

## EDITORIAL

# DO DIAGNOSIS-RELATED GROUPS EXPLAIN VARIATIONS IN HOSPITAL COSTS AND LENGTH OF STAY? – ANALYSES FROM THE EURODRG PROJECT FOR 10 EPISODES OF CARE ACROSS 10 EUROPEAN COUNTRIES

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## 1. BACKGROUND

Payment mechanisms represent one of the fundamental building blocks of any health system, introducing powerful incentives for actors in the system and fierce technical design complexities. The move in most countries towards diagnosis-related group (DRG)-based hospital payment systems was driven by the objective of incentivizing hospitals to improve their performance. Prior to the introduction of DRG-based hospital payment systems, countries used two basic mechanisms to pay for hospital care: fee-for-service payments and global budgets. These systems provide a specific set of incentives, which are different from the incentives of DRG-based systems. Therefore, in order to understand the international success of DRG-based systems, it is necessary to be aware of the incentives of these alternative systems and of the objectives that hospital payment systems are supposed to achieve. Hospital payment systems should motivate providers to treat patients in need of care and to deliver an adequate number of necessary services (level of activity), while taking into account the appropriateness of the services and patient outcomes (i.e., quality). Finally, a hospital payment system should balance activity and expenditure control incentives, thus contributing to increasing efficiency, while minimizing administrative effort and maximizing transparency. This demonstrates two things: (i) the design of ‘good’ payment systems needs to take into account various dimensions; namely, those of patients and of providers, of the provided services, of payers, and possibly of society at large; and (ii) because of this complexity, it simply cannot be expected that any payment system is ‘optimal’ in all respects (Geissler *et al.*, 2011). Most importantly, however, the DRGs used to group patients need to be defined in a way that patients are medically homogeneous, and the payment rate should accurately reflect the resources and costs of treating patients within that group.

Despite the fact that DRGs have been adopted in an increasingly large number of countries around the world, knowledge about the effects of DRG systems and DRG-based hospital payment systems, as well as about optimal design features of these systems, remains surprisingly limited. Although initially DRG systems were often introduced for the purpose of measuring hospital activity, they have later become the principal means of hospital payment in most countries. Some countries used DRGs over an extended time exclusively

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just for measuring activity and increasing transparency (for example, up to 10 years in England), in order to become acquainted with the DRG grouping logic before they started paying hospitals on the basis of DRGs. Others introduced DRGs after a short period of conversion (for example, in Ireland, DRGs were introduced in 1992 and first used for budgetary allocation in 1993) (Geissler *et al.*, 2011).

A DRG-based hospital payment system consists of several essential building blocks and provides a specific set of incentives that is different from other payment mechanisms (Quentin *et al.*, 2011). In short, in DRG-based hospital payment systems, (i) a patient classification system is used to group patients with similar clinical characteristics and relatively homogeneous resource consumption into DRGs (Kobel *et al.*, 2011); (ii) some kind of hospital cost information (Tan *et al.*, 2011) is used to determine the DRGs' weights, usually at (about) the average treatment costs of patients falling within a specific DRG (Cots *et al.*, 2011); (iii) DRG weights are converted into monetary values and the payment rate may be adjusted for structural (teaching status, region) and further resource-consumption variables (length of stay, utilization of high-cost drugs, or services) (Cots *et al.*, 2011); before (iv) hospitals are paid on the basis of the number and type of DRGs that they produce. The popularity of DRG-based systems is related to the fact that they are thought to have a number of (predominantly desirable) effects on efficiency (Street *et al.*, 2011) and quality (Or and Häkkinen, 2011), if the DRG system is designed properly, whereas the effects on technological innovation are controversial (Scheller-Kreinsen *et al.*, 2011).

Thus, the sometimes fierce debate among practitioners, researchers, and the public indicates that case payments still pose considerable technical and policy challenges, and many unresolved issues in their implementation remain. For example, the *HealthBASKET* project had shown that DRG systems differ greatly between European Member States (Schreyögg *et al.*, 2006). One of the key conclusions of *HealthBASKET* was that structural components (i.e., regional or hospital-specific factors such as location or wage levels) may play an even more important role than heterogeneity of treatment patterns ('medical and management decision variables') in cost variations within an episode of care – whereas the methodological approach used in the *HealthBASKET* project did not allow to quantify the impact of patient variables such as age, diagnoses, and severity of the illness as it used a case vignette-approach with standardized patients (Busse *et al.*, 2008).

## 2. THE EURODRG PROJECT: OBJECTIVES

From previous experience, it is thus clear that international experiences with DRG systems and DRG-based hospital payment systems can inform countries when developing and optimizing their national systems. In addition, in a context of growing patient mobility facilitated by the European Union (EU) *Directive on the Application of Patients' Rights in Cross-Border Healthcare*, an increasingly important issue relates to whether there is scope for harmonization of DRG systems within Europe. This is because if harmonization is not possible, it will remain difficult (or at least non-transparent) to pay hospitals in one EU Member State for care provided to patients from another EU Member State. Furthermore, cross-border comparisons of hospital prices and performance – which are increasingly being conducted in attempts to improve the understanding of differences in terms of efficiency and costs – will continue to be complicated by the lack of a common basis for comparison.

The EuroDRG project was organized in different phases in order to scrutinize these challenges for researchers and policy-makers alike. It concentrated on both the design features of DRG systems in European countries, as well as the performance of these systems across countries. In addition, it had a strong focus on ensuring the transfer of knowledge from research into practice. Regarding the design features, the project concentrated on comparative analyses of the essential building blocks of DRG-based hospital payment systems across 12 European countries that are embedded in various types of health systems (Austria, England/UK, Estonia, Finland, France, Germany, Ireland, the Netherlands, Poland, Portugal, Spain, and Sweden). This stream of research aimed at identifying the differences and similarities of their objectives and purposes as well as the country-specific methodologies of patient classification, DRG weight calculation, and hospital payment.

In its second phase, the project aimed at comparing the performance of DRG systems across European countries. One essential indicator of performance for a DRG system is its ability to define (resource) homogeneous groups of patients. Otherwise, reimbursement for a large number of patients is not appropriate: it is either too high or too low; and performance comparisons on the basis of DRGs do not adequately control for differences of patients within groups. The problems with evaluating DRG performance resemble those of evaluating hospital efficiency. The main problem with studies regarding the latter is that they usually cannot control adequately for differences in case-mix and that an episode-specific approach might therefore be a better alternative. This approach is based on the assumption that data pertaining to specific health conditions will illuminate interconnected aspects (i.e., financing and use of medical technologies) responsible for health systems performance (Häkkinen and Joumard, 2007). It was for the same reason that the *HealthBASKET* project had chosen case vignettes with a standardized definition of patient characteristics per vignette (Busse *et al.*, 2008).

### 3. THE 'EPISODE OF CARE' APPROACH

In the EuroDRG project, we built on this experience but widened the methodological approach to 'episodes of care' (EoCs), which are no longer standardizing patient characteristics but encompass all patients falling into the definition of the respective EoC. The EoCs are uniformly defined across countries through diagnosis and/or procedure codes and can be understood as 'meta-DRGs' which encompass varying numbers of actual DRGs within countries. EoCs were selected in order to represent different medical specialties (internal medicine, surgery, obstetrics and gynecology, etc.) as well as diagnostic and/or therapeutic procedures (including the use of innovative technologies). In addition to the five indications of the five inpatient vignettes used in the *HealthBASKET* project – that is, *Appendectomy* (Schreyögg, 2008), *Normal delivery* (Bellanger and Or, 2008), *Hip replacement* (Stargardt, 2008), *Stroke* (Epstein *et al.*, 2008), and *Acute myocardial infarction* (Tiemann, 2008), we originally selected 10 additional indications, giving us a pool of 15 potential EoCs, all defined using ICD-10 codes for diagnoses and ICD-9-CM codes for procedures (cf. Table I in Street *et al.*, 2012 for the 10 selected EoCs). However, five of them (*Colorectal cancer*, *Diabetes*, *Community-acquired pneumonia*, *Urolithiasis*, and *Traumatic brain injury*) had to be dropped because resource consumption-relevant information on severity, procedures or therapies was not available in the routine data across countries (cf. Table III in Street *et al.*, 2012 for the databases used across 10 countries).

The analysis of the performance of the DRG systems was twofold for each EoC: (i) We looked at the specific classification variables used by the 12 DRG systems (e.g., diagnosis, procedure, age, length-of-stay, death), the number of different DRGs and the resulting reimbursement for seven homogeneously defined patients per EoC across countries; the results are reported elsewhere (see for example for appendectomy: Quentin *et al.*, 2012). (ii) We evaluated the ability of the DRG systems to explain variation in resource consumption among patients and across hospitals – the contents of this *Health Economics* supplement.

In brief, we did so by calculating the explanatory power regarding variation in costs or length-of-stay for three models ( $M_D$ ,  $M_P$ , and  $M_F$ ), which were calculated for each EoC and each country (see Street *et al.*, 2012 for details):  $M_D$  to analyze the explanatory power of the country-specific DRGs to explain variation in costs or length-of-stay of patients treated within that country,  $M_P$  to analyse the explanatory power of a common set of patient-level variables, and  $M_F$  as the 'benchmark' using both sets of variables.

### 4. RESULTS AND DISCUSSION

Looking across the 10 analyses in this issue (Cots *et al.*, 2012; Gaughan *et al.*, 2012; Geissler *et al.*, 2012; Häkkinen *et al.*, 2012; Mason *et al.*, 2012; Or *et al.*, 2012; O'Reilly *et al.*, 2012; Paat-Ahi *et al.*, 2012; Peltola, 2012; Scheller-Kreinsen, 2012), the reader will notice that the average  $R^2$  across countries for  $M_D$  ranges from 0.49 for childbirth and cholecystectomy to 0.30 for stroke, that is, DRGs are, on average, better able to explain

cost variation in the former and worse in the latter. This is further supported by the fact that the  $R^2$  is at least 0.5 in five of the 10 countries for cholecystectomy (England, Estonia, Finland, France, and Sweden), in four for childbirth but only in one for stroke (France). Looking across countries, the  $R^2$  is at least 0.5 for seven out of 10 EoCs in England and France but for no EoC in Austria and Ireland. It is not immediately obvious which of the design features of DRG systems lead to better explanatory power. For example, while the relatively well-performing English system gives a high priority to procedures (rather than diagnoses), though so does Austria which performs relatively poorly. Similarly England and France have a high number of DRGs in their system, so does Germany where the  $R^2$  is at least 0.5 for only two EoCs.

Looking at the results for  $M_P$ , that is, for the models with a uniform set of patient level variables across all 10 countries, the average  $R^2$  is also highest for cholecystectomy (at 0.61) and lowest for stroke (at 0.34) – an indication that our ability to explain differences in patient-level costs or length of stay is limited, at least with the information available in our data sets. In these analyses, the  $R^2$  is at least 0.5 for six out of 10 EoCs in England, five each in France and Germany and only one in Sweden. Perhaps surprisingly, the standard set of variables has – in the vast majority of cases and countries – a greater explanatory power than the country-specific DRGs and only in relatively few cases – mainly in England and Sweden – the opposite is the case. These results indicate that the DRG systems in these countries seem to incorporate characteristics that were not included in our standard set of patient variables, whereas in most other cases, the DRG systems do not use certain characteristics that would improve the explanatory power (such as patient age). Besides hinting at limits of current DRG systems and pointing towards possible improvements, our results could also be interpreted to support the search for a true ‘Euro-DRG’ system instead of investing possibly wasted resources to develop country-specific patient classification systems as the basis for DRG systems.

#### CONFLICT OF INTEREST

The author has no conflict of interest.

#### REFERENCES

- Bellanger M, Or Z. 2008. What can we learn from a cross-country comparison of the cost of child delivery? *Health Economics* **17**: S47–S57.
- Busse R, Schreyögg J, Smith PC. 2008. Variability in healthcare treatment costs amongst nine EU countries – results from HealthBASKET project. *Health Economics* **17**: S1–S8.
- Cots F, Chiarello P, Salvador X, Castells X, Quentin W. 2011. DRG-based hospital payment: Intended and unintended consequences. In *Diagnosis-Related Groups in Europe - Moving Towards Transparency, Efficiency and Quality in Hospitals*, Busse R, Geissler A, Quentin W, Wiley M (eds). Open University Press: Maidenhead; 75–92.
- Cots F, Chiarello P, Salvador X, Castells X. 2012. Patient classification systems and hospital costs of care for knee replacement in ten European countries. *Health Economics* **21**(Suppl. 2): 116–128.
- Epstein D, Mason A, Manca A. 2008. The hospital costs of care for stroke in nine European countries. *Health Economics* **17**: S21–S31.
- Gaughan J, Kobel C, Linhart C, Mason A, Street A, Ward P. 2012. Why do patients having coronary artery bypass grafts have different costs or length of stay? An analysis across ten European countries. *Health Economics* **21**(Suppl. 2): 77–89.
- Geissler A, Quentin W, Scheller-Kreinsen D, Busse R. 2011. Introduction to DRGs in Europe: Common objectives across different hospital systems. In *Diagnosis-Related Groups in Europe - moving towards transparency, efficiency and quality in hospitals*, Busse R, Geissler A, Quentin W, Wiley M (eds). Open University Press: Maidenhead; 9–21.
- Geissler A, Scheller-Kreinsen D, Quentin W. 2012. Do DRGs appropriately explain variations in costs and length of stay of hip replacement? A comparative assessment of DRG systems across ten European countries. *Health Economics* **21**(Suppl. 2): 103–115.
- Häkkinen U, Joumard I. 2007. Cross-country Analysis of Efficiency in OECD Health Care Sectors: Options for Research. *OECD Economics Department Working Papers, No 554*. OECD: Paris.
- Häkkinen U, Chiarello P, Cots F, Peltola M, Rättö H. 2012. Patient classification and hospital costs of care for acute myocardial infarction in nine European countries. *Health Economics* **21**(Suppl. 2): 19–29.

- Kobel C, Thuillez J, Bellanger MM, Aavikso A, Pfeiffer K. 2011. DRG systems and similar Patient Classification Systems in Europe. In *Diagnosis-Related Groups in Europe - Moving Towards Transparency, Efficiency and Quality in Hospitals*, Busse R, Geissler A, Quentin W, Wiley M (eds). Open University Press: Maidenhead; 37–58.
- Mason A, Or Z, Renaud T, Street A, Thuillez J, Ward P. 2012. How well do DRGs for appendectomy explain variations in resource use? An analysis of patient level data from 10 European countries. *Health Economics* **21**(Suppl. 2): 30–40.
- Or Z, Häkkinen U. 2011. DRGs and quality: For better or worse? In *Diagnosis-Related Groups in Europe - Moving Towards Transparency, Efficiency and Quality in Hospitals*, Busse R, Geissler A, Quentin W, Wiley M (eds). Open University Press: Maidenhead; 115–129.
- Or Z, Renaud T, Thuillez J, Lebreton C. 2012. Diagnosis related groups and variations in resource use for child delivery across 10 European countries. *Health Economics* **21**(Suppl. 2): 55–65.
- O'Reilly J, Serdén L, Talbäck M, McCarthy B. 2012. Performance of 10 European DRG systems in explaining variation in resource utilisation in inguinal hernia repair. *Health Economics* **21**(Suppl. 2): 89–101.
- Paat-Ahi G, Swiderek M, Sakowski P, Saluse J, Aaviksoo A. 2012. DRGs in Europe: a cross country analysis for cholecystectomy. *Health Economics* **21**(Suppl. 2): 66–76.
- Peltola M. 2012. Patient classification and hospital costs of care for stroke in 10 European countries. *Health Economics* **21**(Suppl. 2): 129–140.
- Quentin W, Geissler A, Scheller-Kreinsen D, Busse R. 2011. Understanding DRGs and DRG-based hospital payment in Europe. In *Diagnosis-Related Groups in Europe - Moving Towards Transparency, Efficiency and Quality in Hospitals*, Busse R, Geissler A, Quentin W, Wiley M (eds). Open University Press: Maidenhead; 23–35.
- Quentin W, Scheller-Kreinsen D, Geissler A, Busse R. 2012. Appendectomy and Diagnosis Related Groups (DRGs): patient classification and hospital reimbursement in 11 European countries. *Langenbeck's Archives of Surgery* **397**: 317–326.
- Scheller-Kreinsen D. 2012. How well do DRG systems group breast cancer surgery patients? – Evidence from 10 European countries. *Health Economics* **21**(Suppl. 2): 41–54.
- Scheller-Kreinsen D, Quentin W, Busse R. 2011. DRG-type payment systems and technological innovation: reimbursement approaches in 11 European countries. *Value in Health* **14**: 1166–1172.
- Schreyögg J. 2008. A micro-costing approach to estimating hospital costs for appendectomy in a cross-European context. *Health Economics* **17**: S59–69.
- Schreyögg J, Stargardt T, Tiemann O, Busse R. 2006. Methods to determine reimbursement rates for diagnosis related groups (DRG): A comparison of nine European countries. *Health Care Management Science* **9**: 215–223.
- Stargardt T. 2008. Health service costs in Europe: cost and reimbursement of primary hip replacement in nine countries. *Health Economics* **17**: S9–20.
- Street A, O'Reilly J, Ward P, Mason A. 2011. DRG-based hospital payment and efficiency: Theory, evidence, and challenges. In *Diagnosis-Related Groups in Europe - Moving Towards Transparency, Efficiency and Quality in Hospitals*, Busse R, Geissler A, Quentin W, Wiley M (eds). Open University Press: Maidenhead; 93–114.
- Street A, Kobel C, Renaud T, Thuillez J. 2012. How well do Diagnosis Related Groups explain variations in costs or length of stay among patients and across hospitals? Methods for analysing routine patient data. *Health Economics* **21**(Suppl. 2): 6–18.
- Tan SS, Serdén L, Geissler A, van Ineveld M, Redekop K, Heurgren M, Hakkaart-van Roijen L. 2011. DRGs and cost accounting: Which is driving which? In *Diagnosis-Related Groups in Europe - Moving Towards Transparency, Efficiency and Quality in Hospitals*, Busse R, Geissler A, Quentin W, Wiley M (eds). Open University Press: Maidenhead; 59–74.
- Tiemann O. 2008. Hospitalization costs of acute myocardial infarction in nine European countries. *Health Economics* **17**: S33–45.