The use of DRGs in hospital management

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Abstract. Four years after the implementation of a payment system based on diagnosis related groups (DRGs) by the National Health Fund (NHF) in Poland, little research has been done on the use of DRGs in strategic management, controlling and managing hospital finances. Today's reality of managing health facilities forces their managers to take DRGs into account. This paper presents the possible use of DRGs in hospital management. The first part of the paper describes the nature of DRGs, while the second discusses best practices in the use of DRGs in hospital management and controlling. The NHF's policy of frequently modifying dictionaries describing DRGs and the way the NHF presents data on its web site hinder the application of DRGs in the strategic and operational management of hospitals. This paper is based on a case study of DRG use in the management of the Barlicki Hospital in Lodz (a clinical hospital of the Medical University of Lodz).

Introduction

Health care reforms as well as the restructuring and conversion of hospitals into non-public health care facilities (NZOZ) make it necessary to introduce new management methods, a new approach to effectiveness, labor efficiency, costs and performance, and DRGs should be part of these new tools. "Apart from their use in reimbursement systems, case-mix systems such as DRG were designed for planning, budgeting, management and financing inpatient care" [7]. Currently, the DRG system benefits mainly (only) the NHF. Hospitals are struggling to implement DRG-based planning, budgeting, and management.

Four years after the NHF implemented the DRG system, DRG data have yet to be applied in hospital management. DRGs may have a significant impact on hospitals' contracts and financial position. With proper use of data from the NHF DRG Statistics web service, hospitals can achieve a competitive advantage and increase their effectiveness. There is a huge potential for improving hospital management and profitability using DRG

data. The key to success is to combine internal (hospital) and external (NHF) data. Few hospital managers have a vision of how to use DRGs for effective management and very few hospitals in Poland have incorporated DRGs into controlling and strategic management processes. The concept of including DRGs in hospital strategic management faces many challenges. Managers of public hospitals in Poland are rarely able to plan long term, or to see beyond the term of the hospital's contract with the NHF.

Hospital managers lack the knowledge and examples of best practices on how to implement DRGs at each level of management – from strategic to operational. The profitability of a hospital as a whole depends on the profits of each individual hospital unit (of each contract and process). The implementation of an appropriate level of detail in the measurement of hospital performance requires external data as a basis for benchmarking. Hospitals should introduce financial monitoring and controlling at the level of hospital departments and units. An increase in liability for medical and financial results at the lowest level of organizational structure leads to higher profitability.

This paper begins a discussion series aimed at extending management "beyond traditional 20th century hospital management." Over the years, controlling has been "the next big idea" in management theory, but few hospitals have put it into management practice.

The application of DRGs is presented as part of the process of building a hospital data warehouse. Some examples are also shown of how managers can compare costs on the basis of DRGs. DRG-based decision-making ideas and models may be used for the improvement of hospital management.

The history and nature of DRGs

DRGs were introduced in the 1960s, when Robert Fetter started a project aimed to compare the quality of medical services. The challenge he faced was to eliminate the impact of the state of patients' medical complications on the performance of health care facilities. Subsequently, DRGs were used to analyze the costs of medical services. The DRG system is used in most OECD countries. The first attempts to introduce DRGs in Poland were made in the years 2000–2003 by the Lower Silesian Sickness Fund, but the liquidation of Sickness Funds and the establishment of the NHF halted the above-mentioned efforts. Prior to July 1, 2008 the NHF used the Catalogue of Hospital Services to determine payments for hospitals. It was not until July 1, 2008 that hospitals around the country started

DRG-based reporting. Introducing DRGs, the NHF made the following assumptions:
 a) an active influence on the costs of services;
 b) a possibility for comparing the performance of hospitals.
   The new way of determining payments has given hospital managers the opportunity to:
 a) plan their budgets;
 b) develop variants of contracts for negotiation with the NHF and other payers;
 c) monitor, control and actively manage costs in accordance to DRGs;
 d) link resource planning (medical personnel, medicinal products, hospital infrastructure-equipment, beds, etc.) with DRG-based contracts.
   The Polish DRG system is based on only one principal diagnosis, and its distinguishing feature is that it also includes time spent in hospital and separate valuation of scheduled and emergency hospitalization [6]. The Polish DRG system contains 16 major categories and 519 groups. The basic dictionary includes: age, sex, mode of admission and discharge, and international classification of medical procedures.

Methodology

   The methodology used for DRG-based hospital management in the various areas comprises of:
 a) general data warehouse theory;
 b) data warehouse design for hospitals;
 c) controlling, benchmarking, strategic management.

The role of controlling

   Controlling in hospitals can be considered part of managerial control. The purpose of controlling is to examine budget implementation and deviations from plans, and to calculate the costs and financial results for different units in the organization's structure. The DRG system is an additional dimension, specific to controlling processes in hospitals. The factors affecting the organization and frequency of controlling activities include:
 a) the complexity and turbulence of the economic environment;
 b) the value of the contract with the NHF (initially one should focus on controlling contracts with the highest value);

   c) the organizational level at which goals are assigned, plans developed and responsibility for financial results delegated.

Many hospital mangers find it difficult to combine medical objectives with economic ones. Economic objectives affect the manner of management, which is "focused on the market of medical services, the rational use of resources and the rendering of services in compliance with the practice of medicine" [10]. Most public hospitals which have been converted into non-public hospitals may not expect a rapid increase in revenues. In the initial phase after conversion the NHF remains the basic source of revenues. This means that the survival and development of these facilities depends on their contracts with the NHF. After signing a contract, managers should focus on the effective management of costs and resource utilization [3]. The costs of contracts with NHF can be considered a typical optimization problem. At this stage, however, optimization does not seem to be used to a sufficient extent in hospital management. The issues of optimization of contracts signed with the NHF can be seen in terms of two basic strategies:

– maximizing the value of contracts and financial results given the available resources;
– minimizing the use of resources at a given value of the contract, with active management of costs.

While developing a model for optimizing the financial results of a contract, the function describing the costs should be constructed in the following way:

– it should be built on a multi-dimensional cost model which includes the mode of admission and discharge, sex and age of the patients;
– it should be taken into account that costs are not always proportional to the length of stay; costs are often the highest in the first few days, and gradually decrease along with improving patient health;
– it should be remembered that "The estimated values of c all being positive could be the result of the overall costs mainly being driven by the costs made for non-survivors, which is not surprising given the well known fact that dying patients are, on average, far more cost consuming than surviving patients." [3].

It is generally believed that the costs of medical services are undervalued in NHF contracts. This in turn means that contractor bears higher costs than are reimbursed by payments received from the NHF. The hospital may take steps to carry out the contract on a larger scale in order to avoid losses. Nevertheless, smaller facilities are left in a situation in which revenues from the contract will be lower than the costs. The only thing they can do is reduce costs. In the case of hospitals, it is important for the costs of

particular DRGs to be lower than those posted on the NHF DRG Statistics web site. Hospitals may reduce costs by:
  – reducing the costs of daily patient hospitalization and treatment;
  – shortening the length of stay in hospital; if the hospital does not perform scheduled operations on Saturday and Sunday, then admitting a patient on Friday means increased costs and therefore it should be avoided as long as the patient's life is not at risk.

Cost analysis is based on expenses per patient admission. Costs include expenses incurred from admission to discharge [8]. The prerequisite for cost reduction is that income / financial result maximization must not deteriorate the quality of care provided. The purpose of analysis is to determine whether it is more cost effective to use expensive technology which would shorten the length of stay or use traditional therapy with longer stays. Daily expenses include all patient expenses (expenses which a patient has generated) per day. These expenses are usually the greatest during the first day after admission, but there are some exceptions and therefore separate models should be developed for each element of the multidimensional analytical space.

The use of a cost reduction strategy may collide with the other strategy, that is, shortening the time of stay. For example, if a less potent medical product is administered, the patient may stay longer in hospital and vice versa. Thus, we are faced with a dilemma: Which costs should be minimized? What should the cost function contain? How often should the cost function be updated? High costs may result from the low labor productivity of medical personnel or from insufficient use of expensive specialized equipment. The right path leading to lower costs is to increase the use of resources by gaining more clients who will complement contracts with the NHF.

A problem with the implementation of this strategy is the Polish employment law which prevents dynamic changes in the number of employees according to needs. Civil contracts are much more flexible in this respect, but hospital managers who exclusively use this form of employment risk that highly specialized doctors might easily change jobs. The employment of highly skilled staff should be governed by contracts of employment. Specialist equipment that may not be effectively used because of reduced NHF contracts is yet another problem. Under the circumstances, active management of operating costs to maximize financial results is a partial solution for hospital mangers. Active cost management requires the implementation of a controlling system and an appropriate change in the organizational structure of the health care facility.

Petre Iltchev, Aleksandra Sierocka, Michał Marczak

How to create value with DRGs?

The key to ensuring the financial success of a hospital by using DRG-based payments is managing the profitability of contracts at the DRG level. This means that a hospital obtains higher revenues than costs for a particular DRG. Given the fact that in Poland there exist both public and non-public hospitals, it is easy to predict the winners and losers. The non-public ones will be in a better position because in public health care institutions medical goals take precedence. DRGs, if used appropriately, may be an asset for the organization. Therefore, DRG data should be used adequately in hospital management. DRG analysis is similar to balance sheet analysis:

- change of data over time characterizing a given DRG and the major category;
- change of proportion of particular major categories over time;
- change of proportion of a given DRG in a given major category and in overall DRGs.

Having data concerning the performance of a contract in a given hospital at the DRG level, one can compare these results with data from the NHF DRG Statistics web service. This shows where a given hospital stands relative to other hospitals in terms of costs, length of hospitalization, ICD-9 and ICD 10 medical procedures used, and mode of patient admission and discharge.

In order to efficiently utilize DRG information, one needs to have detailed historical data concerning contracts: a) from the hospital's IT system; b) from the NHF DRG Statistics web service for all hospitals. The managers theoretically have detailed information on DRGs obtained from the hospital's IT system. What is important in analysis of the potential of DRG use in the process of hospital management is to have data on hospital costs broken down by DRG, wards, cost centers, patients, and medical procedures. A hospital's IT system may combine both of the abovementioned sources of data to use them in management. The following stages of DRG analysis may be distinguished:

a) extracting data from the hospital's IT system;
b) importing NHF data;
c) combining data from these two sources;
d) data analysis – comparing, developing models, describing data, and making forecasts on their basis. New analyses using DRGs and new data from the NHF DRG Statistics data web service make it possible to compare hospitals in particular regions and by hospital type. Thus,

one can identify the best, average, and the worst hospitals. An example here is a comparison of clinical hospitals across Poland.

The role of data warehouses

Data warehouses are often used as a platform supporting strategic management processes. In Poland it has not been until now that hospital managers find it necessary to use such solutions. A data warehouse, being an analytical platform, facilitates such analyses as:

a) monitoring the achievement of medical and financial goals by a hospital;
b) analysis of a hospital's efficiency and benchmarking vs. all hospitals/hospitals of the same kind;
c) analysis of profitability by DRG;
d) analysis of tendencies in use of medical services;
e) analysis of cost levels;
f) analysis of cost influencing factors and their change over time (e.g. length of hospital stay);
g) analysis of the structure of a medical service by age, sex, and mode of admission and discharge.

Typical questions that may be addressed by analysis of processed and aggregated data from the NHF DRG Statistics web service include:

– What is the share of 10 DRGs with the highest value in the hospital's contract with the NHF?;
– Where do those DRGs come in the NHF ranking?;
– What are the factors that determine differences between the hospitalization time in a given hospital and the average hospitalization time as given by the NHF for a particular DRG?;
– The share and cost of a given DRG in a given major category;
– The share and cost of a given DRG against all DRGs;
– Average daily costs for a given DRG;
– Which DRGs are characterized by the highest/lowest costs?;
– Patients with which DRGs are hospitalized for the longest/shortest time?

The development of a data warehouse in a hospital must bring economic benefits. The managers must learn how to create business value using the implemented data warehouse. In this context, it would be useful to address questions such as: What new business value and benefits can be gained using a data warehouse? Where does the hospital stand relative to its competitors? This question can be answered only if the hospital uses benchmarking

to compare its results with those of other hospitals. The role of DRG analysis increases in a fast-changing environment with substantial changes in the costs of medical technologies, labor, and entry of new market players (competitors).

Of utmost importance is the manner of extracting, transforming, cleaning and combining external and internal data. From the business point of view it is important to have a documented approach to combining DRG data from the NHF and from the hospital. It is better to combine dictionary categories in the process of analysis rather than while building a data warehouse. In this way, one can ensure consistency with NHF data.

Before one can commence data analysis, it is necessary to develop a data model. The key issue here is to determine which data will be obtained from which source. Modeling data for DRG use in hospital management is an element of a larger project – developing a data warehouse for the hospital. The data model was designed using the free application BizAgi Process Modeler. The model employs the main functional components which are crucial for the hospital's controlling. The first data warehouse model was expanded by reengineering data obtained from the NHF DRG Statistics web site. The objective was for the application to create value for the hospital's managers as early as in the initial phase of development.

Hospital managers do not wait until the full comprehensive solution is in place. During the implementation of the project, management consultants train the hospital managers on how to use DRGs in controlling and strategic decision making. Seeing and assessing the real benefits and business value connected to DRG data, the hospital's managers will support the subsequent part of the project, which is aimed to increase the number of dimensions and the level of detail of available data.

The following analytical tools for storing and processing multidimensional data may be identified:

 a) spreadsheets with pivot tables;
 b) databases;
 c) Google Fusion Tables.

Each of these tools has its strengths and weaknesses. Spreadsheets can be comfortably used for importing NHF data concerning several DRGs and their comparison with a hospital's performance. However, with greater volumes of data the advantage of database management systems is evident. In turn, Google Fusion Tables are a useful tool for data presentation and visualization and ensuring good data accessibility.

Comparative analysis of DRGs in the Barlicki Hospital (a clinical hospital in Lodz) with the NHF DRG statistics

Hospital managers may find it difficult to extract value from DRGs. To achieve this, they need to compare internal DRG data with external data. The first step is to import data from the NHF DRG Statistics web service. Subsequently, data from the NHF service need to be combined with the hospital's data. After this process has been completed, it will be possible to analyze and compare the performance of the hospital with that of other hospitals. Such an analysis may equip the hospital's managers with information that may be used for making strategic choices concerning the direction of developing the hospital's medical activity. To draw business benefits from DRGs, the hospital's managers need to have some knowledge in such areas as controlling, performance management and strategic management. The necessary data must be prepared by analysts and the IT personnel. This team needs to have expertise on databases, data warehouses, multidimensional modeling and OLAP technology.

Some of the challenges related to importing data from the NHF web site with Excel include:

a) data are not available in a spreadsheet, but are presented on web pages;
b) there are no clear rules for generating top-level page addresses for DRGs or second-level page addresses for NHF regions and hospital types;
c) data may not be readily imported form the NHF web site to a spreadsheet; if a NHF branch does not have any patients with a given DRG, that branch does not show the value "0"; rather, it is not displayed on the web page at all.

Data imported from the NHF DRG Statistics web service are stored in 13 sheets:

– the first one contains all data from tables 1 to 5;
– data in the second tab are data from table 6 of the web service – information on ICD-9;
– the third tab presents data from table 7 – ICD-10 codes;
– the other tabs contain detailed data concerning NHF branches and hospital types.

In order to decrease the volume of data imported from the DRG Statistics web service, one should decide which DRGs are most vital to the hospital. This can be done according to contract values, number of patients or man-days.

Some of the practical problems related to data analysis that must be

solved in the process of modeling include the lack of DRG dictionaries and frequent modifications of DRG dictionaries.

To provide an example of data analysis, this paper presents data concerning those DRGs that are most important to the Barlicki Hospital. It was assumed that dictionaries describing the data are to incorporate those elements that were present throughout all the studied years. [Tab. 1] presents a dictionary of admissions and [Tab. 2] a dictionary of discharges. These dictionaries will be expanded in the future as the NHF adds new elements.

Tab. 1. Dictionary of admission modes used in 2009–2012

Description of admission mode	Applied in DRG in the year			
	2009	2010	2011	2012
Scheduled admission	Yes	Yes	—	—
Scheduled admission based on referral	—	Yes	Yes	Yes
Emergency admission with referral from the emergency	Yes	—	—	—
Emergency admission resulting from transfer by a medical emergency team	—	Yes	Yes	Yes
Emergency admission with referral other than from the emergency	Yes	—	—	—
Emergency admission without referral	Yes	Yes	—	—
Emergency admission – other cases	—	Yes	Yes	Yes
Admission of a newborn as a result of childbirth in this hospital	—	Yes	Yes	Yes
Scheduled admission of a person who benefited from health care services out of turn under a privilege afforded her by the law	—	Yes	Yes	Yes
Transfer from another hospital	—	—	—	Yes
Admission of a person subjected to mandatory treatment – admissions related to the implementation of statutory compulsory treatment set out in art. 26 of the Act of 26 October 1982 on upbringing in sobriety and counteracting alcoholism and art. 33. 1 and art. 34.1 of the Act of 5 December 2008 on preventing and fighting infections and infectious diseases in humans	—	—	—	Yes
Forced admission – forced admission in connection with the statutory obligation to submit to hospitalization referred to in art. 35.1 of the Act of 5 December 2008 on preventing and fighting infections and infectious diseases in humans, art. 21.3, art. 23, 24 and 29 of the Act of 19 August 1994 on the protection of mental health, art. 30 and 71.1 and 3 of the Act of 29 July 2005 on counteracting drug addiction, art. 94, 95a and 96 of the Act of 6 June 1997 on Penal Code, art. 203 and 260 of the Act of June 6, 1997 on Code of Criminal Procedure and art. 12 and 25a.2 of the Act of 26 October 1982 on proceedings in juvenile cases	—	—	—	Yes

Source: Based on DRG data from the NHF site: "DRG Statistics". Available at https://prog.nfz.gov.pl/APP-JGP/KatalogJGP.aspx, accessed on 12.06.2012.

Tab. 2. Dictionary of discharge modes used in 2009–2012

Discharge mode	Applied in DRG in the year			
	2009	2010	2011	2012
Completion of a therapeutic or diagnostic process	Yes	Yes	Yes	Yes
Referral for further treatment in an outpatient clinic	Yes	Yes	Yes	Yes
Referral for further treatment – other cases	Yes	Yes	—	—
Discharge at the patient's own request	Yes	Yes	Yes	Yes
Death of patient	Yes	Yes	Yes	Yes
Referral for further treatment in another hospital	—	Yes	Yes	Yes
Referral for further treatment in a stationary care facility	Yes	—	—	—
Referral for further treatment in a stationary care facility other than a hospital	—	Yes	Yes	—
Referral for further treatment in a long-term care facility	Yes	—	—	—
The person treated left a stationary care facility without formal discharge before the completion of a therapeutic or diagnostic process	—	Yes	Yes	—
Discharge under art. 22.1.3 of the Act of August 30, 1991 on health care facilities	—	Yes	Yes	—
Referral for further treatment at a unit (other than a hospital) of a health care facility offering therapeutic medical services such as stationary and 24 h medical care;	—	—	—	Yes
The person treated left a unit of a health care facility offering therapeutic medical services such as stationary and 24 h medical care without formal discharge before the completion of a therapeutic or diagnostic process	—	—	—	Yes
The person treated, admitted with code "9" or "10", left the hospital without formal discharge	—	—	—	Yes
Discharge under art. 29.1.3 of the Act of 15 April 2011 on medical activity	—	—	—	Yes

Source: Based on DRG data from the NHF site: "DRG Statistics". Available at https://prog.nfz.gov.pl/APP-JGP/KatalogJGP.aspx.

What are the transformation rules for dictionaries describing admissions and discharges? These rules may only be determined on the basis of analyzing and mapping medical conditions. Without appropriate mapping of dictionaries used by the NHF in particular years, it would be impossible to compare hospitals' activity in respect of a given DRG in a detailed and accurate way. A comparison that takes into account patients' age and sex, medical procedures used, and mode of admission and discharge may form the basis for comparing one hospital with others in terms of both their medical and economic performance.

Another problem with DRG data analysis is the lack of grouping rules, or a so-called grouper, which is no longer made available by the NHF.

Tab. 3. Analysis of DRG groups with the highest values at the Barlicki Hospital in 2010 using data from the "DRG Statistics" service

DRG	Description of DRG	Barlicki Hospital			Main data for selected DRG groups			NHF Lodz region			Clinical hospitals			Municipal, county, city hospitals			District hospitals		
		N	L	W	N	L	W	N	L	W	N	L	W	N	L	W	N	L	W
A11	Comprehensive intracranial treatment	0.27	9	1.7	6.6	11	1.4	0.43	11	1.4	4.3	11	1.4	0.3	15	1.0	2.0	13	1.2
A23	Major operations on the spinal cord and spinal canal	0.23	8	1.4	11.0	8	1.4	1.2	8	1.4	4.5	8	1.4	1.4	6	1.9	4.5	8	1.4
B13	Uncomplicated cataract surgery by emulsification with simultaneous lens implantation	0.93	2	1.6	106.0	2	1.5	8.2	2	1.5	16.1	2	1.5	18.3	2	1.5	31.8	2	1.5
B12	Complicated cataract surgery by emulsification with simultaneous lens implantation	0.62	2	1.8	54.6	2	1.7	3.1	2	1.8	14.4	2	1.8	9.8	2	1.8	16.0	2	1.8
Q01	Endovascular aortic aneurysm repair	0.03	6	10.3	1.7	7	8.9	0.16	6	10.3	1.1	7	8.9	0.2	6	10.3	0.3	7	8.7
L94	Kidney Transplant – category II	0.04	4.5	9.5	0.7	19	2.3	0.08	22	2.1	0.5	19	2.3			0	0.2	19	2.4
F11	Comprehensive gastric and duodenal surgery	0.17	4	3.1	3.7	13	0.9	0.3	8	1.6	1.3	8	1.5	1.0	15	0.8	1.2	14	0.9
G34	Endoscopic and percutaneous procedures on biliary tract and pancreas	0.48	3	1.4	19.5	4	1.0	1.3	4	1.0	5.0	4	1.0	6.2	4	1.0	5.7	5	0.8

Notes: N – Number of hospitalizations (000); L – Length of stay, median (days); W – Average price for 1 day of hospitalization (PLN 000)

NordDRG is an example of a DRG system that gives access to information about the grouper [9].

The present study compared the number of patients, costs and length of stay in the Barlicki Hospital with other Polish clinical hospital. We focused on those DRGs with the greatest share in the hospital's budget or the largest number of patients or man-days.

[Tab. 3] presents 8 top DRGs in terms of contract value or number of patients or man-days. Furthermore, it is shown why one should use detailed data in medical-economic analyses. As it can be easily seen from the table, comparisons of the Barlicki Hospital's performance with overall NHF data and with data for clinical hospitals lead to very different results. The difference in costs and average length of hospital stay (median) between particular hospitals in terms of the selected DRGs may influence the comparison results.

Conclusions

The DRG system in Poland should not be limited to contracting, reporting to the NHF and determining NHF payments to hospitals.

In the process of DRG implementation in hospital management we gain experience and test various approaches to data collection, cleaning and aggregation. The managers voice their opinions about reports and identify potential future improvements. Further development of data warehouses should focus on tapping external data sources. Real benefits from data warehouses may be gained when they are used in combination with dashboards in the process of management. Polish experiences in terms of employing DRGs in hospital management are particularly relevant for countries which have yet to implement a DRG system or which have introduced it only recently.

R E F E R E N C E S

[1]   BizAgi Process Modeler, [http://www.bizagi.com/index.php?option=com_content&view=article&id=126& Itemid=127&dwl=3b17460c2172fa142a8add7a95e9b283&lang=en]

[2]   Enterprise Warehouse Solutions, Inc, World-Class Data Warehousing Models: Healthcare – Clinical, Enterprise Warehouse Solutions, Inc, 2009. www.EWSolutions.com (10.02.2010 r.)

[3]   Hanna V., Sethuraman K., The Diffusion of Operations Management Concepts into the Health Care Sector, 2005. http://www.mbs.edu/download.cfm?DownloadFile=951E3EB1-123F-A0D8-42DC3582CE6ECFE6 (21.12.2011)

[4] Imhoff C., Galemmo N., Geiger J., Mastering Data Warehouse Design, Wiley, 2003.

[5] Jegers M., Applying cost minimization techniques to hospitals: A comment, European Journal of Operational Research, 197, pp. 828–829, 2009.

[6] Kozierkiewicz A., Jednorodne grupy pacjentów. Przewodnik po systemie, Narodowy Fundusz Zdrowia, Centrala, Warszawa, 2009.

[7] Serden L., Lindqvist R., Rosen M., Have DRG-based prospective payment systems influenced the number of secondary diagnoses in health care administrative data?, Health Policy, 65, pp. 102, 2003.

[8] Suthummanon S., Omachonu V., Cost minimization models: Applications in a teaching hospital, European Journal of Operational Research, 186, pp. 1175–1183, 2008.

[9] The NordDRG Manual documents the grouping rules of the NordDRG system, http://www.nordcase.org/eng/norddrg_manuals/

[10] Zbroja A., Decyzyjny rachunek kosztów w szpitalu – konieczność czy alternatywa?, w: Zarządzanie finansami placówek medycznych, Instytut Przedsiębiorczości i Samorządności, Warszawa, 2001. http://www.emedyk.pl/artykul.php? idartykul_rodzaj=8&idartykul=1 (21.12.2011).

[11] Ustawa z dnia 15 kwietnia 2011 r. o działalności leczniczej, Dz. U. Nr 112, poz. 654.