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Review

Hospital financing: Calculating inpatient capital costs in Germany with a comparative view on operating costs and the English costing scheme

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ABSTRACT

Objectives: The paper analyzes the German inpatient capital costing scheme by assessing its cost module calculation. The costing scheme represents the first separated national calculation of performance-oriented capital cost lump sums per DRG.

Methods: The three steps in the costing scheme are reviewed and assessed: (1) accrual of capital costs; (2) cost-center and cost category accounting; (3) data processing for capital cost modules. The assessment of each step is based on its level of transparency and efficiency. A comparative view on operating costing and the English costing scheme is given.

Results: Advantages of the scheme are low participation hurdles, low calculation effort for G-DRG calculation participants, highly differentiated cost-center/cost category separation, and advanced patient-based resource allocation. The exclusion of relevant capital costs, nontransparent resource allocation, and unclear capital cost modules, limit the managerial relevance and transparency of the capital costing scheme.

Conclusions: The scheme generates the technical premises for a change from dual financing by insurances (operating costs) and state (capital costs) to a single financing source. The new capital costing scheme will intensify the discussion on how to solve the current investment backlog in Germany and can assist regulators in other countries with the introduction of accurate capital costing.

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1. Introduction

German hospitals are funded by a dual financing scheme, regulated by a federal act in 1972 [1,2]. Operating costs are financed by statutory and private health insurance premiums. Capital costs are financed by the 16

German states and federal grants through tax revenues. There is a consensus that the actual level of financing of capital costs is falling below infrastructural needs [3] and leads to inefficient investment [4]. While the general economic rate of investment in Germany dropped from 23.6% to 19.0% from 1992 to 2008, the hospital rate of investment dropped from 10.0% to 4.6% [5]. In recent years, overall hospital capital cost reimbursement in Germany has been about €2.8 billion per year. However, experts calculated a target corridor of €4.7 billion to €5.7 billion, when compared with rates of investments in other service sectors [5]. Estimates of the investment backlog produced between €12 billion and €50 billion are dependent on the

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calculation and are discussed controversial because of the dire financial situation of many hospitals [6]. There are no exact, patient-based calculations confirming this hypothesis and quantifying actual capital costs. Hospital planning is still based on the Hill-Burton formula (bed-to-population ratios) [7] and several expert reports, combining hospital planning with the financing of hospital capital. Planning concerning the number of beds, specialties, and the hospital's care level is controlled by the state government and a consortium of stakeholders, such as the hospital associations, the health insurance associations, and the physicians associations [8]. To quantify actual patient-based capital costs, the legislative authority authorized the hospital and health insurance associations to reform the financing of inpatient capital costs with a new costing scheme widely introduced in 2013. Thus, the Institute for the Hospital Remuneration System (InEK) – also responsible for the advancement of operating cost calculation within the G-DRG system – developed a scheme to calculate capital cost lump sums for capital cost modules [9] to add a capital cost case weight to the operating cost case weight in the case-based lump sum G-DRG reimbursement catalog [9,10].

Although the case-based lump sums for capital costs have the potential to substitute the dual financing scheme for monistic financing, capital costs are intended to be reimbursed by the states through tax revenues in the near future [1]. The states can decide whether they use the new case-based lump sum mode, the old system, or a mixture of both. However, lump sums for cases are the first step to either monistic financing (operating and capital costs are financed by sickness funds) as in other European countries and/or more accurate financing based on actual resource use. Comparative research on DRG operating costing standards started in 2006 [11,12] and has been developed recently in Europe and the U.S. [13,14]. Capital costing, as a discrete costing scheme, is linked up with operating costing and has to follow this discussion. Although recent papers show that costing schemes for capital costs and operating costs should be separated [15], most countries use a single system for operating and capital costs, following the costing needs of operating costing, and are thus not accounting for the different prerequisites of a costing scheme that deals with capital costing data. Current systems are unable to differentiate capital costs from operating costs, limiting reasonable reimbursement and asset accounting. German inpatient costing is the first to explicitly introduce a detailed capital costing scheme besides the standard operating costing scheme. In contrast to the G-DRG system, which was based on the Australian Refined DRG system (AR-DRG), the system for calculating capital costs did not have a comparable international role model [16]. Recent publications have analyzed the G-DRG system comprehensively only in relation to operating costs in a general manner [3,17], focusing on the transparency and efficiency of operating costs [18]. Analyses of the cutting-edge G-DRG capital costing scheme – an innovation in calculating hospital capital costs separately and at patient level – are still missing. Capital expenditures account for about 8% of total hospital costs in Germany, England, and the U.S. [2,19,20], with high variance concerning state or trust. This 8% of total hospital costs is still a black box in

hospital accounting, as calculation methods are imprecise, are not comparable, have low managerial relevance, and in many countries are simply adapted from operating costing. Thus, the capital costing scheme might serve as a comparative standard for future capital costing schemes in other countries.

Its analysis, and especially its impact on efficiency and transparency is important as the scheme is the first of its kind worldwide and might serve as the reference case for other countries, just as the U.S. and Australian DRGs system served as a reference for the German grouping process. As capital costs were dealt with similar to operating costs, existing literature only refers to overall costing schemes of countries that include capital costs in the general costing process [13,21,22]. Literature recommends to introduce activity-based costing also for capital costs, just as established in this new costing scheme [13,23]. This is the first work that discusses the special requirements of a capital costing data in such a process. Thus, the aims of the paper were to give an executive summary on the German capital costing process and to assess the efficiency and transparency of its calculation steps to improve the system and give advice for adaptors. To understand requirements of the system a comparison to operating costing and the English costing scheme as a standard that combines operating and capital costing is elaborated. In the international setting, both the English (PLICS – Patient-level Information and Costing System) and the German operating costing system use a patient-level costing approach [21], with the difference being that English capital costing is part of the operating costing scheme. Thus, costing in the English health care resource group (HRG) system [24] is an ideal comparative partner for the G-DRG costing scheme [25]. A comparison to the established operating costing schemes is essential, as capital costs – so far excluded or calculated with operating costing methodology – require a separate calculation due to the special nature of capital costing data that is subject of depreciation and must therefore be allocated to cases over several years. By a comparison of operating costing and capital costing, similarities and differences can be elaborated that need to be taken into account by other counties when integrating elements of the scheme in their current system.

2. Conceptual framework and method

The paper reviews and assesses the three steps in capital cost resource allocation at hospital level: (1) the accrual of capital costs; (2) cost-center and cost category accounting; and (3) data processing for capital cost modules (Fig. 1). The three steps are assessed with reference to the two main goals of DRG introduction: improving efficiency and improving transparency [3]. While transparency is strongly related to accuracy in the costing context, efficiency is strongly related to the managerial relevance of the capital costing scheme [21]. However, there is no clear causality between transparency, accuracy, efficiency and managerial relevance. Both goals are interrelated: transparency and accuracy also affect managerial relevance, and managerial relevance usually improves accuracy; e.g., the exclusion of costs of land and building makes the calculation less

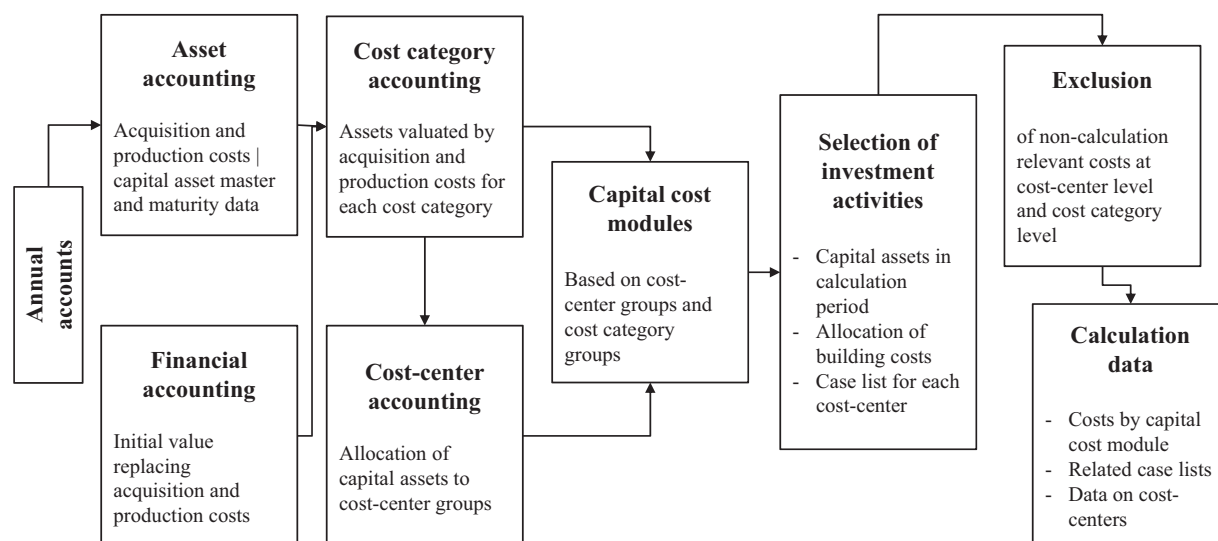


Fig. 1. Calculation steps in capital cost accounting, own illustration based on [15].

transparent for policy makers, but also less efficient for hospital management, as the requirements of a full cost approach are not achieved. Fig. 1 refers to the capital costing process evaluated: asset and financial accounting of the annual accounts of a hospital are used to generate capital costs modules that are based on capital assets spreading over several cost categories and cost-centers. Investment activities are allocated to capital cost modules and the cases that utilize respective capital cost modules.

The *first* aim of this study is to give an executive summary on the standardized inpatient capital costing approach and to assess its calculation steps at the hospital level by common systematics [3,18,21,26]. Concerning transparency, assessment criteria analyzed are e.g., the ability to improve participation rates and representativeness in the calculations [17], an accurate disclosure of basic costing measures such as cost categories, cost-centers, and cost units at different aggregation levels [23,27], and the use of accurate key cost drivers for transparent allocation of costs [23]. Concerning efficiency, assessment criteria are e.g., the ability to calculate case-based, the ability to support innovation and strategic planning, and the ability of the scheme to generate a full cost approach, to make the scheme relevant from both the physician and the management perspective [21]. *Second*, the study analyzes and discusses the relationship of G-DRG operating costing to capital costing based on the capital costing calculation steps. And *third*, the national perspective is expanded by a comparison of German and English capital costing in terms of costing methodologies and reimbursement to show differences and optimization potential. The comparison of the full cost approach in Germany and England already performed for operating costs [21] is now completed by the capital costing comparison. The English system is used as a comparative system because it has similar operating costing methodologies that are also used for capital costing as part of the English Payment by Results (PbR) costing

scheme. Further, the English system has experience in separate reimbursement based on DRG capital costing because of the private financing initiative (PFI). Criteria that the evaluative comparison is based on, are derived from standard costing literature [23,27] and have also evolved in the health care costing literature [11,17,21,28].

The capital costing scheme will support an accurate calculation of the investment backlog in hospitals, support fair reimbursement, and more care equity based on a standardized nationwide system relating to an actual, patient-based allocation of capital assets. The differentiation of operating and capital costs will give more insight into the cost structures of hospitals, with the ultimate goal of an exact full cost approach for the complete cycle of care of a medical condition, including operating and capital costs [29]. In the analysis, we concentrate on the hospital level [18], as the national calculation level (performed by InEK internally), including plausibility checks, inlier calculation, and the “one hospital” approach, is not yet documented in an official report for the first calculation in 2013.

3. The standardized inpatient capital costing approach

3.1. Accrual of capital costs

Based on a handbook for capital cost calculation, the InEK calculating scheme describes fundamentals and procedural methods to calculate capital cost weights [16]. It is based on asset accounting for capital assets or acquisition and production costs from financial accounting for expenses of utilized assets (Fig. 1). As capital assets are part of the care process, they are associated with resource use of cases in cost-centers. Capital costs are costs for new buildings, modifications, expansions and initial equipment, and acquisition and maintenance costs of capital assets related to inpatient care not explicitly excluded, such as land cost

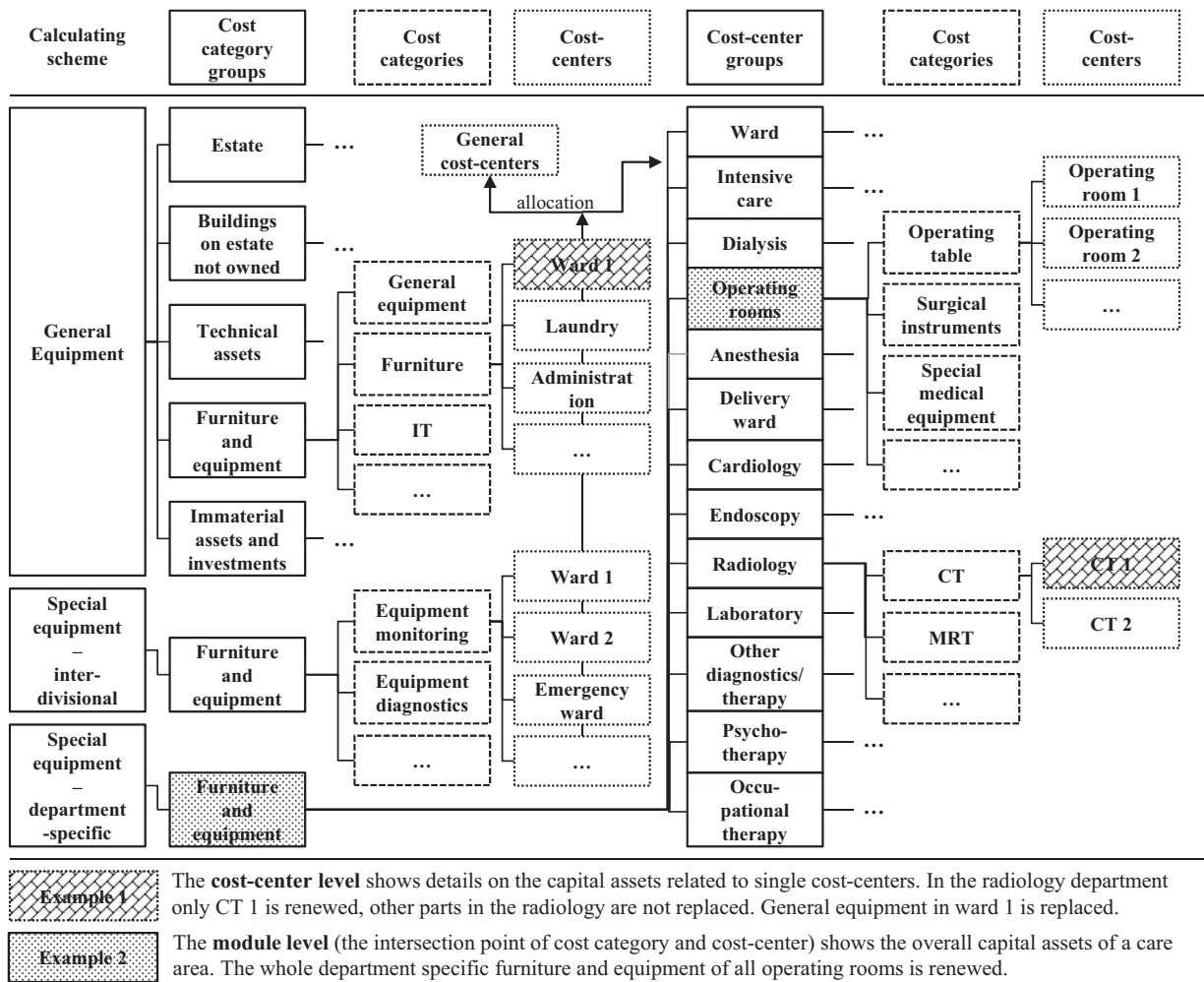


Fig. 2. The allocation of capital assets to capital cost modules, own illustration based on [15].

or capital assets with an average usage of up to 3 years [1]. Not all capital investments of a hospital are DRG-relevant (e.g., capital assets for outpatients), and are therefore reimbursed proportionately according to DRG-relevance. Costs for training and education are calculated separately. Capital costs not included are costs of assets in the phase of planning or construction, cost of land and its financing, liability of shareholders for uncalled capital, buildings on estate not owned, immaterial capital assets and investments, low-value assets, consumer goods, and telematics infrastructure. To be calculated, the capital asset has to be part of an explicitly defined capital cost module (Fig. 1). With respect to medical innovation, the scheme only considers capital assets with an acquisition date of not more than 7 years: the calculation is related to one data year, corresponding to the cases, equipment, and infrastructure of that year, but includes capital assets acquired during the data year and the 6 years before. Tax or book depreciation is not allowed. The calculation of investment-needs in each year is based on the service life of the asset.

3.2. Cost-center and cost category accounting

The structure of cost-centers and cost categories used in the accounting process follows the hospital financing act and the requirements of the fiscal authorities of asset accounting [30]. Cost-centers and cost categories with similar business activities and similar kind and function of capital assets are combined into cost-center groups and cost category groups. These cost category/cost-center combinations define a certain number of allowed capital cost modules to which the asset is allocated, determining a sound section of asset accounting that can be captured nearly completely by such a module (Fig. 1). Each area of the building and the equipment has its own cost-centers to allocate capital investments within the calculation. Cost-centers are separated into direct (patient contact) and indirect (no patient contact) cost-centers. The direct cost-centers are assigned to cost-center groups similar to G-DRG calculation (Fig. 2). Indirect cost-centers are assigned to a general cost-center, which is separated into functional

areas. Each capital asset is related to the cost-center where it is responsible for the care process. Capital assets with a comprehensive use in several cost-centers have to be allocated proportionally. Capital assets generating indirect costs should be allocated to direct cost-centers by compensation keys. In case an allocation is not applicable, general cost-centers such as a building cost-center are used for indirect costs that cannot be allocated to principal utilizers by a compensation key such as surface area (Fig. 2). Cost category groups add capital assets that are similar in kind and function, have a comparable service life, and are used for special care procedures or have a relation to patients according to a common criterion. The same capital costing scheme is used for psychiatric and general G-DRG areas, as cost-center groups from the operating cost G-DRG matrix [18] are extended by cost-center groups for psychiatric services (Fig. 2) [31].

Finally, case-based procedure documentation relates the services of cost-centers with capital assets and can therefore allocate patient-related costs to assets. A list of all capital assets has to include the following master and maturity data: cost-center group, cost-center, cost category group, cost category, year of purchase, inventory number, description, average usage, useful economic life, and acquisition and production costs. Capital cost lump sums for DRGs are calculated on the basis of case-based usage of equipment (service/activity statistics of capital cost modules).

3.3. Data processing for capital cost modules

In principle, the calculation offers two points of view (see examples 1 and 2 in Fig. 2). While the module level, as the intersection point of cost category and cost-center, shows the overall capital assets of a care area (e.g., operating room), the cost-center level can show details of the equipment related to single cost-centers (e.g., new MRT). The module level is used when the sum of acquired capital assets in the calculation period reaches 90% of the overall value of the capital assets of all cost-centers that a cost module represents (Fig. 2). In case more than 10% of all the costs of a cost module cannot be allocated to direct cost-centers, the cost-center level has to be used instead of the module level.

4. Relationship of operating and capital costing in Germany

Resource allocation for capital costing has some similarities but also essential differences in the calculation process compared with operating costing [18]. Hospital operating costs can be calculated at different aggregation levels, such as hospital/department/DRG group/DRG/case, to allow a comparison of the refinanced costs in each cost category/cost-center segment. Capital costs can also be calculated at different aggregation levels: for each DRG on a patient basis or for each general investment; whether capital cost module based for comprehensive investments in whole care areas or cost-center based for single investments. Both schemes propose a full cost approach. Performing also capital costing at a patient basis, implies

the ability to calculate also at hospital/department/DRG group/or DRG level as the patient is the cost unit that can be allocated to a DRG, DRG group, a cost-center, or a department that he passes. For both the capital costing and the operating costing scheme, hospitals use a separate system besides the legally necessary standard accounting system of a hospital that is able to perform cost-center and cost category accounting on the basis of mandatory costing guidance [18,30]. While operating costs are allocated to cases during the calculation year, capital costs have to be allocated to cases that use an investment during its depreciation period. This fundamental difference requires separate accounting rules for operating and capital costs that can either be dealt within a single comprehensive accounting system or two schemes that separate operating and capital costs. As Germany included only operating costs in its activity-based costing scheme at the patient level, a separate system was established that best accounts for the nature of capital costs. While operating costs are directly allocated to cost categories and cost-centers, capital costs are allocated to general equipment, special equipment used interdivisional, and special equipment used only in one division. This declaration is necessary as allocation processes vary between the three categories (Fig. 2).

Both schemes claim an exclusion of costs at the highest possible level of aggregation to reach a full cost approach. For capital costs, this aim is reached by the possibility of calculation at the module level or the cost-center level. Table 1 gives a comparison of the costing modalities and steps in operating and capital costing: Both schemes use a full cost approach and case based data. Cost-center groups are similar, but capital costing includes the additional cost-centers for psychiatric services, so that the scheme can also be used in addition to the separate costing scheme for psychiatric services (Table 1). While the G-DRG scheme uses a detailed and similar cost matrix for every case, capital costing differentiates between the cost-center level and the cost-module level (Table 1).

In contrast to G-DRG calculation, the link between case-based services and capital costs is then not done by the hospital itself, but by the InEK. While the operating costing scheme results in a uniform cost-matrix for every calculated case, the capital costing scheme generates capital cost modules of investment areas that have to be allocated to cases by the InEK internally. Therefore, the InEK relies on the costing information that relates each case to the involved cost-centers and the case-based procedure codes. For hospitals participating in case-based G-DRG calculation, this information is already available. Hospitals that do not participate in G-DRG operating cost calculation have to provide case-based service data that are cost-center based.

5. Comparison of English and German capital costing

While the German G-DRG costing system is a pure operating costing scheme because of the historical separation of operating cost reimbursement and capital cost reimbursement, the English P&R scheme combined operating and capital costing from the beginning due to monistic financing. English hospitals that are not part of a Private Financing

Table 1
Comparison of costing modalities and steps in operating and capital costing.

Comparison of costing modalities and calculation steps	G-DRG operating costing scheme	Capital costing scheme
Full cost approach, actual costs	Yes	Yes
Case-based data	Yes	Yes, partially
Necessity of separate systems besides the productive accounting system	Yes	Yes
Inclusion of psychiatric services	Separate scheme for psychiatric services	Set of cost-centers for use with both psychiatric and G-DRG services
Cost frame	Calendar year, financial accounting	7 years, mixture of financial accounting and asset accounting
Cost-center groups	Ward, intensive care, dialysis, operating rooms, anesthesia, delivery ward, cardiology, endoscopy, radiology, other diagnostics/therapy	Ward, intensive care, dialysis, operating rooms, anesthesia, delivery ward, cardiology, endoscopy, radiology, other diagnostics/therapy, psychotherapy, occupational therapy
Non-DRG-relevant costs	Cost centers: ambulatory care, research and teaching, psychiatric care, extraordinary expenses, and expenses not relating to the calculation period Cost categories: accruals, most amortizations, private physician liquidation, capital costs, tax, insurance, interest, etc.	Capital assets for outpatients, research and teaching, assets in the phase of planning and construction, cost of land and its financing, liability of shareholders for uncalled capital, buildings on estate not owned, immaterial capital assets and investments, low-value assets, consumer goods, and telematics infrastructure
Common set of cost-centers and cost categories	Yes, exactly defined cost-matrix for every case with a defined number of cost modules	Yes, allowable cost-center/cost category combinations generate cost modules. Their composition can differ for every case
Merger of cost-centers and cost categories to cost-center/category groups	Yes	Yes
Internal allocation methods for costs on indirect cost centers	Allocation based on key cost drivers necessary, cost drivers follow the method of causation	Allocation based on key cost drivers possible, costs on general cost-centers are not allocated on a patient basis by the hospital, but by the InEK at a later stage
Elimination of non-DRG-relevant costs	According to cost-center-specific, DRG-relevant resource utilization, for indirect and direct cost-centers; costs on direct cost centers are eliminated after the allocation process from indirect to direct	Direct elimination of non-DRG-relevant capital assets; in case of partial DRG-relevance elimination is based on DRG resource utilization
Allocation of operating costs and capital assets	Operating costs are allocated to cost-centers they accrue to	Costs of assets are allocated to the cost-center where the asset is used; mobile capital assets are allocated based on the location of demand proportionally.
Cost category groups	Labor cost-, material cost-, and infrastructure cost-categories	Infrastructure area: estates and buildings, buildings on estate not owned, technical equipment, facilities, immaterial assets and investments, etc.
Link between case-based services and operating/capital costs	By the hospital using key cost drivers	By the InEK using key cost drivers and operation and procedure codes
Case-based costing information	All key cost drivers in the cost-matrix; additional info for case-based plausibility checks, e.g., surgery, anesthesia, and setup time in operating rooms	Master and maturity data for capital assets: cost-center group, cost-center, cost category group, cost category, year of purchase, inventory number, description, average usage, useful economic life, and acquisition and production costs; additionally a corresponding, cost-center-based case list (procedure documentation, etc.)
Value of costs	Operating costs are based on actual values	Capital costs are based on the value of the activated capital assets at the time of calculation, evaluated by its acquisition and production costs or the initial value of financial accounting
Points of view	Detailed cost-matrix for cases, DRGs, departments and the overall hospital	The module level for overall capital assets of a care area and the cost-center level for equipment related to single cost-centers; a patient-based view can be optionally conducted by the hospital

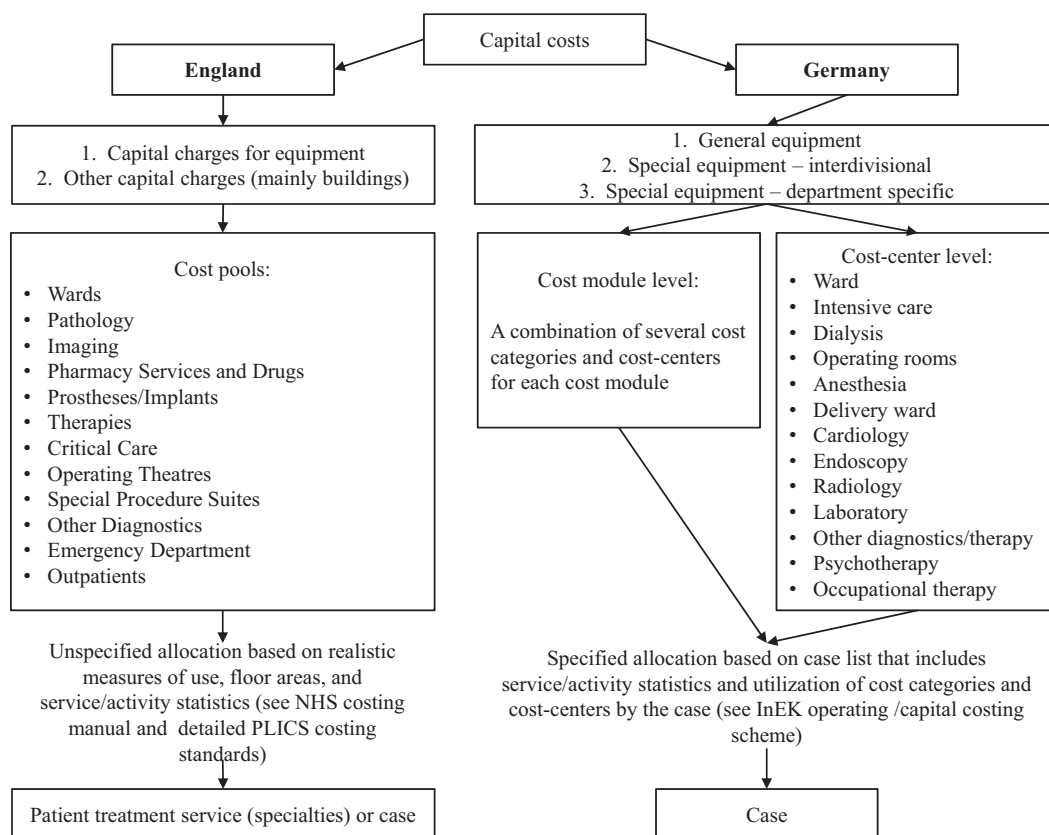


Fig. 3. Comparison of the English and the German capital costing scheme.

Initiative (PFI) are paid for operating costs and capital costs by the NHS based on one PbR tariff. They are responsible for depreciation on capital assets and the dividend on public dividend capital, their “rent” to the NHS for the hospital building and infrastructure. These two elements of capital costs are reimbursed by the PbR tariff besides operating costs. PFI hospitals pay to the PFI provider instead [19,32], but are reimbursed in the same way by the PbR tariff. Capital costs are part of the PbR tariff and therefore part of the reference costs [33,34]. Capital charges are dependent on market force factors (MFF) to link charges regionally with reimbursement of capital costs [35]. While cost calculation in the G-DRG system for medical and nonmedical infrastructure captures operating costs only, indirect costs in the PbR scheme also include the capital costs of equipment and buildings [36]. In the PbR costing manual, a rough allocation of capital costs as overhead costs is described (Fig. 3) [37]. As the calculation of capital costs uses the scheme that is mainly developed for operating costing, the costing process for capital costs cannot be as accurate as with a separate capital costing scheme. So far, both schemes have similar reduction in variance based on DRG costing at a high level. The PbR scheme is closer to a full cost approach both in the PFI and non-PFI case, as it excludes no complete cost categories, but only special services explicitly [37]. A comparison of the separated German capital costing scheme and the integrated part of English capital costing in operating costs reveals further differences and similarities (Fig. 3).

While the English patient-based system allocates operating and capital costs to cost pools, the German scheme uses the cost-center allocation of operating costing and includes a cost module level that combines related cost categories and cost-centers based on the nature of capital costs (overall capital assets of a care area, e.g., operating rooms, see Fig. 2) [21]. The English scheme allocates costs to patient treatment services/specialties and finally cases via service/activity statistics in an unspecified way similar to operating costing [21,36,37]. Graded calculation methods that are based on the accuracy of key cost drivers are used. The German capital costing scheme uses a highly specified way based on a case list that includes service/activity statistics and utilization of cost categories and cost-centers by the case [16,21].

6. Assessing the German capital costing scheme

6.1. Accrual of capital costs

The capital costing scheme excludes many possibly relevant capital costs, e.g., land costs or assets with an average usage of up to 3 years. However, some capital assets might be within the 3-year limit. Land costs are excluded because the development of new hospitals is seen as an exemption in the system. This contributes to an investment-averse policy. In case the system should be used for monistic financing or replace the current “calculation” of capital

costs, a full cost accounting is necessary also for capital costing, to close the investment backlog and reimburse all actual capital costs. Technical differences in the calculation method of operating and capital costing make a separate calculation necessary: the time horizon of operating costs (1 year) and capital costs (several years to account for the service life) is an essential difference that has not been recognized in former accounting systems. However, there are many assets that have longer or shorter depreciation than the fixed 7 years in the German system, causing temporary funding gaps. It is not yet clear how exactly the asset costs are distributed to the cases in the calculation year. In case the hospital changes its patient structure from high to low capital cost cases, the hospital might suffer from an investment backlog, as it is reimbursed only for low capital cost cases. Hospitals that contribute greatly to the calculation of a special module might start thinking in 7-year blocks and capital cost modules to optimize reimbursement of capital assets, independent of current necessity. Compared with alternative depreciation methods, it is a simple method with high compliance. But linear or declining balance depreciation could possibly be more asset-specific for medical innovation.

Thus, the new capital costing scheme clearly supports transparency of capital asset allocation as it is more accurate than hospital planning based on bed-to-population ratios, but the accrual of capital costs, including the exclusion of large areas of capital assets such as land costs, limits transparency and the managerial relevance (efficiency) of the scheme for new investments and a managerially relevant full cost approach (Table 2). The depreciation of assets and its time horizon is unclear and thus limits managerial relevance and transparency. Efficiency is further limited by the discussed investment backlog and clustering investments to 7 year blocks. Most limitations of this calculation step can be remedied by a more comprehensive costing approach and the use of actual amortization rates of capital assets.

6.2. Cost-center and cost category accounting

The standardized master and maturity data in asset accounting and the standardized consolidation of cost-centers and cost categories to groups provide a basis for a unique, comparative capital costing scheme. But hospitals might concentrate on cost-modules related to their own future strategic investments. Non attributable costs are allocated to general cost-centers, limiting transparency but simplifying the scheme. As the calculation offers two ways of capturing capital expenditures (cost-center and cost module level), the scheme differentiates between single investments and investments into a whole care area. Before an investment in a whole cost module is accepted, an examination concerning the 90% fraction of the calculation-relevant costs in the cost module is necessary. But defining 100% of production and investment costs of a cost-module can be subject to interpretation. An initial definition of standard capital assets and a reimbursement of missing assets for each cost module, to reduce the investment backlog until the scheme is well established, would generate equivalence in starting conditions. Although the InEK has

introduced a large number of allowed cost-center and cost category combinations to create a large set of capital cost modules in order to cover the different sets of patients and their respective capital expenditure, the scheme does not directly create a manageable capital cost calculation for each DRG that can be added to G-DRG operating cost reimbursement (Fig. 2). Instead, a large number of single capital cost modules are generated. This has the advantage that less calculation has to be performed by the hospital, as patient relation is conducted by the InEK.

Non-case-based calculations of the hospital limit the managerial relevance (efficiency) of the scheme for the hospital management and compliance with the InEK-internal, nontransparent case-based allocation, as exact key cost drivers for case-based allocation are not yet published: the allocation is “somehow” based on year of purchase, the average usage of the asset, case-based operations and procedures data (OPS), and the cost-center/cost category information. Thus, transparency and efficiency are limited. Further transparency limitations appear by the large number of capital cost modules that lower comprehension of the scheme, further efficiency limitations appear by a concentration on cost modules that relate to future strategic investments. Most limitations of this calculation step can be solved by an additional DRG-based calculation of operating costs directly by the hospital, appropriate to operating costing.

6.3. Data processing for capital cost modules

For hospitals already participating in the G-DRG operating cost calculation, additional administrative expenditures for calculation activities after initial setup of the system are low: cost-center-related case data are already provided for G-DRG calculation and the matching of case data and capital costs is performed in a standardized way by the InEK. This ensures high comparability, a high participation rate, and is fail-safe. Besides its managerial relevance, there is a monetary incentive for participation. Based on the quality and amount of capital cost modules provided, hospitals receive compensation for calculation activities. For hospitals already participating in G-DRG calculation, this compensation might be suitable. For non-G-DRG calculation participants, the fee is too low to compensate for the effort. During the first years of capital costing introduction, financing solely based on the calculation scheme is critical, as each hospital and even each comparable department or cost module does not have the same level of capital assets available. Comparable new and old hospitals (e.g., in the cost module operating room) would receive the same reimbursement if they treat similar patients, meaning that a new hospital can maintain high standards, while an old hospital cannot close its funding gap. Advantages of hospitals with large capital assets are the consequence [19,33], if the individual capital assets of a hospital are not considered in reimbursement. Hospitals with assets that do not have to be replaced yet might invest irrespective of the actual value or technical state of their assets, as they are reimbursed based on treated cases. Depreciation can become the primary reason for investment. And if not bound to special cost modules or cost-centers, new hospitals might

Table 2
Assessing the G-DRG capital costing scheme.

Steps in capital cost resource allocation	Goals of G-DRG introduction	
	Improving efficiency	Improving transparency
(1) Accrual of capital costs Author's recommendations*	Medium standard, improvements possible - Complete, DRG-relevant capital cost inclusion - Adapt 7-year limit to actual loss in value of capital assets (depreciation)	Medium standard, improvements possible
(2) Cost-center and cost category accounting Author's recommendations*	Medium standard, improvements possible - Simplified illustration of capital cost modules to enable easier comparison - Definition of standard assets for each cost module to reduce investment backlog - Publication of standardized module costs besides capital case weights - Additional DRG-based calculation for capital costs by the hospital itself	Medium standard, improvements possible
(3) Data processing for capital cost modules Author's recommendations*	Low standard, improvements necessary - Publication of InEK- internal calculation modalities Higher monetary participation incentives for non G-DRG participants - A simplified model for non G-DRG operating cost calculation participants - An infrastructure fund and additional cost module-based reimbursement	Low standard, improvements necessary

* Based on experience from operating costing and common cost accounting standards.

not invest the capital reimbursement, but generate high yields.

As reimbursement is highly dependent on the investment of other hospitals with similar cases in the same period, reimbursement is insecure and limits local costly innovation. Performance-oriented capital cost lump sum reimbursement can help to reduce overcapacity, but will also challenge hospitals in economically underdeveloped areas with few specialization abilities and low capacity utilization. An infrastructure fund that partially reallocates reimbursement can be a solution, if an area-wide complete health care supply is intended by health policy [6]. A complete time-driven activity-based costing with time as the only key cost driver [13,23], which is already partially used in G-DRG and PbR operating costing, contributes to an efficient and accurate capital costing.

Efficiency is limited by a large share of certain DRGs of a hospital in the nationwide calculation, causing a participation bias. Efficiency is further limited due to a non-equal level of capital assets that causes a funding gap for initially less equipped and older hospitals and a higher than necessary reimbursement for well equipped or new hospitals. The dependency of the financing of own investments on the average investments of other hospitals lowers efficiency, as structurally different hospitals can differ in the financing of innovation and strategic investment. The interface to the national capital costing process by the InEK and InEK internal case based calculation is not transparent. Most limitations of this calculation step can be remedied by the introduction of an infrastructure fund that is regionalized, and by a graded calculation based on the accuracy of key cost drivers with higher monetary incentives. [Table 2](#)

summarizes the assessment of the capital costing scheme in the three calculation steps and gives recommendations how to improve the scheme.

7. Optimization potential derived from the English-German comparison

The combination of operating and capital costing in the English scheme has advantages and limitations. Advantages are the use of a single system with the same aims and the same reimbursement source. Limitations are the inaccuracy of the capital costing scheme, as the system is in generally adjusted to calculate operating costs, which determine over 90% of overall costs. Thus, concerning accuracy and managerial relevance, implementation of a capital cost module calculation is conceivable in many countries to improve future capital cost reimbursement: in Germany, to support an exact reimbursement based on the actual case-mix of the hospital; in England, to support capital cost calculation in the tariff, to generate the basis for an exact dividend on public dividend capital, or to calculate the rent to the PFI provider. To enable policy makers to compare the English and the German capital costing scheme to improve their systems based on relative advantages of other systems in each calculation step, the efficiency and transparency aims are analyzed stepwise ([Table 3](#)): while the PbR scheme uses a real full cost approach, the German scheme has less managerial relevance as it excludes cost of land and buildings. Concerning cost-center, cost category, and cost pool allocation, the German scheme distributes in more detail ([Figs. 2 and 3](#)). Allocation of costs to cases is performed

Table 3

Comparison of the English and the German capital costing scheme on transparency and efficiency.

Steps in capital cost resource allocation	Goals of G-DRG introduction			
	Improving efficiency		Improving transparency	
	England	Germany	England	Germany
(1) Accrual of capital costs	High managerial relevance because of full-cost approach	Less managerial relevance as cost of land, buildings, etc. are excluded	Is not given as a separate listing of capital costs is not mandatory	Is given for all included capital costs, as they are listed separately
(2) Cost-center/cost category/cost pool accounting	Is limited to the cost pools (Fig. 3) and follows operating costing; managerial relevance is limited	Has a structure adapted to capital costing and separates between the cost-center and the cost module level to reach high managerial relevance	Is given in low detail for the cost pool level (see Fig. 3)	Is given in high detail for the cost-center level and the cost module level (Fig. 2)
(3) Data processing for capital cost modules/cost pools	As allocation methods are specified only roughly, managerial relevance depends on the chosen accuracy of allocation	Managerial relevance is given due to cost unit accounting but is limited because of unclear depreciation handling	Is given only partially as the allocation methods are specified only roughly	Is given in high detail concerning the allocation of costs to cases but not concerning the depreciation and thus the distribution of investments over several years

with more structure in the German scheme, resulting in higher managerial relevance and transparency. More detailed capital cost manuals ensure an exact calculation and also foster useful medical innovation, as exact costs are the focus of public interest by national capital cost module calculation. The distribution of investments over several years and their depreciation is included only in the German scheme, improving its managerial relevance. But transparency is as low as in the PbR scheme because the handling of depreciation is not specified. To allow for higher participation rates, graded calculation methods that are based on the accuracy of key cost drivers, as in the English PbR system [32], or a service/activity data modeling approach for hospitals not participating in G-DRG operating costing might support representativeness without downgrading the current accounting standards or making participation in the calculation mandatory.

The investment backlog – present in England and Germany – was intended to be solved by the PFI in England. Not the NHS but private investors are used to acquire the capital assets to build and run a hospital. As the new calculation scheme in Germany also does not intend to tamp the investment backlog, private funding for financing capital costs of public health care becomes more and more important in Germany. However, it has been shown in England that PFI is only a short-term alleviation of hospital capital costs [38,39]. In the long run, capital costs increase and will have to be reimbursed by higher base-rates for cases in order to pay the PFI or private funding interest rates. The current development of the capital costing scheme should therefore avoid the errors made in English PFI, which force hospitals into too much private investment [40]. And because of the dire financial situation of many German hospitals, the costs of acquiring capital loans can be prohibitive.

8. Conclusions

The new G-DRG capital costing scheme was introduced to allow investment incentives based on performance-oriented capital cost lump sums. The scheme generates a continuously improved data basis for the development of standardized national calculation of capital cost weights [9]. In each calculation step, it has limitations concerning efficiency and transparency that can be minimized by lessons learned from operating costing and the use of common cost accounting standards. The capital costing scheme has the potential to become a de facto standard for calculating capital costs. It is about to complement the proposed full cost approach for reimbursement and management. Standardized capital costing in the G-DRG system can lead to more efficient capital asset utilization, more transparent and efficient cost- and activity control, and might support a slow diminution in the investment backlog. The capital costing scheme allows monistic or dual financing based on actual capital costs on a DRG or capital cost module basis. The new scheme will intensify the discussion on how to solve the current investment backlog in German hospitals and can assist regulators in other countries with the introduction of an accurate capital costing scheme. However, the synchronization of investments with this standardized approach might lead to similar strategic decisions of hospitals and can thus foster a hog cycle in investment decisions. With its cost-center and cost module calculation, it is a costing solution that can accompany fundraising activities or other equity financing for capital assets with accurate costing information. It is an accurate management instrument for specialization of hospitals, for technology dispersal, and the appropriate use of technology [15], as cost modules calculate investment costs of specific technology improvement and support their specific reimbursement in a standardized scheme.

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