Introduction of diagnosis-related groups in Germany: evaluation of impact on in-patient care in a dermatological setting

P. Hensen1,2, S. Beissert1, L. Bruckner-Tuderman3, T. A. Luger1, N. Roeder2, M. L. Müller2,3

Background: German diagnosis-related groups (G-DRG) have been introduced in Germany as a reimbursement system for in-patient care. The aim of this study was to report data-based experiences from the introduction process and to evaluate the impact on in-patient dermatology. Methods: A quantitative analysis including clinical data from two large university centres of dermatology over a time period of 4 years (2003–06) has been performed. Results: It was found that the case-mix index values increased after the introduction period, but subsequently declined on the initial value. At the same time, an increase of dermatological hospital admissions can be noticed parallel to a significant reduction of LOS (P < 0.001) and a moderate increase of average age (P < 0.001). Analysis of DRG assignment revealed an initial significant decline of surgical in-patient procedures and increasing medical treatments, however, without obvious long-term changes. Furthermore, a growing importance for dermatological oncology and inflammable skin diseases within the in-patient setting could be observed. Conclusions: The introduction of the G-DRG system in Germany induced changes in in-patient care affecting hospital admission rates, LOS and cases treated in an in-patient setting. In-patient activities have not been reduced with the DRG introduction; however, long-term interdisciplinary research approaches are needed to explore the future impact on health care providing and quality of health care in depth.

Keywords: DRG, hospital care, impact, in-patient dermatology, length of stay

The introduction of a prospective payment system on the basis of diagnosis-related groups (DRG) was an important change in the German health care system. After decades of paying a set fee for every day of hospitalization the changeover from a rigid budgeting system to a completely new hospital reimbursement system highlighted a paradigm shift in national health policy.1 Similar to many other countries where DRGs are in use such as the USA and Australia, one of the major goals for implementation of DRG has been reducing health care expenditures and cost control by setting hospitalization payment for all payers at a fixed DRG-rate per admission.2 The well-established Australian-Refined DRG (AR-DRG 4.1) scheme has been adopted as a basis for creating a German DRG (G-DRG) system in the year 2000 because of its high degree of accurateness in differentiating resource consumptions. The subsequent adoption process from AR-DRG to G-DRG was then encouraged by authorized self-governing bodies in collaboration with professional medical societies and medical associations. Selected hospitals started the hospital reimbursement based on DRG in 2003 on a voluntary basis.3 Thereupon, all national hospitals were legally obliged to use DRGs for billing their in-patient services at the beginning of 2004.4 To protect hospital budgets from unexpected losses the legislative authorities have defined a transition period over the subsequent 5 years. It is planned, that after this adaptation period, the G-DRG scheme will be the only economical basis for hospital reimbursement except for psychiatric cases.

As a matter of course, the changes in hospital funding affected health care supplies and the different fields of medicine in an unequal manner. Dermatology, in particular, had to deal with the unique situation that the existing in-patient treatment standards did not primarily fit into an Anglo–American-tailed patient classification system. In central Europe and in Germany, respectively, dermatology has a long tradition as an individual and broad-spectrum field in medicine which has a main focus on in-patient care. Therefore, evaluation studies have been conducted which brought recommendations for a DRG adjustment that partly had been adopted in the further development of the G-DRG system.3,5,6 Beside these systemic inquiries on a health care system level, restructuring of health care delivery processes will be the most important challenge for health care providers. International experiences give reason to believe that introduction of DRG will probably lead to drifts and shifts in lengths of hospital stay, extent of service providing and quality of care.7-9 Hence, all fields of health services delivery and, in particular, well-established in-patient dermatology will be concerned by these developments.10,11

To report first data-based experiences since the introduction of the G-DRG system, a quantitative analysis including recent in-patient data are shown and discussed in regard to care-related impacts.

Methods

G-DRG classification

The G-DRG classification system primarily based on the AR-DRG system, groups together several parameters such as diagnosis, procedures, patient’s age, complications and so on.
into one G-DRG code. Cases were assigned to one of 25 organ-related major diagnostic categories (MDC) by their principal diagnoses. Nearly two-thirds of in-patient dermatology is represented by MDC 09 (skin, subcutaneous tissue and breast). The remaining third is predominantly represented by MDC 23 (factors influencing health status and other contacts with health services) that covers most of in-patient allergic treatments, MDC 17 (haemalic and solid neoplasms) comprising lymphoma of the skin, MDC 05 (circulatory system) that contains arterial and venous diseases including therapy of varicose veins and ulcers and MDC 08 (musculoskeletal system and connective tissue) that covers connective tissue diseases and systemic vasculitis.

G-DRG assignment (DRG grouping) is reliant on multiple criteria defining unequal resource consumptions. In the first 2 years of German DRG, the main criteria for differentiation have been age, patient clinical complexity level (PCCL) and length of stay (LOS). PCCL is a measure of the cumulative effect of a patient’s complications and comorbidities and it is calculated by arithmetic operations during the grouping process. From 2004 up to now, a number of newly recognized factors, such as complex procedures (e.g. simultaneous lymph node excisions or radio therapy of cancer diseases), secondary diagnoses (e.g. ulcer diseases or severe infections) were added to create a highly differentiated system with a growing number of DRG groups (total number; 2003: \( n = 664 \), 2004: \( n = 824 \); 2005: \( n = 878 \); 2006: \( n = 954 \)). The German coding guidelines are legally obliged instructions to ensure appropriate coding and DRG assignment. In the early years, these guidelines have been adapted in accordance with the Hospital Payment Institute to increase DRG homogeneity. In 2004, for example, coding of systemic cancer therapy was generally modified. In this study, these changes have been appropriately taken into account on algorithms defining clinical patient groups.

**Data sources**

We analysed clinical data from two large university departments of dermatology in Southern (Freiburg) and North-Western Germany (Münster) providing similarly both health services on a secondary and tertiary care level. Data were collected from in-patients regularly admitted during a time period of 4 years (2003–06) and retrieved from the patient data management system. The patient population of each hospital represents a random sample of hospital admissions in national departments of dermatology. The study comprises 18,318 patients’ data sets ascertained via the status of discharge.

Each data set consists of a patient data block (e.g. age, sex, date of admission, date and status discharge), and a clinical data block (e.g. coded diagnoses and procedures). Clinical data were coded by attending physicians in compliance with the current national coding standards. Accuracy of coding was ensured by daily checks of physicians specially qualified in coding procedures. Coding of principal and secondary diagnoses was based upon the revised German version of the International Statistical Classification of Diseases, 10th revision (ICD-10), namely ICD-10-SGB V (2.0), ICD-10-GM 2004, 2005 and 2006. Surgical and medical procedures were coded by default according to the national classification of surgeries and procedures (OPS-301), namely version 2.1, version 2004, 2005 and 2006.

The data sets were retrieved from each department via a standardized data format imported into a specially developed program checking completeness and plausibility. After processing and checking accuracy, data were regarded as providing high coding quality. These data have been grouped on a standard computer system using a G-DRG grouping engine (GEOS mbh, Nuremberg, Germany) performing the grouping algorithms that corresponds to the discharge year, namely G-DRG version 1.0, G-DRG version 2004, 2005 and 2006. In several cases, code mapping was required.

**Data analysis**

The resulting matrix of patient, clinical and G-DRG data were then analysed regarding cost weight tables and case-mix results and several other G-DRG-related parameters on a standard computer system. A single cost weight (relative weight), which will be annually recalculated on the basis of nationwide hospitals’ actual costs was assigned to each G-DRG by the grouping algorithm. The sum of all G-DRG cost weights within a time unit is described as the economic case-mix relevant for a hospital’s G-DRG revenue. However, in addition, the term case-mix may also be taken to refer to both the number and types of patients treated, and the mix of bundles of treatments, procedures and so on provided to patients.

Usually the average cost across all G-DRGs is chosen as the reference value, and given a weight of 1. Case-mix divided by the number of cases will indicate the average severity of a defined group of patients described as the case-mix index (CMI). In this study, cost weights were processed from the official national cost weight tables of the annual calculation rounds. The effective CMI was taken into account including additional per diem payments and discounts for outlier cases in terms of length of hospital stay.

We analysed care-related aspects regarding hospital admissions and their underlying diagnoses over time as well as evolutions in LOS, average age and number of cases treated in in-patient settings described above. To evaluate specific aspects of data in more detail, a previously developed clinical model was applied that clusters data into particular treatment groups based on principal diagnosis.

**Statistics**

Data were processed using Microsoft Access and Excel (Microsoft Inc., Seattle, WA, USA). Statistical analysis was conducted using SPSS, release 14.0 (SPSS Inc., San Diego, CA, USA). The Mann–Whitney U-test was used to compare differences between both annual time intervals (January 2003–December 2003 with January 2006–December 2006) and initial-end-point time intervals (January 2003–March 2003 with October 2006–December 2006). The alternative hypothesis has been accepted at a statistical significance level of \( P < 0.01 \).

**Results**

We analysed data focussing on economic impacts on the G-DRG system level in terms of case-mix index. Care-related aspects were analysed considering frequencies and shifts in dermatological in-patient admissions. Surgical and medical procedures of in-patient care and variables such as LOS in hospital, number of cases and average age have been investigated. The percentage changes over the years and the distribution of cases in total and by hospital are shown in figure 1. A more detailed analysis at hospital level is provided in figure 2. Results of statistical testing are displayed in table 1. Case-mix and CMI are dependent on the results of the nationwide calculation rounds considering present hospital costs. The present database shows that CMI values tend to increase from the beginning of the year 2003, but subsequently declining on the initial level, however, with inter-hospital differences (figures 1a and 2a).
High-volume groups (annual Top-10 DRGs) and their relative rates per year concerning number of cases and proportion of case-mix are presented in table 2. Medical treatment in dermatology is represented by DRG I66, J61, J64, J66, J67, J68, R61, X62, Z62 and Z64. In contrast, surgical treatments are predominately covered by DRG J08, J10, J11, J21 and J22.

Analysis of average age indicates a small increase over time ([average age; 2003: 52.3 years; 2004: 53.6 years; 2005: 54.6 years; 2006: 54.9 years](figures 1a and 2b)), however, with statistical significance ($P < 0.001$). Patients in Freiburg are 5.8 years on average older than in Münster.

Both the evolutions of LOS and the number of dermatological cases admitted to hospital were analysed over time (figures 1a, 2c and d). The LOS of a patient is calculated by subtracting the date the patient is admitted from the date of discharge. A ‘same-day patient’ is allocated a LOS of 1 day including an overnight stay. The number of cases per month was determined via the date of discharge. It is shown that average LOS has been continually reduced (hospitalization days; 2003: 8.4; 2004: 7.3; 2005: 6.8; 2006: 6.3). At the same time, the average number of admitted cases increased (average patients per month; 2003: $n = 366$; 2004: $n = 374$; 2005: $n = 397$; 2006: $n = 386$). Altogether, a significant reduction of LOS can be noted ($P < 0.001$) with an increase of dermatological admissions of about 5.9% indicating that in-patient activities have not been reduced (figures 1a, 2a and b). Non-parametric significance testing was not possible for absolute number of cases.

Figure 1 Trends of care-related variables. (a) Percentage change of variables in comparison of the years from 2003 to 2006; CMI: casemix index; LOS: (average) length of stay, (b) Distribution of cases on case groups from 2003 to 2006 in total and by hospital; MS: data from Münster; FR: data from Freiburg; Case group I: infectious and parasitic diseases and infections of the skin; Case group II: treatment of primary benign and malignant neoplasms and follow-up examinations without pathological findings; Case group III: treatment of secondary neoplasms; Case group IV: autoimmune diseases; Case group V: eczematous diseases and exanthematic dermatitis; Case group VI: papuloussquamous diseases; Case group VII: urticaria, erythematous diseases and radiation-related disorders; Case group VIII: venous and arterial vessel diseases; Case group IX: allergic treatments; Case group X: other diseases of the skin and subcutaneous tissue not previously listed; Case group XI: cases not representing primarily inpatient dermatology.
In Germany, real 'same day cases' in day clinic units are patients treated several hours a day within an in-patient setting without an overnight stay. These same day cases are being currently not reimbursed by DRG. Over time, a moderate increase of same day patients in day clinic units is observable (same day cases per month; 2003: \( n = 562 \); 2004: \( n = 661 \); 2005: \( n = 668 \); 2006: \( n = 638 \)) underscoring that in-patient treatments have not been reduced. Furthermore, over the years, proportions of in-patient same day cases remained relatively stable (DRG J68, table 2).

A further point of interest is the ratio of surgical versus medical treatments in an in-patient setting. According to the hierarchically organized grouping process for the G-DRG, the coding of a surgical procedure (operating room procedure) classifies for the surgical partition. Hence, lack of such a procedure classifies for the medical partition. If a special

![Figure 2](https://academic.oup.com/eurpub/article-abstract/18/1/85/442203/18/08/44203)

**Figure 2** Data plotted monthly from 2003 to 2006. (a) Casemix Index (CMI), (b) average age, (c) average length of stay (LOS) and (d) number of cases; MS: data from Münster; FR: data from Freiburg; Total: pooled data.

<table>
<thead>
<tr>
<th>Variables</th>
<th>( P )-value ( ^b ) 2003–2006</th>
<th>( P )-value ( ^c ) Annual intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMI</td>
<td>0.524</td>
<td>0.013</td>
</tr>
<tr>
<td>LOS</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Average age</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Number of cases</td>
<td>&lt;0.001</td>
<td>0.278</td>
</tr>
<tr>
<td>Surgical partition</td>
<td>0.041</td>
<td>0.032</td>
</tr>
<tr>
<td>Medical partition</td>
<td>0.052</td>
<td>0.043</td>
</tr>
<tr>
<td>Number of diagnoses</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Number of procedures</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>(I) Infections/Infectious diseases</td>
<td>0.010</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>(II) Primary neoplasms and follow-up</td>
<td>0.107</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>(III) Secondary neoplasms</td>
<td>0.016</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>(IV) Autoimmune diseases</td>
<td>0.691</td>
<td>0.030</td>
</tr>
<tr>
<td>(V) Dermatitis and eczema</td>
<td>0.013</td>
<td>0.001</td>
</tr>
<tr>
<td>(VI) Papulosquamous skin diseases</td>
<td>0.246</td>
<td>0.146</td>
</tr>
<tr>
<td>(VII) Urticaria and erythema</td>
<td>0.714</td>
<td>0.618</td>
</tr>
<tr>
<td>(VIII) Vascular diseases and ulcers</td>
<td>0.731</td>
<td>0.032</td>
</tr>
<tr>
<td>(IX) Allergic and intolerance reactions</td>
<td>0.319</td>
<td>0.949</td>
</tr>
<tr>
<td>(X) Other diseases of the skin</td>
<td>0.014</td>
<td>0.021</td>
</tr>
<tr>
<td>(XI) Other diseases</td>
<td>0.944</td>
<td>0.858</td>
</tr>
</tbody>
</table>

\( ^a \): Mann–Whitney U-test, two-tailed
\( ^b \): Comparison of 3-month periods (see Methods section); initial point period \( n = 1014 \), end point period 2006 \( n = 1180 \)
\( ^c \): Comparison of annual intervals 2003 \( n = 4399 \) and 2006 \( n = 4658 \)
The ratio of surgical versus medical case groups indicates the extent of surgical care in a dermatological in-patient setting. Data in figure 1a show that the proportion of surgical treatment is rather low (mean: 29.2%) with a decreasing trend over the first years, but a notable increase in 2006 (2003: 28.7%; 2004: 26.1%; 2006: 32.1%). Notably, non-operative treatments are dominant (mean: 70.7%) with a decreasing trend over the first years, but a notable increase in 2006 (2003: 70.6%; 2004: 67.9%; 2005: 67.8%). Together, the results indicate an initial decline of surgical in-patient activities and increasing medical treatments, however, no long-term changes due to DRG introduction are observable.

The number of coded diagnoses shows a trend to decrease (average number of coded diagnoses; 2003: n = 3.8; 2004: n = 3.8; 2005: n = 3.7; 2006: n = 3.3). In contrast, analysis of coded procedures shows a strong increase in the year 2006 (average number of procedures; 2003: n = 1.6; 2004: n = 1.9; 2005: n = 1.5; 2006: n = 2.8) because coding of (partially new established) procedures has become more important for DRG assignment.

The total volume of re-admitted patients per year shows no significant changes (number of patients re-admitted; 2003: n = 471; 2004: n = 461; 2005: n = 472; 2006: n = 493).

To obtain a more detailed view on care-related developments we utilized a clinical model system. The whole data were broken down into 11 case groups (figure 1b). Interestingly, the results show that the number of admitted patients with infectious diseases (I), vascular ulcer diseases (VIII) and secondary neoplasms declined with high statistical significance for group I. At the same time, a marked increase of skin malignancies without secondary neoplasms (II), eczematous diseases like atopic eczema (V) and papulosquamous diseases like psoriasis (VI) were documented with statistical significance for group II and V (P < 0.001, table 1). These findings argue that over the observed time period dermatological oncology and some of the conservative dermatological treatments became more and more important in an in-patient setting, whereas some other treatment standards of allergy-related disorders, wound care and infectious diseases appear to be placed in an out-patient setting.

### Discussion

Germany is one of the last countries to adopt a DRG-based per case payment for in-patient care. In contrast to many other countries, DRG is used for reimbursement of all in-patient services except for psychiatry and psychosomatic medicine. In the US, the clinical impact of the Medicare Prospective Payment System, which was based on DRG, is well examined. However, only few international comparisons and reports concerning the quality of care under DRG conditions in European countries are available at present. Despite a number of known limitations, such as the representativeness of the study populations or the unknown coding quality, it could be expected that increased hospital re-admissions and earlier discharges due to cost-cutting incentives may occur as a result of DRG. In the US, it was reported that some of these developments have reached in-patient dermatology as well. A marked decrease of dermatological in-patient activities was observed in academic programs, the number of institutions supplying in-patient dermatological services decreased and a reduction of LOS may have affected the dermatologists' ability to ensure complete resolution of skin lesions before discharge.

In our study using present in-patient data from two large departments of dermatology over 4 years, several of these DRG-related developments could be detected with a similar magnitude. As reported in the US, LOS was reduced. In contrast, however, at the same time hospital admissions were increased. Importantly, the results presented here indicate
that, in Germany, in-patient activities appear not to decline with the DRG introduction. Notably, no significant decrease of specialized dermatological in-patient services in Germany has been reported as yet.

In total, the results presented here should be interpreted with caution because of multiple interactions that may determine hospital admissions and the need of hospital bed days. It is likely that the case-related revenues associated with DRG reimbursement will enforce the incentives for splitting treatment periods and earlier discharges leading to higher re-admission rates. On the other hand, the observed changes, such as reduction of LOS, may have resulted from other factors, such as changes in health service providing. Over the last years, dermatological treatment patterns also changed regarding the appropriateness of admissions and of LOS. The moderate increase of average age may indicate that in-patient admissions focus increasingly on patients with a higher grade of complexity and co-morbidities. It was noted, e.g., that poorly proven therapeutic modalities have been more or less eliminated from in-patient settings. While on the other hand, new therapeutic modalities, for instance biologics and new immunosuppressant drugs, open up new vistas for medical therapy, and might be able to shorten hospitalization stays, prevent adverse events and increase re-admission rates, respectively. It can be assumed that the described trends in in-patient dermatology are subject to both the introduction of G-DRG and the evolutions and innovations of therapeutic modalities.

The observed modifications in CMI appear to be an arbitrary fact, but this trend is most likely due to modifications to the relative weights. There was a general trend of reducing dermatological group weights as of 2005. The inter-hospital differences in CMI can be carefully explained as follows: In 2004, a new head was appointed at the dermatological department in Freiburg. As a result, more considerations have been given to the requirements of DRG management (e.g., appropriate coding). Moreover, the relative higher CMI values in Freiburg may occur due to the higher average age in the patient sample leading to higher complication and complexity levels.

The initially observed decrease of surgical in-patient services may be a result of the legal transition framework attending the G-DRG introduction. Although surgery of malignancies of the skin, such as excision of melanoma or sentinel lymph node biopsy is a growing segment even for in-patient dermatology, several simple operative procedures or venous leg surgery have been legally shifted from the in-patient setting to an office-based surgery except for certain severe cases. However, several low extensive surgical procedures have been removed from these legal regulations in 2006. This might be a reason for the observed increase of surgical DRGs in 2006.

Germany has a health care system that is mainly characterized by socialized health insurances. In contrast, the health care financing system that has evolved over the past 30 years in the US involved a complex blend of public and private responsibilities. There is no doubt that Germany will bring about some of the experiences made in the US, in Australia or other European countries. But the relative homogeneity of the health care system should be a positive influence on the future developments.

It is not yet the time to provide assured empirical results about all the consequences of the G-DRG system. In this study, we observe an intermediate state of a long-term adaptation process for a specific group of health services. The presented results are not valid for German health care as a whole, but they are useful to point out that developments with the introduction of per case payment have to be observed individually for each care sector in the field of health services. It is of importance that not every consequence that can be internationally observed is completely transferable to the German health care system, but reduction of LOS appears to be a comprehensive characteristic for all health systems with DRG reimbursement. Further research approaches will be necessary and should increasingly focus on the interface between health economics, health services research and clinical research. There is a great need for persistent observations and considerations in which politicians, researchers, health economists and medical professionals should be equally involved. Lessons should be learned from other countries in a close global dialogue that should be sought in the near future.

Acknowledgements
Dr. Hensen and Dr. Müller received grant support from the German Society of Dermatology.

Conflicts of interest: None declared.

Key points
- The introduction of the G-DRG system in Germany induced changes in in-patient dermatology affecting hospital admission rates, LOS and cases treated in an in-patient setting.
- As reported in the other countries where per case payment has been introduced, the length of hospital stay was reduced, however, in contrast, at the same time in-patient admissions were increased in Germany.
- Initially, dermatological surgery procedures decreased and medical treatments increased in the in-patient setting but without significant long-term changes.
- In Germany, dermatological in-patient activities appear to change but not to decline with the DRG introduction.
- Changes that may occur with the introduction of per case payment have to be observed individually for each care sector in the field of health services.

References


16 Ljunggren B, Sjöden PO. Patient reported quality of care before vs. after the implementation of a diagnosis related groups (DRG) classification and payment system in one Swedish county. *Scand J Caring Sci* 2001;15:283–94.


Received 26 October 2006, accepted 18 May 2007