Breast cancer surgery and diagnosis-related groups (DRGs): Patient classification and hospital reimbursement in 11 European countries

David Scheller-Kreinsen, Wilm Quentin, Alexander Geissler, Reinhard Busse, on behalf of the EuroDRG group

Department of Health Care Management, Berlin University of Technology, Straße des 17. Juni 135, 10623 Berlin, Germany
European Observatory on Health Systems and Policies, Brussels, Belgium

Article history:
Received 17 May 2012
Received in revised form 29 September 2012
Accepted 4 November 2012

Keywords:
Breast cancer
Mastectomy
Diagnosis-related groups
Europe
Prospective payment system
Hospitals

Abstract

Researchers from eleven countries (i.e. Austria, England, Estonia, Finland, France, Germany, Ireland, Netherlands, Poland, Spain, and Sweden) compared how their DRG systems deal with breast cancer surgery patients.

DRG algorithms and indicators of resource consumption were assessed for those DRGs that individually contain at least 1% of all breast cancer surgery patients. Six standardised case vignettes were defined and quasi prices according to national DRG-based hospital payment systems were ascertained.

European DRG systems classify breast cancer surgery patients according to different sets of classification variables into three to seven DRGs. Quasi prices for an index case treated with partial mastectomy range from €577 in Poland to €5780 in the Netherlands. Countries award their highest payments for very different kinds of patients.

Breast cancer specialists and national DRG authorities should consider how other countries’ DRG systems classify breast cancer patients in order to identify potential scope for improvement and to ensure fair and appropriate reimbursement.

Introduction

Diagnosis-related group (DRG) systems are used to classify, and ultimately pay for, hospital patients, including those receiving breast cancer surgeries in many European countries. In addition, they form the basis of performance comparisons, which are becoming increasingly important in the context of so-called pay-for-performance initiatives. DRGs are “diagnosis related” groups of patients that are characterised by (a) similar resource consumption patterns and that are (b) clinically meaningful. They are defined by patient classification systems (PCS) — i.e. DRG systems — which group hospital cases into DRGs on the basis of classification variables such as diagnoses, procedures and demographic characteristics. A prerequisite for a DRG system to serve as the basis for a fair hospital payment system or as the basis of performance comparisons is its ability to define (resource) homogenous groups. 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.

Breast cancer surgery is characterised by features that complicate the definition of DRGs: (1) constantly evolving treatment patterns resulting in changing costs; (2) a lack of consensus on preferred treatment options; and (3) substantial differences in the configuration of care within countries. For regular updates of DRG systems, several countries have implemented mechanisms to incorporate suggestions from professional medical associations or medical consultants into their classification systems. In this context, comparative analyses of how other countries’ DRG systems classify patients can help clinicians identify potential areas for improvement. Furthermore, analyses of how the services of clinicians in treating different patients are valued and reimbursed in other DRG-based hospital payment systems may inform and substantiate discussions about the adequacy of cost weights (or other indicators of resource consumption). However, for breast cancer surgery...
cancer surgery, detailed comparative analyses of classification algorithms are currently unavailable.\textsuperscript{11}

This study comprehensively evaluated DRG systems across 11 European countries and had 3 main objectives: (1) to assess classification variables and algorithms used to group patients with breast cancer surgery into DRGs; (2) to compare variations in DRG weights; and (3) to determine DRGs and quasi prices for six types of breast cancer surgery patients with different demographic, diagnostic and treatment characteristics.

Materials and methods

Definition of episode of care and breast cancer surgery index case

As part of the EuroDRG project, researchers from 11 European countries (Austria, England, Estonia, Finland, France, Germany, Ireland, the Netherlands, Poland, Spain, and Sweden) agreed upon a common definition for a breast cancer surgery episode of care (EoC). An EoC defines cases independent of the assigned DRG via common diagnoses and/or procedures that can be identified across countries. The definition of the breast cancer surgery EoC builds on the work of the Hospital Data Project and was based on the 2007 version of the International Classification of Diseases 10th edition (ICD-10) for diagnoses and the 2008 version of the ICD-9 Clinical Modification (ICD-9CM) for procedures.\textsuperscript{12} It is summarised in Table 1. Researchers from each country translated the definition into national codes for diagnoses and procedures, considering mappings from the Hospital Data Project if available.\textsuperscript{12}

An index case was defined to facilitate comparisons of resource intensity of DRGs within countries. The index case is characterised by the most common patient and treatment characteristics of uncomplicated breast cancer cases in hospitals of the selected countries: a 55 year old woman with malignant neoplasm of the central portion of breast without complications, partial excision of mammary gland, and treated as inpatient.\textsuperscript{13}

Data sources

In each country, researchers identified national or regional hospital databases and obtained access to all information necessary for the purposes of this study. Table 2 provides an overview of the number of observations of breast cancer surgery patients, data years available, and databases used for each country. Databases were required to contain information about age, diagnoses, procedures, treatment settings, length of stay, mode of discharge, and DRGs of individual cases in order to facilitate the identification of breast cancer surgery patients conforming to the agreed definition.

Analysis of patient classification systems

Detailed comparative analyses of classification variables and of grouping algorithms of national DRG systems were performed for the most frequent DRGs, i.e. those DRGs that individually contained at least 1% of all breast cancer surgery patients in the relevant database (and certain less populated DRGs that are necessary for understanding the grouping logic).\textsuperscript{14–22} Grouping algorithms were mapped graphically to facilitate comparisons between systems. In addition, the percentage of all breast cancer surgery cases grouped into each DRG was calculated. As national measures of DRG weight are expressed in different units, i.e. cost weight, score or tariff, a standardisation had to be performed to ease comparisons across countries. Therefore, we calculated a DRG weight index where the defined across

Table 1
Definition of episode of care and index case.

<table>
<thead>
<tr>
<th>Definition</th>
<th>Name</th>
<th>Breast cancer surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defined by</td>
<td>Primary diagnosis</td>
<td>AND procedure</td>
</tr>
<tr>
<td>Procedure</td>
<td>85.20–85.23: partial excision of mammary gland OR 85.33–85.36, 85.4: total mastectomy</td>
<td></td>
</tr>
<tr>
<td>Index case</td>
<td>Age 55, malignant neoplasm of central portion of female breast without complications (i.e. C50.1), partial excision of mammary gland (i.e. 85.22), treated as inpatient</td>
<td></td>
</tr>
</tbody>
</table>

Table 2
Key characteristics of databases by country.

<table>
<thead>
<tr>
<th>Country</th>
<th>Data year</th>
<th>Observations (patients)</th>
<th>Source of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>2008</td>
<td>6619</td>
<td>Krankenanstaltenfinanzierung (LKf) database of the Bundesministerium für Gesundheit (BMG)</td>
</tr>
<tr>
<td>England</td>
<td>2007/08</td>
<td>30,186</td>
<td>Hospital Episode Statistic (HES) database</td>
</tr>
<tr>
<td>Estonia</td>
<td>2008</td>
<td>594</td>
<td>Estonian Health Insurance Fund (EHIF) database</td>
</tr>
<tr>
<td>Finland</td>
<td>2008</td>
<td>4473</td>
<td>Finnish Hospital Discharge Register Programme de Médicalisation des Systèmes d'Information en Médecine, Chirurgie, Obstétrique (PMSI MCO) database</td>
</tr>
<tr>
<td>France</td>
<td>2008</td>
<td>65,457</td>
<td>Programme de Médicalisation des Systèmes d'Information en Médecine, Chirurgie, Obstétrique (PMSI MCO) database</td>
</tr>
<tr>
<td>Germany</td>
<td>2008</td>
<td>88,948</td>
<td>Krankenhausstatistik (DRG-statistic) of the Federal Statistical Office (Destatis) database</td>
</tr>
<tr>
<td>Ireland</td>
<td>2008</td>
<td>2188</td>
<td>Hospital In-patient Enquiry (HIPE) database</td>
</tr>
<tr>
<td>Netherlands</td>
<td>2008</td>
<td>18,462</td>
<td>Diagnose Behandeling Combinaties (DBC) Onderhoud database</td>
</tr>
<tr>
<td>Poland</td>
<td>2009</td>
<td>10,895</td>
<td>Register of episodes of care and reimbursements of the National Health Fund (NHF) database</td>
</tr>
<tr>
<td>Spain (Catalonia)</td>
<td>2008</td>
<td>4113</td>
<td>Hospital Minimum Basic Data Set (CMBS) database of the Public Hospital Network of Catalonia (XHUP) database</td>
</tr>
<tr>
<td>Sweden</td>
<td>2008</td>
<td>6665</td>
<td>The National Patient register (NPR) of The Board of Health and Welfare database</td>
</tr>
</tbody>
</table>

Case vignettes and quasi prices

Six standardised case vignettes of patients with different combinations of primary and secondary diagnoses, procedures, age, length of stay, and treatment settings were defined (Table 3). Case vignettes were selected specifically to illustrate differences in DRG systems across countries, i.e. only those patient and treatment characteristics were specified that are relevant for the classification of patients and reimbursement of hospitals in at least one country but not in all other countries. Patient and treatment characteristics were varied in order to show the impact that different variables have on the classification of and reimbursement for different types of patients. Case vignettes 1–3 represent less complicated cases, whereas patients 4–6 are more complex cases.

DRG-based hospital payment systems differ among countries and sometimes even within countries, complicating comparisons.\textsuperscript{22} Therefore, quasi prices were ascertained for each case vignette and for the index case using an approach similar to that of Koechlin et al.\textsuperscript{11} Quasi prices were calculated by converting national measures of DRG weight (i.e. cost weights, scores, average tariffs —
taking account of outlier deductions/additional payments where possible) into Euros using national average monetary conversion rates. If necessary, prices were deflated to year 2008 national currency using national GDP deflators, and converted to Euros using average currency exchange rates for the year 2008.24,25

In addition, in order to facilitate comparison of the quasi prices for case vignettes one to six within and across countries, a quasi price index was calculated with the index case assuming a value of 1. The index score of all other case vignettes was calculated by dividing the value of the quasi price of each case vignette by that of the index case. This relative measure allows to compare the price levels of different types of patients across countries, despite the substantial national differences with regard to input prices.

Results

DRG systems: grouping algorithms and classification variables

Fig. 1 provides a graphic illustration of grouping algorithms and classification variables of DRG systems in 11 European countries. The figure includes classification variables of those DRG systems that individually represent at least 1% of breast cancer surgery cases in each country.4 On the left hand side, the figure specifies the version of the DRG system and the percentage of all breast cancer surgery cases shown in the graph. The arrows indicate the sequence in which different types of classification variables are considered in the grouping algorithm.

The last column on the right shows the percentage of cases of the EOc covered by each DRG and the DRG weight index. The Finnish and the Swedish algorithms are combined, as both use versions of the NordDRG system which are very similar for breast cancer surgery. The index DRGs, i.e. those which contain the index case, are highlighted in dark grey.

Fig. 1 shows that the percentage of all breast cancer surgery cases covered by the DRGs included in our analysis ranges from 96% in Sweden to 100% in Estonia, Finland, Poland, and Spain. The number of DRGs individually representing at least 1% of breast cancer surgery cases differs substantially across countries ranging from three DRGs in Austria to seven DRGs in England, Germany, Spain, and Sweden. In addition, the distribution of cases across the set of DRGs differs. The most populated DRG in England covers only about 30% of cases, while in Poland approximately 80% of all cases fall into a single DRG. Similarly, the number of classification variables differs widely across countries. The Austrian system differentiates only between two variables: (1) the most costly procedures (breast cancer surgery, intraoperative radiotherapy, reconstruction of the breast) and (2) age, whereas the French system uses seven different classification variables to group patients into DRGs.

The type and combination of classification variables also varies significantly across countries. The main diagnosis is used as a classification variable in all countries except Austria, England and Poland. The Austrian, Irish, Dutch, and Polish DRG systems do not differentiate patients with comorbidities or complications (CC), while all other countries consider CCs in their classification system. Yet, most countries only make a distinction between patients with and without CCs, while the French GHM system differentiates among four levels of CCs and the German G-DRG system calculates cumulative patient clinical complexity levels (PCCLs).

Treatment variables dominate the classification algorithm in all countries. For example, seven DRG systems differentiate between partial mastectomy and total mastectomy (as defined in Table 1). The English HRC system and the related Polish JGP system differentiate between major procedures (including total mastectomy and certain types of partial excision of the breast) and minor procedures (including biopsy and excision of lesion of breast). Only the Austrian LKF system and the Dutch DBC system do not differentiate between different types of mastectomy.

Almost all DRG systems consider whether a reconstruction of the breast was performed. In addition, some countries (England, Estonia, Germany, and Ireland) make a distinction between different types of reconstruction. Only Spain’s AP-DRG system and the Dutch DBC system do not classify patients on the basis of whether or not a reconstruction was performed.

Furthermore, some countries differentiate between unilateral and bilateral mastectomy (Germany and Netherlands), whether radiotherapy was performed (Austria and Germany), and whether a lymph node procedure was performed (England, Germany, Ireland, and Poland).

Age serves as a classification variable only in France and Austria. Length of stay is relevant for grouping cases into DRGs only in France, although it is considered either for outlier deductions or for additional payments in a number of other countries, such as in Austria, England, Germany, and in France.26

Variation in relative DRG weights

In Austria, Sweden, France, the Netherlands and Spain, the index DRG which contains the index case (see Fig. 1) covers the highest...
Fig. 1. Grouping algorithms, classification variables, and relative DRG weights in 11 European DRG systems.
percentage of cases of breast cancer surgery patients. In England, Estonia, Finland, Germany, Ireland and Poland, other DRGs are more populated. In England and Estonia, the most populated DRG has a DRG weight index score similar to the index DRG, i.e. approximating 1, and in Finland, the most populated DRG has a DRG weight index score below one (0.93). In contrast, the most populated DRGs in Germany, Ireland and Poland have DRG weight index scores substantially higher than the index case (2.2, 1.90 and 1.98, respectively).

The lowest variation of DRG weight index scores exists in Austria, Finland and the Netherlands with a range of about one. In these countries, but also in England, Estonia, and Sweden, the DRG with the highest weight has a DRG weight index score below or close to 2, indicating that the systems do not systematically account for cases that are more than twice as resource intensive as the index case. In contrast, the range of DRG weight index scores is considerably higher in Germany (1.0–2.83), Poland (0.20–3.31), Spain (1.0–2.93) and Ireland (1.0–2.96).

Furthermore, a comparison of DRG weight index scores may point to potential flaws in the systems. For example, in England, DRGs for patients with intermediate complications and comorbidities (CC) (HRG JA07B) are valued lower than DRGs for patients without CCs (HRG JA07C). In Estonia, hospitals receive only marginally higher payments for total mastectomy patients without complications (DRG 258) than for partial mastectomy patients without complications (DRG 260). In France, hospitals receive less payment if they perform a skin graft or wound care procedure (GHM 09C031) in addition to a partial or total mastectomy for patients without comorbidities than they would without this additional procedure. And similarly, at the time of our study, French hospitals were disincentivised to perform a total reconstruction on patients because of lower DRG weights for the additional procedure. And similarly, at the time of our study, French hospitals were disincentivised to perform a total reconstruction on patients because of lower DRG weights for the additional procedure.

DRGs and hospital quasi prices for case vignettes

Table 4 shows a comparison of DRGs and hospital quasi prices for the index case and the six case vignettes. For each case vignette, the first column specifies the DRG into which a case vignette patient would be classified and whether she would be considered an inlier or outlier (i.e., whether length of stay is below the upper or lower predefined threshold). The second column of each case vignette presents the quasi price. Interestingly, in Austria, the predefined length of stay threshold for the index case is below the lower threshold, making it an outlier case with an associated lower reimbursement.

Partially reflecting differences in terms of GDP per capita, the quasi price of the index case varies substantially across countries, ranging from 577€ in Poland to 5780€ in the Netherlands. Similarly, we find a very high variation of quasi prices across countries for the other case vignettes.

However, countries that pay a higher price for one type of patient do not necessarily pay a higher price for all kinds of patients. For example, hospitals in France would receive much higher payments than those in England for an 85 year old woman with breast cancer who is treated with total mastectomy and has wound complications (infection and disruption of the operation wound) after surgery leading to a long length of stay (patient 6). Conversely, hospitals in England would receive much higher payments than those in France when treating a younger breast cancer patient with total mastectomy and performing a total reconstruction of the breast (patient 4).

Fig. 2 facilitates these kinds of comparisons by presenting the results of Table 4 using the quasi price index score, which compares hospital quasi prices within countries for each patient to the quasi price for the index case.

Fig. 2 illustrates that quasi prices for patients 1–6 vary substantially in Austria, France, Germany, Ireland, Spain and, at a lower level, in Sweden. In contrast, the range of quasi prices in Finland, Poland, and in the Netherlands is relatively small.

Moreover, Fig. 2 shows that countries provide the highest payments for very different kinds of patients. For example, in Austria, England, Finland, Germany, Ireland, Poland and Sweden, hospitals would receive the highest payments for patients 4 and 5 (breast cancer patients who are treated with total mastectomy, lymph node resection, and total breast reconstruction).

On the other hand, in France and Spain, quasi prices are highest for patient 6 who suffers from a disruption of the operation wound (T81.3) and an infection following the procedure (T81.4) (Fig. 2). Interestingly, only in France, hospitals receive considerably higher payments for a patient with lymph node metastasis who dies during admission (patient 5) than for an otherwise similar patient without metastasis (patient 4).

Discussion

To date, this is the most comprehensive comparative analysis of grouping algorithms, classification variables and prices for breast cancer surgery patients across European DRG systems. It shows great heterogeneity with regards to (1) the number of DRGs used to classify breast cancer surgery cases; (2) the number of classification variables applied; (3) the characteristics of the classification variables; (4) the degree of differentiation between complex and less complex cases, i.e. in the relative resource intensity of different DRGs; and (5) the quasi prices for different types of patients (case vignettes).

However, before drawing conclusions on the basis of this study’s findings, limitations of our data and methodology need to be considered. First, the data that was used to identify patients and to assess the relative importance of different DRGs in different countries originated from routine inpatient databases. As highlighted by the Hospital Data Project, there are substantial differences in coding practices across countries and the quality of data is not always comparable.

Second, differences in hospital payment systems among countries complicate comparative analyses of payment levels through quasi prices (Table 4). On the one hand, quasi prices may differ across countries as different countries include different cost categories in DRG-based payments. For example, in Germany, fixed capital costs are not included in DRG-based payment and quasi prices, whereas in most other countries, DRG-based payments are supposed to cover capital costs. On the other hand, different systems of additional payments exist, e.g. England assigns additional Health Resource Groups (HRGs) for certain diagnostic evaluations, such as CT scans; Poland and Austria have additional per-diem based payments for stays in intensive care units. Furthermore, in the Dutch and the Finnish DRG systems several DRGs per hospital stay can be assigned, each leading to additional DRG-based payments. Last but not least, DRG-based payments are adjusted in several countries to account for differences among hospitals or regions. Finally, there are considerable differences in input prices across countries, e.g. salaries of health workers and cost of materials, are much higher in some
Table 4
Comparison of hospital quasi prices for breast cancer patients in Europe.

<table>
<thead>
<tr>
<th>Patient</th>
<th>DRG (in-/outlier)</th>
<th>Hospital quasi price (Euros)</th>
<th>DRG (in-/outlier)</th>
<th>Hospital quasi price (Euros)</th>
<th>DRG (in-/outlier)</th>
<th>Hospital quasi price (Euros)</th>
<th>DRG (in-/outlier)</th>
<th>Hospital quasi price (Euros)</th>
<th>DRG (in-/outlier)</th>
<th>Hospital quasi price (Euros)</th>
<th>DRG (in-/outlier)</th>
<th>Hospital quasi price (Euros)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mel.16.01D (inlier)</td>
<td>2304</td>
<td>Mel.16.01C (inlier)</td>
<td>5051</td>
<td>Mel.16.02B (inlier)</td>
<td>7773</td>
<td>Mel.16.01D (inlier)</td>
<td>8191</td>
<td>Mel.16.01C (inlier)</td>
<td>5051</td>
<td>Mel.16.01D (inlier)</td>
<td>3523</td>
</tr>
<tr>
<td>2</td>
<td>JA07C (day case)</td>
<td>1514</td>
<td>JA07C (inlier)</td>
<td>3310</td>
<td>JA05Z (inlier)</td>
<td>6319</td>
<td>JA06Z (outlier)</td>
<td>4549</td>
<td>JA07C (inlier)</td>
<td>3310</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>258</td>
<td>1254</td>
<td>501B</td>
<td>5992</td>
<td>09C052 (inlier)</td>
<td>4142</td>
<td>09C111 (inlier)</td>
<td>3182</td>
<td>09C044 (inlier)</td>
<td>2864</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>259</td>
<td>1340</td>
<td>259A</td>
<td>6165</td>
<td>09C112 (inlier)</td>
<td>3182</td>
<td>09C044 (inlier)</td>
<td>2864</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>258</td>
<td>2179</td>
<td>502</td>
<td>7990</td>
<td>502</td>
<td>7990</td>
<td>502</td>
<td>7990</td>
<td>502</td>
<td>7990</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Mel.16.01D (inlier)</td>
<td>2304</td>
<td>JA07A (inlier)</td>
<td>3311</td>
<td>JA05Z (inlier)</td>
<td>6319</td>
<td>JA06Z (outlier)</td>
<td>4549</td>
<td>JA07C (inlier)</td>
<td>3310</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Index case</td>
<td>260</td>
<td>1543</td>
<td>258</td>
<td>1340</td>
<td>257</td>
<td>1791</td>
<td>257</td>
<td>1791</td>
<td>257</td>
<td>1791</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Austria: Reported values are based on theoretically calculated scores. Actual hospital payment depends on decisions of states which make use of nationwide DRG scores in different ways. Payments differ for the same MEL if patients have received additional procedures (e.g. breasts reconstruction) that is not accounted for in the MEL.
- England: Based on 2009/10 elective tariff prices and HRG version 4. For patient 1, the Short Stay Elective tariff is applicable.
- Estonia: Quasi prices were calculated by multiplying cost weights with the national base rate. In actual payment, hospitals are paid through a mix of DRG based payment and fee-for-service. The actual DRG based payment is only 70% of the reported Quasi price. In Estonia, outliers are identified on the basis of cost thresholds. Because costs were not specified for the case vignettes, outlier status for case vignettes could not be determined.
- Finland: Actual hospital payment varies by type of hospital (i.e. university, central, local hospitals) and hospital district. Provided figures are volume weighted averages across all hospitals. Outlier limits and associated outlier reimbursement differ between hospital districts. In the Table, patients were identified as outliers on the basis of two standard deviations from the average length of stay but payment was not adjusted.
- France: Calculated using national DRG cost weights and the average of state-wide base rates (2803.05 €).
- Germany: Actual hospital payment depends on the county council, which is free to decide how to pay hospitals. In Sweden, outliers are mostly identified on the basis of cost thresholds. In some counties, length of stay limits apply and patient 3 would be considered an outlier. However, because outlier payments differ between counties, relevant adjustments could not be determined.
countries than in others. Therefore, the absolute price levels should not be directly interpreted as reflecting more expensive care in one country compared to another; and they should not be mistaken for indicating less efficient providers in one country compared to another. However, relative price levels within countries that were used for comparisons in Figs. 1 and 2 should be less affected by differences in payment systems as they were always compared to the in-country DRG index case.

Third, as we limit part of our comparative analysis to DRGs that account for at least 1% of cases (Fig. 1), we partially neglect how different systems deal with rare outliers, which may, however, be particularly relevant for reimbursement.

Despite these limitations, our analysis has major implications for gynaecologists and surgeons treating breast cancer patients, as well as for national authorities involved in the development of national DRG systems as it helps to identify systematic flaws. First, all countries with the exception of Austria and the Netherlands differentiate among different types of partial and total mastectomy (Fig. 1). In the case of Austria and the Netherlands, on the other hand, patients treated with very different procedures are grouped into the same DRG. Many other countries need to determine whether they sufficiently take into account secondary diagnoses, reconstruction, or lymph node procedures when grouping mastectomy patients into DRGs.

Second, in several countries, the appropriateness of DRG weights and the related incentives should be carefully reevaluated. For example, in England, the presence of secondary diagnoses does not lead to higher reimbursement for mastectomy patients (see Fig. 1); in Estonia, hospitals receive higher payments for partial mastectomy with complications than for total mastectomy with complications; in France, hospitals that provide additional procedures (e.g. wound care) do not receive higher reimbursement.

Third, some DRG systems achieve a greater degree of differentiation among more and less complex patients than other systems, as is reflected in the different range of the cost index in Fig. 1. If DRG systems do not adequately account for differences among patients, hospitals and surgeons that treat a greater share of more complex cases than others are not adequately compensated for their greater efforts. Possibly, in countries with only a few DRGs to account for differences in complexity, some of the differences in patient populations among hospitals are accounted for through adjustments (e.g. for teaching status or type of hospital) outside of the DRG systems. However, ideally, differences in patient characteristics would be accounted for in the patient classification system and not in the payment system.

Finally, DRG systems are meant to provide precise measures of the kind of services hospitals deliver. This measure is useful only if DRGs describe a sufficiently homogenous group of patients. Therefore, quantitative research is needed to verify whether the most important
Determinants of cost are considered in different patient classification systems, and whether differences among systems reflect country specific differences in treatment patterns. However, it is also important for clinicians to be aware of the significance of adequately designed DRG systems and to engage in optimizing these systems. Information presented in this article about how DRG systems classify breast cancer surgery patients can help surgeons and gynaecologists engage with national DRG authorities. In light of increasing pressure for cost containment, it is very important that DRG systems consider the most important classification variables in order to ensure that limited resources are appropriately allocated for patients undergoing breast cancer surgery.

**Ethical approval**

Ethical Approval was not required.

**Authors’ contributions**

Reinhard Busse had the original idea for the study, which was then designed in close collaboration by all four authors. Wilm Quentin and Alexander Geissler assured the acquisition of data from the EuroDRG partners. David Scheller-Kreinsen and Wilm Quentin analysed and interpreted the data. David Scheller-Kreinsen drafted the manuscript. All authors critically revised and approved the final manuscript.

**Conflict of interest statement**

All authors declare that (1) Scheller-Kreinsen D, Quentin W, Geissler A, and Busse R have not accepted support from a company for the submitted work; (2) Scheller-Kreinsen D, Quentin W, Geissler A, and Busse R have no relationships with any party that might have an interest in the submitted work in the previous 3 years; (3) their spouses, partners, or children have no financial relationships that may be relevant to the submitted work; and (4) Scheller-Kreinsen D, Quentin W, Geissler A, and Busse R have no [non-financial] interests that may be relevant to the submitted work.

**Acknowledgements**

The project was funded through the seventh framework programme (FP7) of the European Commission under Grant Agreement Number 223300. The funding source did not influence the study questions, design, data collection, analysis or interpretation of results at any stage.

Wendy Wisbaum copy-edited the manuscript. We are grateful for her contribution. In addition, we would like to thank two anonymous reviewers for their very helpful comments.

**References**


