225 in phase 1, 107 in phase 2),3,028 non-participating hospitals	Descriptive, chi-square and t-tests	*Not applicable*	1. Index acmission largest cost component 2. Postacute spending large cost component, and explained largest proportion of variation in spending	1. Phase 2 hospitals more likely to be large, located in Northeast, major teaching hospital 2. Only small proportion of hospitals from phase 1 entered phase 2, and for few conditions	
CJR Programme									
Barnett et al. 2019 [131]	USA	Lower extremity joint replacement surgery	1. Institutional spending per joint TEP 2. Rate of postsurgical complications 3. % of “high-risk” patients	2015-2017, 280,161 procedures in 803 hospitals in treatment group vs. 377,278 procedures in 962 hospitals in control group	Difference-in-differences analysis	1. No significant difference in rate of postsurgical complications	1. Greater decrease in spending in treatment group (-US$ 812***/3.1% differential decrease compared to control group)	1. No significant difference in procedures performed on high-risk patients	1. Cost differential driven by lower percentage of episodes discharged to post-acute care facilities / reduction in use of post-acute care serviced in skilled nursing facilities and inpatient rehabilitation facilities
Einav et al. 2020 [132]	USA	Lower extremity joint	1.Volume of CJR-eligible episodes	2013 – 2014, 2016 – 2017	Difference-in-differences analysis	1. Lower probability of -3.4 p.p.*** of traditional Medicare patient to be	*Not applicabl*	1. No evidence of CJR programme on volume of CJR-eligible episodes	

		replacement surgery	2. Discharge setting after CJR-eligible episode 3. Spillover effects on Medicare Advantage patients	Data from Medicare, UnitedHealthcare, Aetna, Humana CMS data: 221,814 episodes for traditional Medicare, and 120,967 patients in Medicare Advanced, HCCI data: 34,804 episodes in traditional Medicare, and 21,126 episodes in Medicare advanced		discharged to postacute care 2. Lower probability of Medicare Advanced patients to be discharged to postacute care (-3.3 p.p.*) (spillover effect)		2. Results roughly similar for HCCI data 3. Spillover effects higher for hospitals with above-median volume of CJR eligible traditional Medicare hospitals compared to below-median volume hospitals	
Einav et al. 2022 [80]	USA	Lower extremity joint replacement surgery	1. Voluntary selection into programme	2013 – 2018 379,150 episodes	Difference-in-differences analysis	*Not applicable*	*Not applicable*	1. Voluntary selection of hospitals greater for hospitals that can increase revenue without changing behaviour and for hospitals that had large changes in mandatory period	1. Voluntary scheme leads to inefficient transfers to hospitals
Finkelstein et al. 2018 [79]	USA	Lower extremity joint replacement surgery	1. Discharge into institutional post-acute care 2. Length of stay in post-acute care 3. Medicare spending 4. Net Medicare spending 5. Patient volume & case-mix 6. Quality-of-care measures	04/2016 – 12/2016 131,285 lower extremity joint replacement surgeries in 75 intervention vs. 121 control metropolitan statistical areas	Difference-in-differences analysis, matching	1. Discharge into post-acute care was 2.9 %*** lower in intervention group 2. No significant findings for other outcomes	1. Medicare spending for postacute care was US$ 307* lower in intervention group 2. Mean overall Medicare spending was US$ 453 lower in intervention group, but not significant	1. No significant change in admission rates and patient mix (e.g., no cream-skimming) detected	Only first 9 months after programme introduction investigated
Haas et al. 2019 [78]	USA	Primary lower extremity joint replacement surgery	1. Total spending per episode 2. Length of stay 3. Readmission 4. 30-day/90-day mortality 5. Postsurgical complications	04/2016 – 03/2018 157,828 cases in 684 hospitals in treatment group, 180,594 cases in 726 hospitals in control group	Difference-in-differences analysis, propensity score matching	1. No statistically significant changes to length of stay, readmission, 30-/90-day mortality, complications	1. Total spending per episode declined by US$ 582/-2.5%*** due to decrease in post-acute spending by 5.5%*	1. No statistically significant changes to volume of episodes & patient characteristics	
Kim et al. 2018 [133]	USA	Lower extremity joint	1. Dropout of hospitals after 2018 2. Characteristics of hospitals	280 hospitals	Descriptive, chi-square and t-tests,	1. Exiting hospitals had longer hospital stays, more institutional postacute care use, and	*Not applicable*		205/280 hospitals left CJR programme, they had a higher share of non-white

		replacement surgery			logistic regression	higher readmission rates 2. Exiting hospitals were less likely to have received reconciliation payments			and Medicare-enrolled patients
Kim et al. 2019 [134]	USA	Lower extremity joint replacement surgery	1. Total episode pending 2. Discharge to institutional postacute care setting and length of stay 3. Readmission rates 4. Spending in each care setting 5. Complication rates 6. Emergency department visits 7. Mortality rates, 8. Discharges to skilled nursing facility 9. Reconciliation payment 10. Spending reduction for a bonus	1,165 hospitals (291 high-dual / 874 low-dual) with 768,224 patients in 67 treatment metropolitan statistical areas vs. 103 control metropolitan statistical areas 2012 – 2017	Difference-in-difference analysis	1. No changes in discharges to institutional postacue care and readmission among both hospital groups 2. Generally no change in quality measures under episode-based payment. Higher discharge to skilled nursing facility with 4- or 5-star rating (+8 p.p.* for high-dual use, +5 p.p.* for low-dual use).	1. Total episode spending decreased in high-dual hospitals by -US$ 851* and by US$ 567** in low-dual hospitals. No statistically significant difference between groups 2 Decrease in institutional postacute spending (-US$ 750* for high-dual and -US$ 525 for low-dual hospitals). No statistically significant difference between groups	1. No statistically significant changes in discharge to institutional postacute care 2. Decrease in postacutce length of stay (-1.2%* in high-dual/-0.8* days in low-dual hospitals). No statistically significant difference between groups	1. High-dual hospitals less likely to receive bonus for spending cuts, higher spending reduction for high-dual use would require more substantial spending reduction than for low-dual hospitals
Li et al. 2021 [135]	USA	Lower extremity joint replacement surgery	1. Postacute care discharge rate 2. Readmission rates 3. Share of patients discharged to 4- or 5-star skilled nursing facilities	2013 – 2017 1,239,452 Medicare only patients, 57,452 dual Medicare eligibilities with full, and 50,189 dual eligibilities with partial Medicare benefits in 75 treatment vs. 121 control metropolitan statistical areas	Difference-in-differences analysis	1. Reduced readmission for patients in all groups (30-days: - 1.6 p.p.***, 90-day readmission: -1.8 p.p.) 2. -2.2 p.p.*** reduction in institutional postacute care discharge 3. Generally no statistically significant differences between Medicare groups 4. Increased rate of 3.9 p.p.** of discharge to 4- to 5- star skilled nursing facilities	1. Reduced skilled nursing facility payments by US$ 574.7**		1. Dual eligibility patients & patients discharged to skilled nursing facilities were slightly older, more likely to be of racial/ethnic minority, have certain conditions, and be discharged from lower volume hospitals
Liao et al. 2021 [136]	USA	Lower extremity joint replacement surgery	1. Total episode spending	2011 – 2017 1,346,756 from 92 voluntary, 752 mandatory, and 894	Difference-in-differences analysis	*Not applicable*	1. Decline in spending in voluntary (-US$469**) and mandatory (-US$477**)	1. Voluntary hospitals were larger, more likely to be non-profit, teaching hospitals, patients were more	

				non-participating hospitals			participants compared to nonparticipants, so statistically significant difference between groups	likely to be non-White, markets had higher ACO penetration	
Meyers et al. 2019 [137]	USA	Lower extremity joint replacement surgery	1. Discharge to postacute care setting and 2. Length of stay in postacute care within 90 days after surgery 3. Type of post-acute care setting and length of stay	01/2013 – 09/2017 1,536,387 patients with joint surgery, out of them 67.8% in traditional Medicare (1,042,410) and the remainder (32.2%/493,977) in Medicare Advanced	Difference-in-differences analysis	1. Reduction in discharge to postacute care by 1.5 p.p.*** and by 0.3 days spent*** (5.6%) for Medicare Advantage patients. 2. Reduction in discharge to postacute care by 2.6 p.p.*** and by 0.8 days*** spent (2.5%) for traditional Medicare patients.	*Not applicable*	1. Changes larger in hospitals with greater proportions of traditional Medicare patients	
Wilcock et al. 2021 [138]	USA	Lower extremity joint replacement surgery	1. Institutional spending per episode	01/2014-12/2019 1,087,177 patients with 321,038 episodes in 702 participating hospitals vs. 456,792 episodes in 826 control hospitals	Difference-in-differences analysis	*Not applicable*	1. Savings declined from US$-792 in 2nd year to US$ -331 in 4th year 2. Reduction in spending in participating hospitals was mostly due to shift of surgical procedures to outpatient setting	1. Participating hospitals shifted fewer TEPs to outpatient setting in year ¾ than control hospitals	1. In areas where participation changed to voluntary, hospitals in highest spending baseline tended to drop out
Shift to less costly setting									
Gaughan et al. 2019 [95]	ENG	191 conditions	1. Share of patients treated with same-day discharge	2006 – 2014	Difference-in-differences analysis	*Not applicable*	*Not applicable*	1. Positive effect on 14 out of 32 incentivised conditions 2. Median elasticity of 0.24 for elective and 0.01 for emergency conditions	1. Estimated impact of 28,400 patients that were treated on a same-day instead of inpatient basis
Cazenave-Lacroutz and Yilmaz 2019 [96]	FRA	153 conditions	1. Share of patients treated on an ambulatory care basis	03/2006 – 02/2014	Difference-in-differences analysis	*Not applicable*	*Not applicable*	1. Effect of financial incentives largely insignificant among private hospitals, but positive and statistically significant among public hospitals	

								3. Effects larger pre-2012 than post-2012	

Note: The evaluation and their alphabetical order within the programmes. ED=Emergency department, * = p<0.05; ** = p<0.01, *** = p<0.001.

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