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Editors

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Monika Raulinajtys-Grzybek, Gertruda Krystyna Świderska**

PAYMENT BY RESULTS VS. COSTS OF 24-HOUR STANDBY IN HOSPITALS: EVIDENCE FROM POLAND

The purpose of the article was to identify the costs associated with hospital's standby and to define methodology of calculating and reporting these costs. Standby costs were defined as the costs of the provision of 24-hour access to health care in hospitals. Reimbursing standby costs on the basis of their costs would complement the Payment by Results model. The costing model for calculation of standby costs has been designed and subjected to empirical verification. The constructive approach method was used for this purpose and the verification process took place in 11 hospitals in the area of obstetrics. The obtained results demonstrate the practical applicability of the designed methodology.

Keywords: cost-based pricing, healthcare, costing model, standby costs, Payment by Results

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1. INTRODUCTION

Technological, demographic and other factors cause continuous increase in healthcare expenditure and place emphasis on the reduction of the cost of providing health care services (Walshe, Smith, 2006; Jones, Mellett, 2007). In order to achieve the actual cost reduction it is necessary to obtain information about the unused potential of hospitals. The use of hospital's resources is economically reflected in its level of costs. The costs may be incurred due to the consumption of resources during the provision of health care services as well as due to the fact that the hospital has continuous access to some resources, regardless of the degree of their current usage. Revenue opportunities depend largely on the ability of linking resources with the services provided and the economic efficiency of their allocation and use (Świderska, 2011). However, to some extent the potential of the hospital suits the emergency health needs of the population.

Acute hospital care means treatment of emergency and elective medical conditions resulting from accidents, injuries or diseases (Hirshon et al., 2013). Hospital serves a specific population, the size of which depends on

* Warsaw School of Economics

the hospital's type. Most patients are referred by primary care practitioners, but some are admitted from the emergency room. The second case may require immediate provision of necessary treatment (e.g. surgery), diagnosis (e.g. X-ray or CT scan) and hospitalization (e.g. in the intensive care unit) (Benson, 2006). Similar needs may suddenly be reported by inpatients, due to the deterioration of their medical condition.

Inpatient care in most countries has the highest or a very significant share of total spending on health care (WHO). One way of solving this problem was the introduction of the pricing of health services based on the volume of their provision and standardization the pricing units within the system of diagnosis-related groups (DRGs) (Fetter et al., 1976, 1977).

The concept of DRGs allowed to control the cost of health care services and created an incentive to optimize the treatment process (Leister, Stausberg, 2005; Evers et al., 2002). Implementation of the payment related to services provided was one of the aspects of the introduction of market-style incentives in health care (Dixon, 2006; Appleby et al., 2012). The result of these changes, among others, was the increase in the number of elective services, shorter hospital stay and reduction in number of inpatient beds in almost all OECD countries (OECD, 2013).

The emphasis on improving hospital efficiency and reducing costs, however, may have side effects. The hospital will seek to eradicate those areas that do not generate revenues and simultaneously incur high costs. This problem is most relevant in case of for-profit hospital but will also occur in case of public and non-profit hospitals if they are required to balance costs and revenues.

Revenue in the DRGs system appears only when the services are provided. Therefore all areas in which the hospital maintains resources to cover any potential needs of patients are areas that generate losses. These include, for example, 24-hour readiness of the operating theatre, readiness at the intensive care unit, spare inpatient beds in the surgical or orthopaedic ward as well as the uninterrupted readiness of selected diagnostic departments (Freeman, 2007; McConnell, 2007).

Excluding these areas in pricing system of health services results in the omission of the significant aspect of the hospital's activity – the 24-hour access to certain health services to meet urgent needs of the population. No reimbursement for such activities may result in the providers' pursuit to limit them, which has a negative impact on the quality and availability of health care.

In Poland, revenue for readiness is paid in emergency departments (Ordinance, 2011; Decree, 2013). Other areas, such as intensive care unit, traumatology centres or specialist surgical departments are paid per results achieved. It is pointed out that the lack of recognition of this issue is one of the reasons for maintaining the unused potential of the hospitals where such units are operating (Stylo, 2014).

The purpose of this article is to identify the costs associated with the provision of 24-hour access to health care in hospitals and to define methodology of calculating and reporting these costs, which would complement the Payment by Results model.

2. STANDBY COSTS AND PAYMENT BY RESULTS – INTERNATIONAL REVIEW

Payment systems for services provided based on the concept of DRGs began to appear in the 1980s. The first solutions were implemented in the United States, Australia, France and England (Wennberg et al., 1984; Crawford, Fottler, 1985; Busse, 2011). This concept quickly gained popularity and now forms the basis of the reimbursement systems in most countries of the European Union, the United States and Australia.

Settlements based on the DRGs are usually the main, but not the only, way of reimbursing hospitals. Total hospital's revenue can be described using the following formula:

$$R_i = R_{DRG\,i} + R_{\sim DRG\,i} \tag{1}$$

where:

R_i – total revenue of the ith hospital,

R_{DRGi} – revenue of the ith hospital allocated on the basis of DRGs provided,

$R_{\sim DRGi}$ – revenue of the ith hospital allocated aside the DRG system.

Hospital's revenue may be settled based on the DRGs provided which corresponds to the Payment by Results approach. In addition, some services can be settled outside the DRG system, e.g. according to global budgets or fee-for-service. Solutions vary among countries. Table 1 shows a summary of the type and coverage of DRG-based payments. The analysis covered those European countries that took part in one of two projects that compared costing and pricing regulations – HealthBasket or EuroDRG. Additionally, the US solutions implemented in Medicare program as well as Australian solutions were included into the review.

Table 1

Type and coverage of DRG-based payments

Country	% of hospital revenues related to DRGs	DRG-based hospital payment model	Range of Payment by Results according to DRG
Australia	nearly 100%	DRG-based case payments	acute inpatient and outpatient care
Austria	96%	DRG-based budget allocation	
Denmark	> 20%, varies	DRG-based case payments (within global budget)	inpatient and outpatient care
England	60%	DRG-based case payments	acute inpatient and outpatient care
Estonia	39%	DRG-based case payments	inpatient and surgical outpatient care
Finland	varies	DRG-based case payments (within global budget)	most hospital districts: inpatient and day care; remaining districts: also surgical outpatient care
France	80%	DRG-based case payments	acute inpatient and outpatient care
Germany	80%	DRG-based case payments (within global budget)	acute inpatient care
Hungary	n/a	DRG-based case payments (within global budget)	acute inpatient care
Ireland	80%	DRG-based budget allocation	
Italy	n/a	DRG-based case payments	inpatient care
Netherlands	84%	DRG-based case payments (within global budget)	inpatient and outpatient care
Poland	> 60%	DRG-based case payments	inpatient and outpatient care
Portugal	80%	DRG-based case payments and DRG-based budget allocation	inpatient and surgical outpatient care
Spain (Catalonia)	20%	DRG-based budget allocation	
Sweden	varies	DRG-based case payments (within global budget)	inpatient, day- and outpatient care
United States (Medicare)	n/a	DRG-based case payments	inpatient and outpatient care

Source: Busse, 2011; Department of Health and Ageing, 2011; Bundesministerium für Gesundheit, Familie und Jugend, 2013; Bilde, Ankjær-Jensen, 2005; O'Reilly et al., 2012; InEk, 2007; Gaál, 2005; Fattore, Torbica, 2005; Oostenbrink, Rutten, 2005; Sveriges Kommuner och Landsting, 2009; CMS, 2010

2.1. Payment by Results

Revenues allocated based on the amount and type of services grouped in DRGs represent approximately 80 per cent of all revenues, although it is worth noting that there are differences between countries (Geissler et al., 2011). In some countries, the level of hospital's activities is further limited, which is intended to prevent excessive increases in the number of services. The payment model used in Austria, Ireland and Spanish Catalonia differs from the typical Payment by Results approach, as DRGs are used for determining the prospective hospital budget but do not directly affect the level of revenues. In most countries, a functioning system of reimbursement assumes that the revenue depends on the services provided. The method of determining the DRG-based revenue is described by the following formula:

$$R_{DRG\ i} = \beta_i \sum_{j=1}^{n} \sum_{k=1}^{m} \alpha_{kj} DRG_j \tag{2}$$

where:

$R_{DRG\ i}$ – revenue of the i[th] hospital allocated on the basis of DRGs provided,

β_i – hospital-specific factor of the i[th] hospital,

α_{kj} – patient-specific factor for the k[th] service from the j[th] DRG,

DRG_j – unit price of a service from the j[th] DRG,

n – number of groups,

m – number of services provided.

The revenue depends on the number and type of provided services, which are grouped into DRGs. Defined specific features of the patients (e.g. children or patients with multiple health problems) the unit price for DRG may be increased. Raising DRG tariffs may also result from the characteristics of the hospital – higher rates may be related to the level of specialization or geographical location (e.g. NHS, 2012-13; Epstein, Mason, 2006).

All countries presented in table 1 use this approach for pricing inpatient care. In some systems – for example, in Australia, England and Germany – the approach to acute and long-term care is distinguished and DRG-based pricing is limited to acute inpatient care. In addition, in most countries the reimbursement on the basis of DRGs is also used in relation to outpatient care.

Standby costs do not fit the model assumptions of Payment by Results. By definition, the payment is set at a level proportionate to the costs incurred

in the optimal course of the service (Waters, Husey, 2004; Feyrer et al., 2005; Schreyögg et al., 2006). Standby costs, however, are the costs of inactivity that should not occur at the optimal course of the service. In the most accurate pricing models tariffs are determined with exclusion of the costs of unused potential – and therefore with exclusion of the standby costs.

2.2. Standby costs in DRG tariff

DRG tariff calculation is usually performed on the basis of information obtained from providers who calculate costs in accordance with the adopted costing model (Negrini et al. 2004; Leister, Stausberg, 2005; Epstein, Mason, 2006). Available costing models offer different levels of precision. The level of precision is determined by two factors. One is the identification of cost components – it can be developed using gross costing or micro costing approach. In gross costing only a very limited number of cost components is identifies whereas in micro costing cost components are identified at a detailed level. The other factor is the valuation of cost components – performed using either top-down or bottom-up approach. The top-down approach calculates the average cost by dividing total costs by total number of cost drivers (e.g. patients). The bottom-up method identifies resources used for each service provided. The combination of the two dimensions creates a four-field matrix (Wordsworth et al., 2005; Tan et al., 2009; Chapko et al., 2009).

The literature is dominated by the belief that the most accurate approach is bottom-up approach micro costing that allocates the costs to individual services in amounts that correspond to their actual absorption of resources (Jackson, 2001; Kaplan, Porter, 2011; Vogl, 2013). The most common alternative is a top-down micro costing, which involves the allocation of all costs into services provided. Table 2 shows the classification of the models used in the analyzed countries.

Bottom-up micro costing approach is used in Australia, Germany and Sweden, where costing guidelines recommend allocating costs at each stage according to the actual amount of resources used in the treatment of a particular patient (Department of Health and Ageing, 2011; InEk, 2007; Sveriges Kommuner och Landsting, 2009).

In these three countries costing takes place at the patient level. Patient collects all the costs incurred during the individual medical treatment. For example, the cost of staff in the hospital ward is assigned in proportion to their actual involvement in care, and in the operating theatre – in proportion to the duration of surgery. Expensive drugs and materials are assigned

Table 2

Methodology of cost accounting of health services to determine the DRG tariff

Country	Methodology of cost accounting of health services	Stages of cost accounting
Italy Portugal United States (Medicare)	top-down gross costing	• 1st stage: simplified calculation of the average cost of each category (e.g. diagnostics or operating theatre) • 2nd stage: calculation of the average cost of the DRG
Austria	top-down micro costing + gross costing	• 1st stage: calculation of the average cost of intermediate products (e.g. procedures, inpatient days) • 2nd stage: simplified estimation of the average cost of the DRG
England Estonia Hungary Netherlands	top-down micro costing	• 1st stage: calculation of the average cost of intermediate products (e.g. procedures, inpatient days) • 2nd stage: calculation of the average cost of the DRG
Denmark Finland France	top-down + bottom-up micro costing	• 1st stage: calculation of the average cost of intermediate products (e.g. procedures, inpatient days) • 2nd stage: calculation of the actual patient cost
Australia Germany Sweden	bottom-up micro costing	• 1st stage: calculation of the actual cost of intermediate products for each patient • 2nd stage: calculation of the actual patient cost

Source: own work

according to their actual consumption. A similar solution is postulated in Australia in relation to the cost of diagnostic procedures. The German and Swedish models recommend the calculation of the standard cost of medical procedures and assigning it based on the information about the number and type of procedures provided. Some simplification is applied to the cost of basic drugs and materials as well as ward's infrastructure costs which are allocated on the basis of length of stay.

Precise identification of the resources that are involved in the treatment process results in separation of costs of resources that did not participate in the provision of services. This is the cost of unused resources that will not be included when estimating DRG-based tariffs. Such a separation will not occur in a top-down approach, which involves the allocation of all costs into services provided. Costs calculated using top-down approach will include the cost of unused resources and, therefore, will include the standby costs.

Exclusion of the unused potential in the cost calculation is the direction that has been recognized in the management, because it supports the efficiency improvement and resource management in the organization (Kaplan, Cooper, 1998; Cokins, 2001; Horváth & Partners, 2005). It also enables capturing a causal relationship between the health service and its cost. Indirect recognition of standby costs (and other costs of unused resources) through a top-down approach results in a loss of information about the actual costs of the health service as well as the actual level of standby costs. It is impossible to identify the most efficient providers. There is also no possibility to determine what are the costs of ensuring continuous availability of the specific health services to population served by the hospital.

2.3. Standby costs in additional payments

In addition to payments made in proportion to the amount and type of services performed, in all systems hospitals receive an additional form of reimbursement. Additional payments may arise from the lack of recognition of defined services in the DRG system – for example, in some countries, non-acute inpatient care is settled separately. Additional payments may also be present in certain areas of health care, or in relation to certain categories of costs. The most common categories, which are not included in DRGs tariffs, are education and research (E&R). Additional payments may take the form of a global budget, fee-for-service or per diem and surcharges (see table 3).

In several countries some specialties are excluded from the DRG system. From the point of view of standby costs the most important are separate payments for emergency and intensive care units, which are allocated to hospitals in Finland, France, Germany and Italy. These are examples of units where standby costs typically occur. Exclusion of emergency and intensive care from DRG-based pricing is primarily due to the fact that the costs in these areas are largely associated with constant readiness for providing services in case they are necessary. These areas do not typically treat any elective patients.

Additional payment for these areas are implemented complementarily to the payment for the DRGs. For example, in France those units are provided with additional daily supplements over the DRG tariff (Bellanger et al., 2005; Bellanger, Tardif, 2006). In Germany there is a statutory regulation which entitles the hospital to additional payments when providing certain services is necessary to ensure the safety of the population and simultaneously their quantity is not sufficient to cover the total cost of the resources needed for

Table 3

Revenues allocated aside the DRG system

Country	Other payment components	Areas excluded from DRG payment	Costs not included in DRG tariff
Australia	per diem		E&R, in case of some providers also capital costs
Austria	per diem		E&R, capital costs and interest
Denmark	varies		E&R, capital costs and interest
England	global budget, additional payments	psychiatric services, community and ambulance services	E&R
Estonia	fee-for-service, per diem		E&R
Finland	varies	psychiatric services, intensive and emergency care	E&R, capital costs and interest
France	global budget, additional payments	psychiatric services, intensive and emergency care, rehabilitation, neonatology, dialysis, inpatient radiotherapy	E&R and expensive drugs
Germany	global budget, additional payments	intensive and emergency care	E&R, expensive drugs, capital costs and interest, allowance for bad debts, taxes, charges and insurance
Hungary	per diem, additional payments (including so called 'standing fee')		capital costs and interest
Ireland	global budget, additional payments		E&R, expensive drugs
Italy	additional payments	emergency, intensive care and organ transplantation	E&R
Netherlands	global budget, additional payments		E&R, expensive drugs and commercial exploitation
Poland	global budget, additional payments	intensive and emergency care	E&R
Portugal	additional payments		E&R and expensive drugs
Spain (Catalonia)	global budget, fee-for-service, additional payments		E&R
Sweden	varies	rehabilitation and burn treatment	E&R, expensive drugs and accreditation
United States (Medicare)	additional payments		E&R

Source: Busse, 2011; Department of Health and Ageing, 2011; Bundesministerium für Gesundheit, Familie und Jugend, 2013; Bilde, Ankjær-Jensen, 2005; O'Reilly et al., 2012; InEk, 2007; Gaál, 2005; Fattore, Torbica, 2005; Oostenbrink, Rutten, 2005; Sveriges Kommuner och Landsting, 2009; CMS, 2010

these services. The occurrence of surcharge and its level depends on the individual negotiations of the public payer with hospitals (KHEntgG §5 Abs. 2).

Interesting approach to the problem can be found in Hungary, where hospitals receive a fixed amount for intensive care, emergency department, traumatology and infectious diseases units. This additional payment is called 'standing fee', which indicates the awareness of the occurrence of standby costs in these units (Gaál, 2005; Gaál et al., 2006).

In other countries, readiness of emergency or intensive care is in no way recognized in the pricing process. In addition, none of the analyzed countries distinguished that standby costs may also occur in other units, such as operating theatres or selected diagnostic centres.

Methodology for determining the 'standby tariff' for hospital's readiness is not defined in any of the analyzed costing manuals that focus exclusively on the methodology of DRG tariff calculation (e.g. Department of Health and Ageing, 2011; Bundesministerium für Gesundheit, Familie und Jugend, 2013; NHS, 2012-13; Monitor, 2014; InEk, 2007; Sveriges Kommuner och Landsting, 2009). No research has been published so far on the level of these costs and cost drivers determining it.

3. METHODOLOGY

The results of the study were obtained in a research project using the constructive research approach suggested by Kasanen et al. (1993). This is an empirical and normative approach that entails a theoretical analysis of a new concept whose usability is further empirically tested. Data is typically obtained using a case study method and the aim of the study is both descriptive and analytical as well as problem-solving.

Information on standby costs were obtained in a five-stage process organized within a project 'Modern management in healthcare institutions – training in cost accounting and management information and tools of restructuring and consolidation of healthcare institutions' held by the Polish Ministry of Health and the Warsaw School of Economics. The stages of the research were as follows:

a) the costing model for standby costs has been designed within six months of ongoing workshops with 60 healthcare managers,

b) the scope and meaning of standby costs were discussed and addressed during meetings with 1200 healthcare managers which were carried for four years,

c) based on the conclusions of practitioners, the approach to identification and calculation of standby costs was refined,

d) costing model for standby costs was verified in 11 hospitals in the area of obstetrics; the verification process lasted three months,

e) the results were analyzed and generalized for the purpose of recognizing the standby costs in pricing of health services.

The choice of hospitals where the costing model was verified was conducted in a targeted manner. They were selected from the hospitals that have participated in the meetings described in the second stage of the research, which was to ensure the proper preparation of cost information. The sample includes diverse hospitals operating in Poland – both general and specialist, working at local and regional level. The diverse selection of units is intended to illustrate that the problem of standby costs occurs regardless of the nature of the hospital. The analysis took place in the second half of 2013. The analyzed sample is not representative and the results were used to illustrate the methodology of collecting and processing information about standby costs.

4. MODELLING THE STANDBY COSTS – FORMALIZATION OF METHODOLOGY

In order to calculate the monthly standby costs it is necessary to implement steps presented in figure 1. Standby costs occur when selected area of the hospital are on duty during the period when services generating DRG-based revenue are not provided. In particular, that means availability at night, during the weekends or on public holidays. This standby has been treated in this model as an activity carried out in various units of hospital. To perform this activity it is necessary to have access to certain human resources, rooms and equipment.

Standby is a special kind of unused potential of the providers. Distinguishing standby costs from other costs of unused potential is an issue that may result in some abuses at the hospital's level. Uniform approach to the calculation of the standby cost can be achieved when some assumptions are determined centrally by the regulatory institution.

Hospital's standby costs can be described using the following formula:

$$S_h = \sum_{i=1}^{n} k_i \times UCS_i. \tag{3}$$

where:

S_h – standby of the hth hospital,

k_i – the number of standby units in the ith cost centre,

UCS_i – unit standby cost in the ith cost centre,

n – the number of cost centres where standby is held.

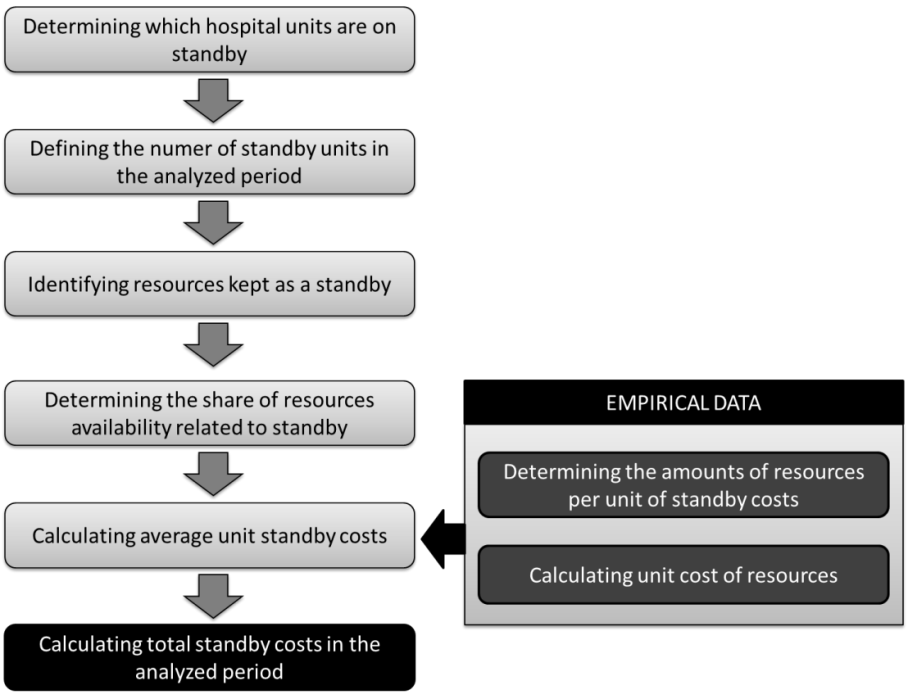

Figure 1. Methodology of standby cost calculation

Source: own work.

The first step is to define the number and types of cost centres which are on standby, always ready to provide services. For each cost centre it is necessary to determine two components – the amount of standby units provided in the analyzed period and the unit standby cost. Unit standby cost is derived from the following formula:

$$UCS_i = \sum_{j=1}^{m} \mu_{ij} \times x_j \times y_j \tag{4}$$

where:

μ_j – a ratio that determines what part on the jth resource is associated with standby,

x_j – the number of units of the jth resource maintained at a time of standby,

y_j – the unit cost of the jth resource,

m – the number of resources kept as a standby.

The ratio μ determines what part of the resource is associated with standby and what other part is associated with activities that occur at the same time in the cost centre. In units providing medical procedures the resources are usually associated fully with either performing the procedure or kept as a standby – so the ratio is 1. The situation in the hospital ward is more complex. The same resources (e.g. clinicians) are at the same time providing full-time medical care to inpatients and are kept as a standby in case of any emergency.

The designed methodology of standby cost calculation assumes that the empirical data collected from healthcare providers will be used to determine the variables x_j and y_j. Other variables are given, e.g. provided by the regulatory institution. Such a limitation in a model reduces the incentives to overestimate the standby costs and reporting other costs of unused potential as standby costs.

Calculation of the unit cost of the resource will be carried out according to the following formula:

$$y_j = \frac{TC_j}{TA_j} \tag{5}$$

where:

TC_j – the total cost of the j^{th} resource,

TA_j – the total practical availability of the j^{th} resource.

The total cost of the resource is determined as the sum of all costs associated with the resource. The practical availability of the resource is the maximum availability of the resource that is achievable in practice. Its estimation includes various limiting factors such as sick leaves for employees or maintenance and repair for equipment.

5. THE STRUCTURE OF STANDBY COSTS – RESEARCH EVIDENCE

The analysis included the standby costs in obstetrics. The surveyed hospitals provided information which cost centres are kept as a standby for the purpose of patients in labour. Results are presented in table 4.

All providers pointed to the maternity ward and delivery suite as units which are on standby for obstetrical patients. A larger discrepancy occurred in the case of diagnostic centre. Most hospitals keep laboratory diagnostic imaging as a standby. Some recipients additionally indicated other units such as serology and microbiology. In some cases, diagnostic services are outsourced and the standby cost of these units is included in the unit price of the service and is not specified separately.

Table 4

Standby at the level of cost centres

H1	Maternity ward	Delivery suite	Diagnostic Imaging
H2			Laboratory, Microbiology
H3			Laboratory, Serology
H4			Laboratory
H5			Laboratory, Microbiology, Diagnostic Imaging
H6			Laboratory, Diagnostic Imaging
H7			Laboratory, Diagnostic Imaging
H8			Laboratory, Diagnostic Imaging
H9			Laboratory, Blood Centre
H10			Laboratory, Serology
H11			Laboratory, Serology, Transfusion, Diagnostic Imaging

Source: own work

The method of calculation of the unit standby cost is presented for delivery suite and maternity ward (table 5). For the purpose of analysis the value of μ ratio was set as 1 for the delivery suite and as 0.1 for the maternity ward. This means that 10% of the resources in a hospital ward is associated with standby, and the remainder with the inpatients.

In addition, it was assumed that the total monthly standby time is 544 hours. This is due to the fact that the medical duty of hospitals in Poland takes place on weekdays between 15.30 and 7.30 (16 hours), on weekends for 24 hours. Between 7.30 and 15.30 on weekdays hospitals should provide elective services. An exemplary month consisting of 16 working days and 8 holidays was taken (16 days times 16 hours plus 8 days times 24 hours equals 544 hours).

The analyzed population of hospitals is relatively small and very diverse. It consists of both local and regional hospitals, both general and specialized ones. Differences in individual hospital's standby costs are significant and are based on two factors:

- differences in the unit costs of resources,
- differences in the amount of resource units kept as a standby.

These factors partly depend on the geographical location of the hospital, which influences the cost of resources. The amount of resources on standby is a derivative of the size of both the hospital and the population which receives health services. Another important factor is also the efficiency of the hospital. This factor is also significant for the level of DRG-related costs. The presented method of collecting data on standby cost allows the assessment of its actual level and drivers that shape it. Table 6 presents the statistical analysis of the standby cost.

Table 5

Unit standby cost in delivery suite and maternity ward (in PLN)

Name	Range/Type of hospital	y	Delivery suite				Maternity ward			
			x	μ	UCS (per hour)	S (per month)	x	μ	UCS (per hour)	S (per month)
H1	local / general	DR = 4.45 IB = 2.11 M = 30.23 O = 52.41	1 DR 1 M	1	34.68	18,865.92	18 IB 1 O 2 M	0.1	15.08	8,203.52
H2	regional / specialist	DR = 1.32 IB = 0.24 M = 35.06 O = 66.42	1 DR 2 M 1 O	1	137.86	74,995.84	62 IB 4 O 1 M	0.1	31.56	17,168.64
H3	local / specialist	DR = 10.91 IB = 0.22 M = 27.10 O = 91.70	3 DR 4 M	1	141.13	76,774.72	16 IB 2 O 4 M	0.1	29.53	16,064.32
H4	local / general	DR = 0.46 IB = 0.16 M = 35.91 O = 37.94	2 DR 2 M	1	72.74	39,570.56	68 IB 2 O 6 M	0.1	30.22	16,439.68
H5	regional / specialist	DR = 0.86 IB = 0.65 M = 38.99 O = 51.83	3 DR 4 M	1	158.54	86,245.76	30 IB 3 O 3 M	0.1	29.20	15,884.80
H6	local / general	DR = 1.75 IB = 0.01 M = 25.09 O = 112.95	1 DR 1 M	1	26.84	14,600.96	57 IB 2 O 3 M	0.1	30.17	16,412.48
H7	regional / specialist	DR = 4.51 IB = 1.18 M = 37.02 O = 47.77	2 DR 3 O 2 M	1	226.37	123,145.30	44 IB 3 O 3 M	0.1	30.63	16,662.72
H8	local / general	DR = 4.31 IB = 1.77 M = 35.37 O = 67.52	1 DR 1 M	1	39.68	21,585.92	30 IB 1 O 3 M	0.1	22.67	12,332.48
H9	local / general	DR = 3.01 IB = 0.21 M = 33.07 O = 57.56	1 DR 1 M 1 O	1	93.64	50,940.16	48 IB 1 O 5 M	0.1	23.30	12,675.20
H10	local / general	DR = 1.05 IB = 0.09 M = 26.39 O = 49.46	2 DR 3 M 2 O	1	180.19	98,023.36	26 IB 1 O 3 M	0.1	13.10	7,126.40
H11	regional / specialist	DR = 7.48 IB = 1.52 M = 34.36 O = 88.66	3 DR 5 M	1	194.24	105,666.60	58 IB 1 O 2 M	0.1	24.55	13,355.20

where:
DR – delivery room
IB – inpatient bed
M – midwife
O – obstetrician

Source: own work

Table 6

Statistical analysis of the standby cost

Variable	Statistical description	Shapiro-Wilk test	Correlation with UCS (suite)	Correlation with UCS (ward)	Statistical test; grouping variable Range	Statistical test; grouping variable Type
UCS (suite)	$\mu = 118.72$ m = 137.86 $\sigma = 69.30$	W = 0.936 df = 11 p = 0.474	$\rho = 1$ N = 11	$\rho = 0.118$ N = 11 p = 0.729	Z = -2.934 p = 0.003 $\mu_{local} = 84.13$ $\mu_{regional} = 179.25$	Z = -2.934 p = 0.003 $\mu_{general} = 74.63$ $\mu_{specialist} = 171.63$
UCS (ward)	$\mu = 25.45$ m = 29.20 $\sigma = 6.43$	W = 0.831 df = 11 p = 0.024	$\rho = 0.118$ N = 11 p=0.729	$\rho = 1$ N = 11	U = 6.000 p = 0.164	U = 6.000 p = 0.126
Range		W = 0.625 df = 11 p = 0.000	$\rho = 0.657$ N = 11 p = 0.028	$\rho = 0.478$ N = 11 p = 0.137		
Type		W = 0.649 df = 11 p = 0.000	$\rho = 0.693$ N = 11 p = 0.018	$\rho = 0.520$ N = 11 p = 0.101		

Source: own work

The average standby cost per hour in the delivery suite is 118.72 with a standard deviation of 69.30. The distribution is left-skewed and the median value (m) is 137.86. The variable UCS (ward) that depicts the average standby cost per hour in the maternity ward presents similar distribution with the average of 25.45 (a standard deviation of 6.43) and the median of 29.20.

The analysis was supplemented with statistical tests examining whether the distribution of variables UCS (suite) and UCE (ward) differs depending on the values of variables Range and Type. The standby cost on the delivery suite is positively correlated with both the range of the hospital (either local or regional) and its Type (either general or specialist). The average standby cost of the delivery suite varies between hospitals operating in the local and regional area as well as between general and specialist hospitals. The difference is statistically significant. In case of the standby cost of the maternity ward none of these factors had a significant impact.

SUMMARY

The presented approach enables the calculation of the standby cost of different units in the hospital. It is based both on empirical data and on the top-down regulations established by the institution responsible for the pricing of health services. Imposed regulations are necessary for a clear distinction between the standby costs and other costs of unused potential. The proposed model uses empirical data to obtain the information about the

unit cost of resources and the number of resource units maintained at a time of standby. On this basis it is possible to calculate the unit standby cost in various hospital areas.

Separation of cost and non-financial data allows for numerous analysis. For example at the regional level it is possible to determine whether the total standby maintained by all providers in the region corresponds with the needs of the population. Obtaining data on the standby costs from a representative sample of hospitals provides the basis for the calculation of the standby cost, which may be taken into account when estimating the additional revenue acknowledged for 'standby'. The presented approach is the extension of cost-based pricing approach above the DRG system into the area of hospital's standby.

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