

# Analysis of Operating Costs of the Diagnostic Imaging and Interventional Radiology Centre at John Paul II Upper Silesian Children's Health Centre in Katowice

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**Abstract**—A properly organized accounting system providing relevant information on costs incurred by healthcare entities is an essential element that enables taking optimal decision regarding their functioning. This paper presents an accounting system as an informative system adapted to the specifics of a healthcare entity. The authors propose grouping costs in terms of resources to facilitate appropriate management and optimization of costs of a healthcare entity. The work is based on costs incurred in 2017 by the Diagnostic Imaging and Interventional Radiology Centre at John Paul II Upper Silesian Children's Health Centre in Katowice.

**Index Terms**— accounting system of healthcare entities, resource cost accounting

## I. INTRODUCTION

The analysis and assessment of costs related to the functioning of healthcare entities e.g. hospitals, is extremely important because these entities utilise public funds. However, this issue is rarely analysed as medical facilities are often considered as non-profit organizations. Nevertheless, it should be remembered that public hospitals, like other business units, should strive to achieve revenues commensurate with the costs incurred. The accounting system maintained in every healthcare entity should ensure efficient control and management of costs. Information that is included in the accounting system of a healthcare entity should increase the level of resource utilization and improve the standards of services provided by this entity. Traditional cost grouping resulting from the inventory system is not sufficient because it divides the costs according to their types. Therefore, appropriate cost grouping methods are needed to allow the healthcare institutions to manage their resources and procedures with efficiency. The

purpose of this paper is to provide model presentation of division of costs into individual categories which will allow for their proper management and optimization. The healthcare entity chosen for the analysis was the Diagnostic Imaging and Interventional Radiology Centre of John Paul II Upper Silesian Children's Health Centre in Katowice which provided the authors with their cost related data for 2017.

## II. ACCOUNTING SYSTEM ADAPTED TO THE SPECIFICITY OF A HEALTHCARE ENTITY

The ongoing intellectual revolution is undoubtedly connected with the spread and development of information techniques and computerization of almost all forms of human activity. The conditions of the global economy of enterprises in modern times are associated with the economy of information (Kwiatkowska 2001) and require not only the application of state of the art methods of communication but also constant revision of the applied business model and frequent updates of basic operating strategies so that the company can meet the challenges of a dynamically changing environment (Karmańska 2006).

The first information system was applied to economic sciences by B. Siwoń, who introduced this notion to the business economics literature. The system was defined as internally coordinated and was characterised by structurally arranged elements. Such a system considered from the outside is a whole unit and when considered from the inside is just a set including only mutually dependent elements (Siwoń 1977). B. Siwoń took into account the cybernetic specifications of B. Gliksman (Gliksman 1972) and described the information system as: a combination of co-dependent and cooperative



actions, ensuring the correct economic measurement of phenomena and processes that are the subject of interest of economic management endowed with a certain degree of autonomy in the implementation of tasks aimed at achieving a particular goal (Siwoń 1977).

The contemporary definition of economic information is very subjective because the nature of every piece of information is determined by the person who creates, performs or processes this information. Therefore, nowadays economic information can even be non-quantifiable in the sense of value. Speaking of an information system, one has in mind an information system of a business unit that collects, processes, creates and reports information which is necessary for management purposes. The information may be measurable, immeasurable, economic, uneconomical, or may have any other characteristics (Karmańska 2006). Information is the basis upon which many important decisions are made in a medical entity; the decisions may be of medical or non-medical nature (Table 1).

TABLE 1.  
DECISIONS OF MEDICAL AND NON-MEDICAL CHARACTER IN A HEALTHCARE ENTITY

Content	Decisions of the medical character	Decisions of non-medical character
The decision-making entity	Head of Ward, physician, nurse, support staff, medical technicians, patients.	Healthcare facility manager, facility administration.
The venue of decision-making	Organizational units (e.g. hospital wards, diagnostic facilities).	Management levels (operational, tactical, strategic).
The horizon of decision	Short-term.	Medium and long-term.
Kind of decision	Programmable, ad hoc.	Key, non-programmable.
The subject of decision	The type of medical services necessary for a given patient at a given time, types of medicines, organization of the process of providing services, selection of technologies (methods of providing services), determining the duration of treatment in a hospital etc.	Conclusion of contracts for medical services (assortment and number of services, provision of medical apparatus and equipment), determination of the service production capacity of the facility, improvement of the availability and quality of health services, prices of medical services, employment of personnel, distribution of labour etc.
Kinds of problems that decision concerns	The patient's state of health and applicable standards of medical care shape the current operating costs of the entire facility and its organizational units (cost centres), they also impact its bottom line.	Shaping of future revenues and costs of the facility as well as financial results and future resources of production factors necessary to carry out the assumed tasks.

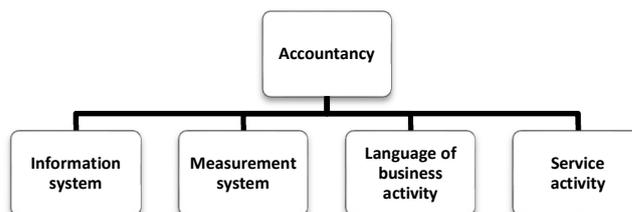
Source: (Hass-Symotiuik, 2010).

The table above presents features of a modern information system of medical and non-medical (management and administrative) entities, whose quality and effectiveness are determined by:

- collection and selection of information from both the external and internal environment of the enterprise;
- assessment of the usefulness of the collected data;
- procedures and efficiency of processing the obtained information;
- synchronization of information flow activities;
- assessment of the decision-making usefulness of the data processed.

The accounting information system is critical for creation of economic information in a medical entity. On the basis of theory and practice, many concepts of accounting systems have been developed. These concepts are presented in Figure 1.

FIGURE 1. DIVISION OF ACCOUNTING DEFINITIONS IN RELATION TO SYSTEM CONCEPTS.



Source: self-study

S. Skrzywan defines accounting as a special type of economic records. It constitutes a system of continuous recognition, grouping, presentation and interpretation of general and detailed figures expressed in money that specify a given economic activity and financial standing of a business unit (Skrzywan 1968). It should be noted that the definition of S. Skrzywan is based on the method of defining accounting in which an important feature of figures is their balancing ability (Gmytrasiewicz & Karmańska 2004). This balance method is considered as the primary source of strength for the accounting system in the struggle with measuring, describing and interpreting economic activity (Surdykowski 1999). The quoted definition limits the scope of accountancy to accounting records i.e. ex post accounting or retrospective accounting, while modern accounting also includes ex ante accounting i.e. planning and management. Z. Kołaczyk explains that the term 'system' means that accounting is comprehensive but at the same time flexible, and has its unique set of rules and principles that result from specific ways of observing, measuring and recording economic events. On the contrary, the concept that accountancy is a special type of economic records means that it is kept in a systematic and continuous manner and it deals with specific economic events occurring in business units (Kołaczyk 1997).

The term accounting is treated by some experts as the language of business activity i.e. a means of conveying information about business activity. S. Tanaka writes that *accountants are trying to map certain economic events of an entity in a unique way, which is called the language of accounting*. Y. Ijiri believes that *as a business language, accounting has many elements in common with other languages. Various business activities of companies are expressed in accounting reports in the accounting language*

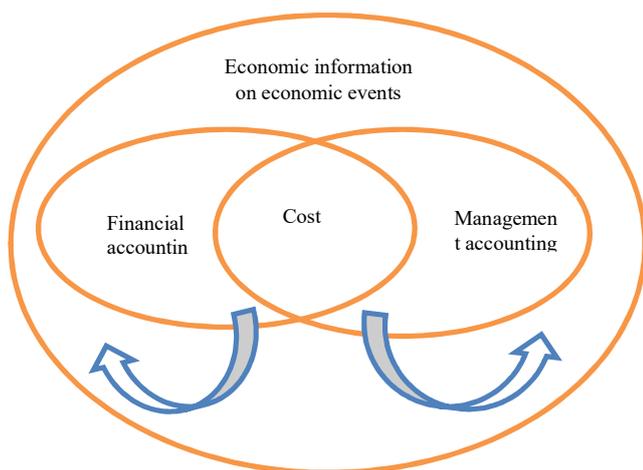
(Samelak 2006).

Accounting is also understood as service activities, as indicated by the definition proposed by the Accounting Principles Board: *accounting is a service activity. Its function is to provide quantitative information, mainly financial, that is useful in making economic decisions* (Szychta 1996). The concept of accounting is also defined as a measurement system. According to R. Mattessich *accounting is a model of double value classification used for the quantitative description and analysis of income streams and aggregate assets and capital volumes, depending on a number of conditions*. Similarly, E. Burzym believes that *accounting is currently considered as the theory of economic measurement (measurement of value) and as a system of such measurement in enterprises and institutions* (Samelak 2006).

To guarantee a more systematic approach to the discipline of accounting, it is necessary to move away from identifying it with economic records and to understand its essence, scope of tasks and functions in a broader perspective (Dobija 2005). An accounting system of a healthcare entity, just as systems of other business units operating in the business environment, assumes a specific structure in which the following elements can be distinguished:

- financial accountancy mainly based on legal acts and accountancy standards - external customer oriented,
- management accounting used mainly in the decision making processes by the executives,
- cost accounting which refers to both abovementioned accounting ranges as well as to interrelations between them (Fig. 2).

FIGURE 2. DIVISION OF ACCOUNTING FROM THE PERSPECTIVE OF INFORMATION ON ECONOMIC EVENTS



Source: self-study.

The end product of financial accounting is the financial report which is the basis for making decisions within management accounting. Individual elements of the financial statement are presented in Table 2.

The balance sheet provides information on the property and financial position of the entity i.e. about the resources owned

by the healthcare entity and their current sources at the time of drawing out the document. The profit and loss account (income statement) presents information on events that occur in a healthcare entity that influence the financial result. The most important revenues of a healthcare entity are revenues from rendering medical services. However, it should be remembered that provision of medical services also generates costs related to these services.

The cash flow statement is a report presenting the revenues and expenses of the healthcare entity divided into: operating activity, investing and financial activities.

International standards define operating activities as the basic type of activity that generates revenues, as well as any other type of activity that is neither investment nor financial activity (Commission Regulation (EC) No 1274/2008 of 17 December 2008 amending Regulation (EC) No 1126/2008 adopting certain international accounting standards in accordance with Regulation (EC) No 1606/2002 of the European Parliament and of the Council with regard to the International Accounting Standard (IAS) 1 / Official Journal of the European Union L 338/3 of 18.12.2008/).

TABLE 2. BASIC ELEMENTS OF A FINANCIAL REPORT OF A HEALTHCARE ENTITY

Financial report	Balance sheet
	Profit and loss account
	Cash flow statement
Additional information	- Intro to the financial report
	- Additional information and explanations
Statement of changes in the entity's own equity	

Source: self-study.

Cash flows from this type of activity are usually the result of transactions and other events that are taken into account when applying the net financial result. Investment activities show the amount of expenditure that was incurred to increase the resources that allow generating future profits from the principal activity. Financial activity is the acquisition or loss of financing sources and it is about changes in the size and ratio of its own and foreign capital (fund) of the entity and the related costs and benefits (Messner 2006). Preparation of cash flow statement based on the income statement and the balance sheet requires the conversion of accrual data contained in these statements into their cash expression.

The statement of changes in the owner's equity presents economic events affecting the value of owners' rights. It is a comprehensive image of balance sheet information contained in

liabilities. The statement of changes in the owner's equity should provide information on:

- total comprehensive income for the period that shows separately the total amounts attributable to the owners of the parent unit and the minority units,
- the impact of retrospective application of changes in accounting policies or retrospective transformations made in accordance with IAS 8 (net profit or loss for the fiscal period, basic errors and changes in accounting policies) for each component of the owner's equity,
- the amounts of transactions with owners as shareholders that show separately the contributions made by the owners and the payments to the owners of the healthcare entity,
- reconciliation of the carrying amount of each equity component at the beginning and end of the period, with a separate disclosure of each balance change.

Additional information includes the introduction to the financial statement as well as explanations and data enabling proper assessment of the entity's material and financial situation. The primary purpose of creating additional information is:

- providing data that enables comparison of financial statements for individual years, applying the principle of continuous preparation of those statements,
- presenting individual structures of balance sheet items and the profit and loss account for the purposes of analysing the financial and property situation of the healthcare entity,
- presentation of tax settlements including costs that are not tax deductible costs,
- providing information that is not included in the financial statements as a result of the adopted net method of their preparation:
  - the amortization value of intangible and legal assets,
  - value of depreciation of fixed assets,
  - contingent receivables and payables,
  - the structure of created provisions for receivables and claims,
  - revaluation write-offs for financial fixed assets,
  - revaluation write-offs of marketable securities,
  - the structure of the distribution of the financial result from the previous year.

To conclude the above considerations, it should be stated that accounting in a healthcare entity due to its specificity, is primarily an information system that provides mainly financial data necessary for external and internal users. The specificity of healthcare entities and their high dependence on the political, legal, tax and social environment causes large fluctuations in the stabilization of the so called health sector (changes in the principles of financing health services, fluctuations of management staff, discretionary decisions made by decision-makers etc.). The above factors create the necessity to take short-term decisions and often ad hoc actions which in consequence gives rise to a situation that broadly understood accounting used in these entities does not always reveal all their

problems and is often limited to purely recording activities.

However, it should be remembered that keeping accounts in medical entities is strictly determined by the system of financing services without which these entities would not be able to operate on the market. Reliable accounting that enables a given entity to perform appropriate calculations under the so-called cost accounting gives the opportunity to apply to the National Health Fund, renegotiate contracts and change prices of medical services. The use of cost accounting in healthcare entities enables an appropriate valuation of medical procedures thanks to which patients can undergo treatment and the services are provided by actual costs incurred.

### III. COST ACCOUNTING IN HEALTHCARE INSTITUTIONS

Data enclosed in statements generated by financial accounting systems of healthcare entities is primarily adjusted to the needs of third party users and does not address the internal needs of decision making. Non-financial information does not constitute a part of data presented in financial accounting systems of contemporary healthcare institutions. The systems record year to year changes in revenues and expenses but the reasons behind these changes are not displayed. Absence of non-financial data such as the number of employees performing specific activities, their experience and education, qualifications, efficiently utilised working time, as well as an amount of materials consumed unreasonably, quality of used materials performed during medical procedures, legislative amendments and rules of contracts, makes the management of healthcare entities very difficult. Successfully developed cost accounting of a given healthcare institution should provide information that will enable:

- efficient management capital;
- proper budget preparation;
- effective cost controlling including reasons for expenses;
- analysis of profitability of medical services provided and determining the real cost of medical services provided (estimation of the medical costs of the procedures used);
- identification and relevant data collection concerning costs in necessary sections;
- identifications of links between individual cost carriers.

Cost accounting of a healthcare institution should provide multidimensional information regarding costs incurred in order to identify expenses and determine interrelationships among cost carriers which constitutes the basis for calculation and taking both strategic and operational decisions.

Pursuant to a concept developed under the guidance of G.K. Świdorska, a system of cost accounting of healthcare institution should consist of three fundamental elements that generate information supplying each other with real data (Świdorska 2013):

1) Patients' medical records :

- consumption of medicinal products for individual patients (both high-value and low-value consumption);
- number of days the patient spent in hospital (broken into

days spent in various wards);

- medical procedures performed on the patient (all medical procedures performed in all wards the patients stayed in- specific information).

2) A properly configured financial and accounting system providing the opportunity to aggregate costs into individual categories:

- medicinal products;
- medical devices and other single-use materials;
- medical devices and other multiple-use materials;
- fixed medical assets and intangibles.
- human resources;
- fixed assets – maintenance of premises;
- external services acquired for patients;
- services from other centres, costs of basic and ancillary activities.

A properly constructed controlling system that enables combining information about patients (point 1) with financial data (point 2). The controlling model should link generated non-financial information with financial data that enables calculation of costs of treatment of each patient. Examples of costs grouping in individual categories of a financial and accounting system are presented in Table 3.

TABLE 3. SIMPLE BASIC COSTS ACCORDING TO THE CATEGORY OF COST CENTRES.

Cost category	Examples of costs
Medicinal products	<ul style="list-style-type: none"> <li>•Unaddressed medicine e.g. analgesics, antipyretics, vitamins</li> <li>•Targeted drugs (e.g. antibiotics; hormonal drugs, alkaloids or derivatives thereof, antisera and vaccines, diagnostic reagents, other medicines and pharmaceuticals).</li> <li>•Blood, blood products and blood substitutes.</li> <li>•Medical gas e.g. oxygen, nitrogen, oxides, carbon dioxide and noble gases.</li> <li>•Contrast to diagnostic tests.</li> <li>•Mix for parenteral and enteral feeding.</li> </ul>
Medical devices and other single- use materials	<ul style="list-style-type: none"> <li>•Diagnostic material e.g. X-ray membranes, ECG paper, EEG, CDs (for CT).</li> <li>•Dressing materials e.g. bandages, swabs, gauze, plasters, adhesive dressings, catgut and similar materials.</li> <li>•Disposable equipment e.g. syringes and needles.</li> <li>•Medical device e.g. endoprosthesis, implants, lenses.</li> <li>•Suturing materials e.g. needles, sutures, stents, staplers, scalpels, adhesive dressings , catgut and similar materials.</li> <li>•Stationery e.g. printing paper, pens, pencils, staplers etc.</li> </ul>
Medical devices and other multiple-use materials not categorised as fixed assets	<ul style="list-style-type: none"> <li>•Economic depreciation of multiple-use surgical clothes e.g. mats, medical gowns, caps.</li> <li>•Economic depreciation of multiple-use medical equipment of low value e.g. surgical instruments.</li> </ul>
Fixed assets (including medical devices) and intangibles	<ul style="list-style-type: none"> <li>•Economic depreciation of fixed asset or hire, rent, and lease service of e.g. equipment, instruments and medical devices, computers, telecommunications equipment etc.</li> </ul>

	<ul style="list-style-type: none"> <li>•Economic depreciation of intangible assets e.g. computer software.</li> <li>•Maintenance and repair of equipment service purchased from external suppliers e.g. repair and maintenance services of machinery.</li> <li>•Used supplies and spare parts for machines, equipment e.g. spare parts for electromechanical hand tools.</li> <li>•Machine or equipment property insurance.</li> </ul>
Human resources	<ul style="list-style-type: none"> <li>•Personal wages and salaries resulting from employment of a group of workers.</li> <li>•Impersonal wages and salaries of a group of employees e.g. due to contract work.</li> <li>•Medical and nursing contracts of a group of employees.</li> <li>•Bonuses, payoffs, and other gratuities of a group of employees.</li> <li>•Employees' contribution for the social security insurance.</li> <li>•Training of employees.</li> <li>•Employees' health check-ups.</li> <li>•Employees' working clothes.</li> </ul>
Fixed assets – maintenance of premises	<ul style="list-style-type: none"> <li>•Economic depreciation or renting and leasing service of a building, premises or rooms.</li> <li>•Fee for perpetual usufruct of land of a building, premises or rooms</li> <li>•Materials for current repairs and maintenance of buildings.</li> <li>•Costs of utilities of a building, premises, rooms such as gas, water, heating and electricity.</li> <li>•Property tax of a building, premises, or rooms.</li> <li>•Detergents and disinfectants for rooms.</li> <li>•Cleaning and waste disposal services for rooms.</li> <li>•Property insurance of rooms.</li> <li>•Protection of property services.</li> <li>•Repair services for premises, buildings, services, rooms.</li> <li>•Telecommunications services of premises, rooms.</li> </ul>
External services acquired for patients	<ul style="list-style-type: none"> <li>•External diagnostic medical procedures and consultations e.g. X-ray, CT, specialist clinics.</li> <li>•Food services e.g. nutrition of patients.</li> <li>•Ambulance services.</li> </ul>
Services from other centres, costs of basic and ancillary activities	<ul style="list-style-type: none"> <li>•Cost of hiring medical equipment of a low reusable value from a storage.</li> <li>•Cost of dispensing medicinal products from the pharmacy.</li> <li>•Cost of sterilisation of medical equipment.</li> <li>•Laundry costs.</li> <li>•Cost of ultrasound.</li> </ul>

Source: (Świdarska 2013).

By selecting cost liability centres it is possible to designate adequate resources to perform activities, as well as determine individuals responsible for the mentioned actions. Moreover, it is also possible to determine the costs incurred while implementing specific tasks by individual cost liability centres of healthcare institutions, thereby there is a possibility to manage the costs rationally.

Implementation of a proper controlling model that combines

non-financial data (mainly quality and quantity data) with financial information arising from a financial and accounting system, empowers simpler cost planning in individual categories (Table 2). It also creates a possibility to compare planned costs to the executed ones not only at the level of the whole healthcare unit but also at the level of individual categories within wards and facilities of the organisational structure of the healthcare institution. All of the above enhances the effectiveness of supervision and ensures quick detection of errors in planning, which is essential from the point of view of rules of provision of medical services.

#### IV. COSTS ANALYSIS OF DIAGNOSTIC IMAGING AND INTERVENTIONAL RADIOLOGY CENTRE IN KATOWICE

The news of the discovery of X-rays was spread around the world on 5 January 1896. Just a few days later K. Olszewski, a professor of the Jagiellonian University in Cracow took the first X-ray picture in Poland, thus opening a new chapter in Polish medicine i.e. radiology. Seeing the great clinical usefulness of X-rays, the medical world unanimously decided to implement the new diagnostic method.

Contemporary medical sciences, including radiology, utilise the latest developments of technology which is an invaluable support for physicians of various specializations to make the right diagnosis and implement the right course of treatment without unnecessary delays. Each hospital or a doctor's surgery are equipped with state of the art modern devices. For radiology technology and modern diagnostic equipment have become the key element needed for proper development and functioning of this area of medicine. What is radiology and what role does it play in the structure of hospitals? Radiology is a separate field of medicine that uses medical imaging to diagnose and treat diseases within human bodies. It can accompany other fields of medicine in the process of treating patients or it can be critical in making diagnosis on the basis of which proper treatment can be implemented. In order to obtain reliable results radiologists use X-rays, CT, ultrasound scans (ultrasonography) and magnetic resonance (MRI). The obtained medical image is then interpreted and described.

It should be highlighted that in order to assure high quality of healthcare services it is necessary to balance a number of needs. To make the right decisions quickly and with confidence, different wards within the hospital must communicate and cooperate. The efficient flow of information within a medical facility cannot be overestimated. When it comes to patients, they require more personalised care at the level which meets their comfort and safety needs.

The costs of functioning of hospital units including radiology centres will always be a subject of interest for the decision makers of a given unit, the National Health Fund (NFZ) and for the public opinion. Health services are predominantly funded from public resources. Changes on the market of medical services require constant improvements and updates of cost management tools as well as methods of measurement, estimation and calculation. In addition, all the requirements should be implemented at the lowest possible costs which is a

difficult task in itself. The costs of radiological procedures such as the ultrasound, X-ray or computed tomography constitute an important component of diagnostic imaging costs. Hospital wards which commission the performance of a given test are charged for performing such tests. Therefore, these expenses and the method of their organisation influence the bottom line of particular wards as well as the financial condition of the entire hospital.

Operations of each radiology centre require a well-thought organisation of work and adequate resources which include:

- necessary materials to perform tests;
- maintenance and servicing of equipment;
- employees;
- departmental costs.

Costs of materials necessary to perform diagnostic tests will largely depend on a given diagnostic laboratory. A computed tomography test requires administration of a contrast medium which must be given intravenously by hand with a syringe, or by means of an automatic syringe. This procedure requires: disinfectant, disposable equipment (a syringe, a needle or a disposable set to administer contrast and saline) and dressings materials. The examination results are provided on a CD. Older X-ray machines (analogue type) use photographic plates which must be developed in a dark room. Therefore, the radiologist needs reagents (fixative, developer) to develop photographic film. The maintenance costs of equipment and medical devices particularly refer to depreciation costs, electricity consumption, replacement of spare parts, calibration services, repairs and maintenance. The equipment and medical devices must be monitored as far as correct technical parameters are concerned, otherwise patients and employees' health and life could be at risk. Typically, servicing and maintenance of medical equipment is performed by specialised external companies.

The costs incurred by the Diagnostic Imaging and Interventional Radiology Centre in Katowice for the year 2017 including individual costs categories are presented in Tables 4-11.

TABLE 4.  
COSTS OF MEDICINAL PRODUCTS IN 2017.

Costs centre:		Diagnostic Imaging and Interventional Radiology Centre		
Assignment category:		Medicinal products		
No.	Cost name	Annual amount of costs incurred in PLN	Cost category number in the financial and accounting system	Assignment method
1	Medicines	90 987,65	1	directly

Source: Own description based on data of John Paul II Upper Silesian Child Health Centre in Katowice.

The Radiology Centre in Katowice in the category 'Medicinal products' distinguishes only one entry i.e. 'medicines' which constitute 2,4743% of all costs of this unit in 2017. The data obtained from patients cost accounting should indicate types of medicines and other medical products administered in the

facility. In this case, the majority of widely understood medicines refer to the contrast medium used in diagnostic tests.

TABLE 5.  
COSTS OF MEDICAL DEVICES AND OTHER DISPOSABLE MATERIALS IN 2017.

Costs centre:		Diagnostic Imaging and Interventional Radiology Centre		
Assignment category:		Medicinal products and other disposable materials		
No.	Cost name	Annual amount of costs incurred	Cost category number in the financial and accounting system	Assignment method
1	batteries, accumulators	93,30	2	directly
2	small disposable equipment	19 267,87	2	directly
3	forms	492,62	2	directly
4	stationery	5 743,09	2	directly
5	medical materials for diagnostic tests	35 949,96	2	directly
6	other medical materials	8 586,01	2	directly
7	registration paper	3 020,49	2	directly
8	other materials	9 551,07	2	directly
9	dressings	2 076,95	2	directly
10	ink, toners	1 730,97	2	directly

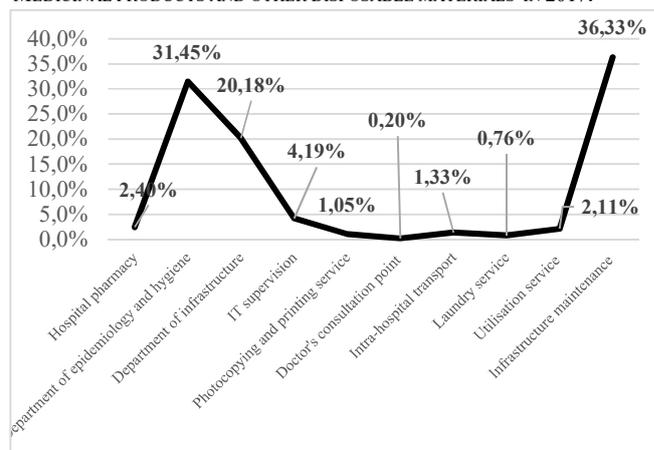
Source : Own description based on data of John Paul II Upper Silesian Child Health Centre in Katowice.

The category 'Medicinal products and other disposable materials' of the Radiology Centre in Katowice features ten cost categories (Diagram 1).

The greatest share of costs in the category 'Medicinal products and other disposable materials' constitutes medical materials used in diagnostic tests, which generate 41,55% of all costs in the category. Meanwhile, small disposable equipment accounts for 22,27% of all expenses in the group, which in total is PLN 86 512,33. For in-depth analysis of all individual costs in the mentioned category it is necessary to maintain detailed analytical records for each type of presented costs.

The category 'Medicinal products and other multiple-use materials not categorised as fixed assets' contains only one type of currently recorded costs, which is 'non-sterile medical equipment', that constitutes merely 0,0715% of all generated costs by the investigated healthcare facility.

DIAGRAM 1. PERCENTAGE OF INDIVIDUAL COSTS IN THE CATEGORY 'MEDICINAL PRODUCTS AND OTHER DISPOSABLE MATERIALS' IN 2017.



Source: Own description based on GCZD data in Katowice

TABLE 6.  
THE COSTS OF MEDICINAL PRODUCTS AND OTHER MULTIPLE-USE MATERIALS, NOT CATEGORISED AS FIXED ASSETS IN 2017.

Costs centre:		Diagnostic Imaging and Interventional Radiology Centre		
Assignment category:		Medicinal products and other multiple-use materials, not categorised as fixed assets		
No.	Cost name	Annual amount of costs incurred	Cost category number in the financial and accounting system	Assignment method
1	Non-sterile medical equipment	2 628,49	3	directly

Source: Own description based on data of John Paul II Upper Silesian Child Health Centre in Katowice.

TABLE 7.  
THE COSTS OF MEDICAL FIXED ASSETS AND INTANGIBLES IN 2017.

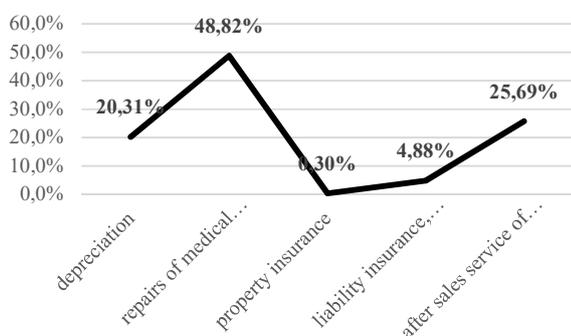
Costs centre:		Diagnostic Imaging and Interventional Radiology Centre		
Assignment category:		Medical fixed assets and intangibles		
No.	Cost name	Annual amount of costs incurred	Cost category number in the financial and accounting system	Assignment method
1	depreciation	77 016,80	4	directly
2	repair of medical equipment	185 123,03	4	directly
3	property insurance	1 142,76	4	directly
4	liability insurance, comprehensive and third party	18 513,46	4	directly

Costs centre:		Diagnostic Imaging and Interventional Radiology Centre		
	insurance, accident insurance			
5	medical equipment maintenance services	97 404,80	4	directly

Source: Own description based on data of John Paul II Upper Silesian Child Health Centre in Katowice.

Based on preserved records, five types of costs are enclosed in the category 'Medical fixed assets and intangibles'. Diagram 2 presents a structure of five types of costs in relation to the whole category.

CHART 2. COST STRUCTURE OF THE 'MEDICAL FIXED ASSETS AND INTANGIBLE ASSETS' CATEGORY IN 2017.



Source: Own description based on data of John Paul II Upper Silesian Child Health Centre in Katowice.

The data presented in Chart 2 clearly points out that 'repair of medical equipment' is the largest cost category among the costs of 'Medical fixed assets and intangible assets', which indicates that this cost center requires a detailed analysis and maybe calls for some vital decisions related to the modernization of medical equipment, otherwise obsolete equipment will generate higher and higher costs in this category. The second group consists of 'Medical equipment maintenance services' (25.69%) these are costs that result from necessary safety regulations related to the use of medical equipment in the audited Radiology Centre. In this category it would be useful to analyze the possibility of reducing costs through modernization or replacement of some of the medical equipment.

TABLE 8. COSTS OF HUMAN RESOURCES IN 2017.

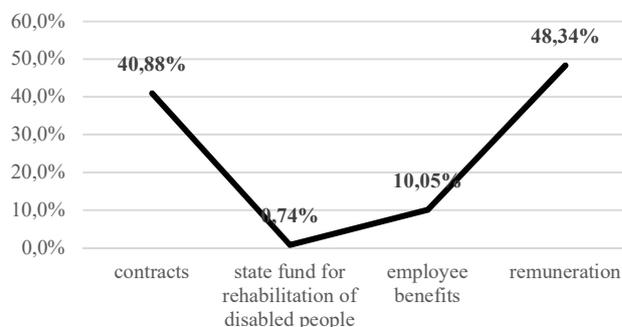
Costs centre:		Diagnostic Imaging and Interventional Radiology Centre		
Cost assignment category:		Human resources		
No	Kind of cost	Annual amount of costs incurred	Cost category number in the financial and	Assignment Method

			accounting system	
1	Contracts	1 082 128,18	5	Directly
2	The National Disabled Persons Rehabilitation Fund (PFRON)	19 583,44	5	Directly
3	Employee benefits	265 943,56	5	Directly
4	Remunerations	1 279 711,93	5	Directly

Source: Own description based on data of John Paul II Upper Silesian Child Health Centre in Katowice.

The category 'Human resources' has been assigned 4 types of costs whose structure in relation to the entire category is presented in Chart 3:

CHART 3. COST STRUCTURE OF THE 'HUMAN RESOURCES' CATEGORY IN 2017.



Source: Own description based on data of John Paul II Upper Silesian Child Health Centre in Katowice.

The data presented in Chart 3 indicate that the costs of 'ordinary' remunerations and the costs of remunerations for contracts are two subjects generating the largest costs in this category (they together account for 89.22% of all costs in this category). A detailed extension of this cost category according to the following diagram would allow a detailed analysis of this category and possible optimization in this respect.

TABLE 9. AN EXTENSIVE SCHEME OF HUMAN RESOURCES COST ACCOUNTING.

Cost driver	Cost type
Doctors /broken down into fixed costs and variable costs/	Remunerations
	Social security and other benefits
	Civil law contracts and other contracts
Nurses /broken down into fixed costs and variable costs/	Remunerations
	Social security and other benefits
	Civil law contracts and other contracts
Resident doctors /broken down into fixed costs and variable costs/	Remunerations
	Social security and other benefits
	Civil law contracts and other contracts
Other medical staff including radiology technicians /broken down into fixed costs and variable costs/	Remunerations
	Social security and other benefits
	Civil law contracts and other contracts
Other remunerations /broken down into fixed costs and variable costs/	Remunerations
	Social security and other benefits
	Civil law contracts

Source: Own elaboration.

A detailed breakdown of 'Human Resources' related costs

will allow for a thorough analysis and indication of the sources of costs, and thus their possible optimization or change.

TABLE 10.

COSTS OF FIXED ASSETS - PREMISES AND THEIR MAINTENANCE IN 2017.

Cost centre		Diagnostic Imaging and Interventional Radiology Centre		
Cost assignment category:		Fixed assets- premises and their maintenance		
No	Kind of cost	Annual amount of costs incurred	Cost category number in the financial and accounting system	Assignment Method
1	Materials for ventilation	555,96	6	Directly
2	Electrical and wiring materials	376,47	6	Directly
3	Cleaning supplies	2 838,84	6	Directly
4	Disinfectants	2 980,15	6	Directly
5	Electricity	167 016,39	6	Directly
6	Heat energy	43 786,95	6	Directly
7	Water	9 937,12	6	Directly
8	Repair services	1 111,76	6	Directly
9	Repair of technical equipment	1 430,76	6	Directly
10	Maintenance services	4 583,47	6	Directly
11	Communication services	369,02	6	Directly
12	Utilities	1 109,26	6	Directly
13	Disinfection, deratisation	885,94	6	Directly
14	Other services	14 670,50	6	Directly

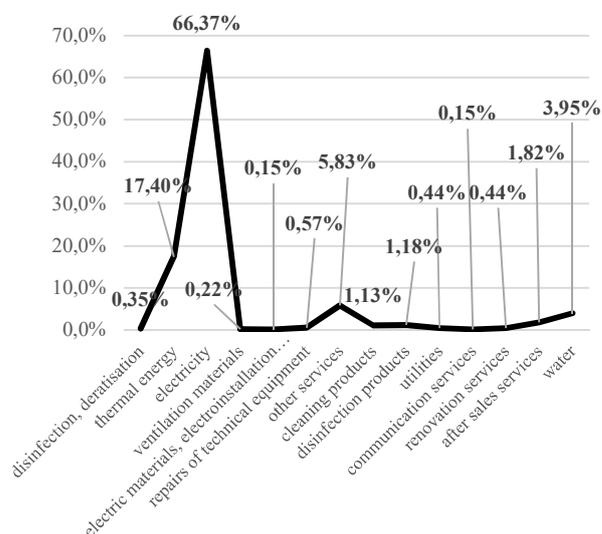
Source: Own description based on data of John Paul II Upper Silesian Child Health Centre in Katowice.

On the basis of the records kept, 14 types of costs were assigned to the 'Fixed assets - premises and their maintenance' category, and the structure of these 14 types of costs in relation to the entire category is presented in Chart 4.

The data presented in the above chart indicates that the cost of electricity accounts for 66.37% of all costs in this category and the cost of heat energy accounts for 17.78% of all costs in this category, which makes them the two objects generating the highest costs. In order to enable a detailed analysis of these costs, it is necessary to record them at the place of origin with a specific division of these costs into fixed and variable. Thus, the introduction of detailed records for the so-called 'Group 5 - costs by origin', broken down into costs directly related to the process of tasks carried out and indirect faculty costs that serve to maintain the functioning of the entire Diagnostic Imaging

and Interventional Radiology Centre, will allow for a thorough analysis of the costs and implementation of optimization processes in this area.

CHART 4. COST STRUCTURE OF THE 'FIXED ASSETS - PREMISES AND THEIR MAINTENANCE' CATEGORY IN 2017.



Source: Own description based on data of John Paul II Upper Silesian Child Health Centre in Katowice.

TABLE 11. COSTS OF SERVICES FROM OTHER COST CENTERS OF PRIMARY AND ANCILLARY ACTIVITIES IN 2017.

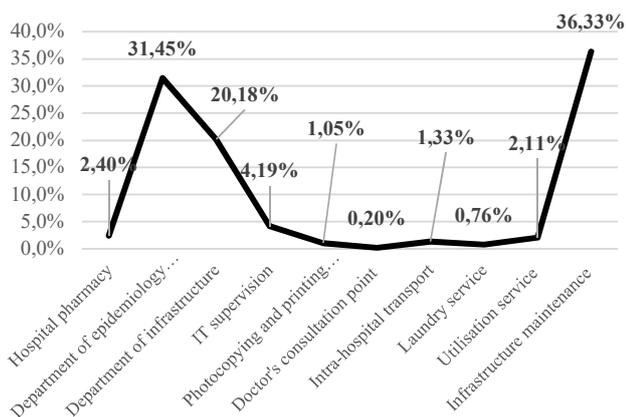
Cost centre:		Diagnostic Imaging and Interventional Radiology Centre		
Cost assignment category:		Services from other cost centers of primary and ancillary activities		
No	Kind of cost	Annual amount of costs incurred	Cost category number in the financial and accounting system	Assignment Method
1	Laundry services	1 666,93	8	Directly
2	Utilization services	4 610,61	8	Directly
3	IT Supervision	9 162,24	8	Directly
4	Department of epidemiology and hospital hygiene	68 839,52	8	Indirectly
5	Department of infrastructure	44 175,41	8	Indirectly
6	Maintenance of hospital infrastructure	79 536,41	8	Indirectly
7	Hospital pharmacy	5 264,20	8	Indirectly
8	Photocopying and printing	2 303,73	8	Indirectly
9	Intra-hospital transport	2 919,56	8	Indirectly

Cost centre:		Diagnostic Imaging and Interventional Radiology Centre		
Cost assignment category:		Services from other cost centers of primary and ancillary activities		
No	Kind of cost	Annual amount of costs incurred	Cost category number in the financial and accounting system	Assignment Method
10	Occupational health officer consultation point	435,17	8	Indirectly

Source: Own description based on data of John Paul II Upper Silesian Child Health Centre in Katowice.

On the basis of the records kept, 10 types of costs were assigned to the 'Services from other cost centers of primary and ancillary activities' category, and the structure of these 10 types of costs in relation to the entire category is presented in Chart 5.

CHART 5. COST STRUCTURE IN THE 'SERVICES FROM OTHER COST CENTERS OF PRIMARY AND ANCILLARY ACTIVITIES' CATEGORY IN 2017.



Source: Own description based on data of John Paul II Upper Silesian Child Health Centre in Katowice.

The data presented in the above chart indicates that indirect costs related to the department of epidemiology and hospital hygiene, department of infrastructure and hospital infrastructure maintenance account for a total of 87.96% of all costs in this category. Thus, a detailed analysis of indirect costs will give the opportunity to optimize the value of the costs incurred.

## V. CONCLUSIONS

Separation of cost categories into individual areas is necessary to manage these costs efficiently. There are cost categories where optimization cannot be made due to the nature of these costs but there are also categories that can be optimized due to the breakdown presented in the study, provided that the medical institution records these costs in various dimensions. Therefore, special attention should be paid to the method of recording costs in the financial and accounting system, which

provides the basis for analysis. The collection and analysis of costs should be made from the point of view of each cost category in each organizational unit of the medical facility, and ultimately from the point of view of the facility as a whole. Costs should be recorded on the basis of internal and external accounting documents, both in a cost by type and the function of expense systems. The cost by type system should allow for efficient preparation of financial statements and help in reporting that is necessary for the purpose of contracting and pricing medical services. In this system, particular attention should be paid to the moment of cost formation i.e. recognition of assets transferred for spending as a cost, and not recognizing assets issued to a given branch/institution as a cost.

The function of expense system should point out places where costs occur in the primary (statutory) activities, ancillary activities and in the management board. As part of the primary activities, the structure of cost centers should be as homogeneous as possible and should reflect the actual course of medical procedures implemented, allowing both cost data and quantitative data to be identified. The costs of ancillary activities should also be recorded, uniformly as far as possible, with the possibility of separating the appropriate cost center and making an appropriate division of common costs on the basis of correctly estimated allocation keys.

Considering the management goals, it is also recommended to keep cost records in a way that separates direct costs and indirect costs of each type of activity, and to make it possible to split costs into fixed costs, i.e. independent from the number of medical procedures carried out and variable costs, i.e. changing with an increase or a decrease in the number of medical procedures implemented.

The method of cost grouping presented in this study is resource-based and allows for transparent control of the costs of owned resources, which enables efficient management. The resource approach to cost accounting allows for a cause-and-effect evaluation of medical procedures conducted by a given branch/institution, it helps to adjust the level of resources to the size of business, allows to budget the costs of individual resources, and gives extensive analytical and control capabilities that allow to calculate unit rates of utilization of a given resource.

## VI. REFERENCES

- Commission Regulation (EC) No 1274/2008 of 17 December 2008 amending Regulation (EC) No 1126/2008 adopting certain international accounting standards in accordance with Regulation (EC) No 1606/2002 of the European Parliament and of the Council with regard to the International Accounting Standard (IAS) 1 / Official Journal of the European Union L 338/3 of 18.12.2008/.
- Dobija, M. (2005). *Teoria rachunkowości w zarysie*. Kraków: Akademia Ekonomiczna w Krakowie, p.161.
- Gliksman, B. (1972). *Cybernetyka zarządzania*. Warszawa: Ośrodek badawczo rozwojowy informatyki, p.1.
- Gmytrasiewicz, M. and Karmańska, A. (2004). *Rachunkowość finansowa*. Warszawa: DIFIN, p.14.
- Hass-Symotiuk, M. (2010). Informacja o stanie zdrowia i opieki zdrowotnej. W: M. Hass-Symotiuk, red., *Rachunkowość. System informacji*

*finansowej Zakładów Opieki Zdrowotnej*. Warszawa: Wolter Kluwer Polska, pp. 18.

Karmańska, A. (2006). *Rachunkowość zarządcza i rachunek kosztów informacji*. Warszawa: DIFIN, pp.121-122.

Kołączyk, Z. (1997). *Rachunkowość finansowa*. Poznań: Akademia Ekonomiczna, p.19.

Kwiatkowska, L. (2001). Strategia przedsiębiorstw w Internecie. *Ekonomika i Organizacja Przedsiębiorstw*, Lipiec, pp. 50.

Messner, Z. (2006). *Rachunkowość finansowa*. Katowice: Akademia Ekonomiczna w Katowicach, p.640.

Samelak, J. (2006). *Rachunkowość finansowa. Teoretyczne podstawy*. Poznań: Akademia Ekonomiczna w Poznaniu, p.9.

Siwoń, B. (1977). *Informacyjna funkcja rachunkowości*. Warszawa: PWE, p.18.

Skrzywan, S. (1968). *Teoretyczne podstawy rachunkowości*. Warszawa: PWE, p.5.

Surdykowski, S. (1999). *Rachunkowość międzynarodowa*. Zakamycze: Kantor Wydawniczy, p.33.

Szychta, A. (1996). *Teoria rachunkowości Richarda Mattessicha w świetle podstawowych kierunków rozwoju nauki rachunkowości – studium metodologiczne*. Warszawa: Fundacja Rozwoju Rachunkowości w Polsce, p.21.

Świdarska, G. (2013). *Rachunek kosztów z Zakładzie Opieki Zdrowotnej. Podręcznik*. Warszawa: Szkoła Główna Handlowa, pp.30-31.