Evaluating Hospital Costs in Kaunas Medical University Hospital

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Nordic School of Public Health

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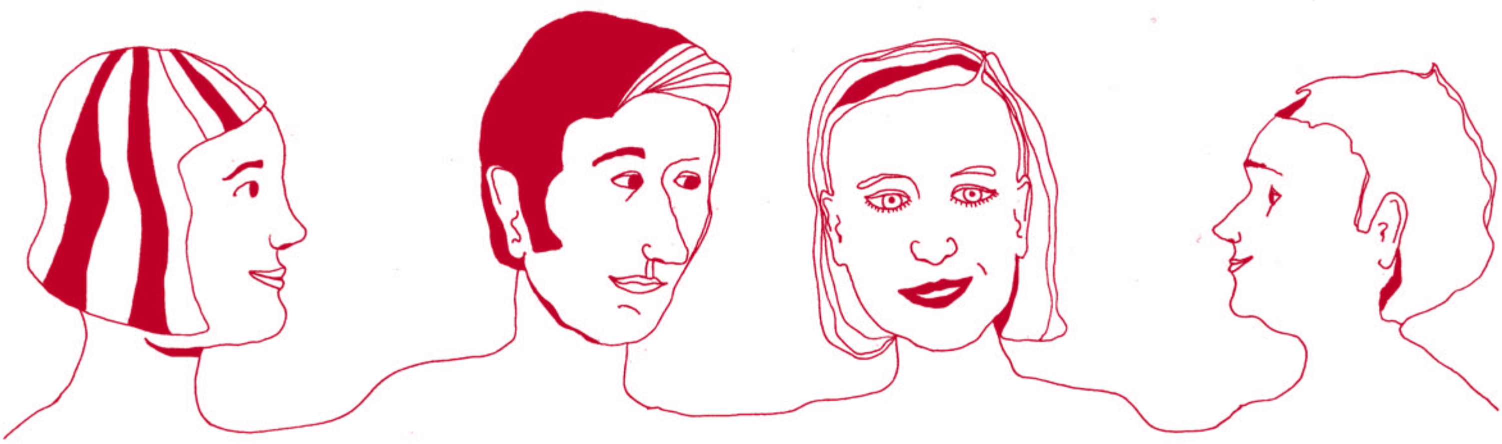

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– Essay –

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Abstract

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Methods. Methods, used in the study include assessment of inputs and outputs, evaluation of average cost per case, estimation of cost structure, estimation of case-mix dimensions in in-patient departments and clinical categories and assessment of impact of case-mix dimensions to cost per case, using multiple regression analysis. Cross-sectional study design was used in the study, evaluating mainly cases and expenses of all 26 specialised in-patient departments of KMUH per year 2002. Five cost groups have been used and defined in monetary terms in each in-patient department: labour costs; medication costs; laboratory, radiology and anaesthesiology costs; running costs of medical equipment supply and other costs (including in-patients' meal costs, transportation, laundry, communication, etc. costs). Case was defined as one treatment episode in particular in-patient department. Cases were analysed using following case-mix dimensions: sex, age, absence or presence of surgical operation, patient separation status and in-patient service group.

Results. Average costs per case vary widely among in-patient departments, ranging from 126.01 Litas (36.52 Euro) to 3451.68 Litas (999.73 Euro) per case. During the study average cost per case were also estimated in clinical profiles – surgery – 1161.0 Litas (336.24 Euro), therapy – 1312.15 Litas (380.02 Euro), obstetrics and gynaecology – 685.82 Litas (198.62 Euro), newborn and child care – 893.54 Litas (258.78 Euro) and intensive care – 1292.92 Litas (374.45 Euro). Using multiple regression analysis method, cost per case in each in-patient department and clinical category according case-mix dimensions were predicted. In all in-patient departments predicted values of average costs per case according case-mix dimensions, comparing with actual values, did not differ so much. Positive contributions to predicted value of cost per case, shows only one variable – IA in-patient service group. In any predicted case contributions of independent variables have not been observed as significant ($p>0.05$).

Conclusions. Inputs (measured in the number of beds) and outputs (measured in the number of in-patient cases and the number of bed-days) are different across in-patient departments, as well as outputs (measured in the number of treatment episodes according to case-mix dimensions). The average costs per case vary widely across in-patient departments and clinical categories. The analysis of the structure of average costs per case demonstrated striking differences in in-patient departments. In all in-patient departments the predicted values of the average costs per case according to case-mix dimensions, do not differ so much comparing with the actual observed costs per case. Positive contributions to the predicted value of the cost per case, shows only one variable – IA in-patient service group. The results of the study have proved the evidence that clinical cases treated within the same in-patient department of the hospital are not similar. The results of study have showed the failure of use of "in-patient service groups" as proxy of International Disease Classification due to number of reasons.

Key words: hospital costs, cost analysis, cost per case, in-patient case-mix

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MPH essay

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List of abbreviations

ACC- Average Cost per Case
ACD – Average Cost per Day
ALS – Average Length of Stay
CV - Coefficient of Variation
DRG – Diagnosis Related Groups
ICD – International Classification of Disease
KMUH – Kaunas Medical University Hospital
RDRG – Redefined Diagnosis Related Groups
SD – Standard Deviation
TC – Total Costs
WHO – World Health Organisation

Introduction

By declaring its independence from the Soviet Union in year 1990, Lithuania inherited Semashko health care model and global budget system, in which health care institutions including all hospitals were budgeted largely on the basis of beds and numbers of medical staff in each institution. It resulted in a high hospital capacity and inefficient use of resources both at an organizational and system level. Indications of inefficiency were given by long lengths of stay and moderate occupancy rates. In the 1990s reductions in the number and use of hospitals were an essential part of reforms (1). Since then, there has been a series of reforms of the health system. In the year 1996 Lithuanian health system was in the process of shifting away from an integrated model towards a contract model, introducing payments to hospitals on the basis of a limited annual contract with Sickness Fund. Payments were based on the cost per case, with cases classified according to 50 groups of diagnoses based on 17 groups in International Classification of Disease (ICD). The price per case was fixed by the Ministry of Health, and based on a cost per day multiplied by a normative length of stay for each diagnosis (2). In 2002, by developing the financing system, a mixed method of financing of hospitals, which combined "global budget" and "prospective per-case reimbursement with a full and partial price" methods, was introduced. Moreover, in order to achieve greater efficiency, "in-patient service groups" have been established, ascribing each in-patient case to one of the four groups, approved by the Ministry of Health. Each in-patient group gives a price per-case distinction.

Never before have health care professionals faced such complex issues and practical difficulties in trying to keep their organizations financially viable. With major changes taking place in payment, delivery, and social systems, health care professionals are faced with dilemma of trying to meet their organization's health-related mission in an environment aimed at economy and efficiency (3). Thus, efficient health care management is essential for community, patients and health care professionals. Inefficient use of resources means that scarce money is wasted, but more importantly implies that the opportunity to save lives and provide care to those in need is lost (4). For some years there has been an increasing interest in the health sector to understand the structure of costs as a major factor in improving efficiency (5). The evaluation of costs, especially in the hospital sector, which is the main consumer of resources in the health care becomes one of the most important management factors. Encountering a difficult situation in many countries hospitals have to be accountable for their expenditures: they have to provide better services at a minimum cost possible, and they have to cater for the increasing demands of patients, relatives and community. The fast development of technology and biomedical sciences is helping to raise the demands and expectations of the population and the cost of the services provided, forcing hospitals to look carefully at what work they do, how they do it, what the results are and how much they cost (6).

Costs in hospital sector could be defined as "the expenses incurred by a hospital in providing care; the hospital costs attributed to a particular patient care episode include the direct costs plus an appropriate proportion of the overhead for administration, personnel, building maintenance, equipment, etc."(7). Expenditures are described as "the amounts spent by health care organizations on total health care and/or its various components. These amounts may or may not be equivalent to the actual costs" (8).

Some authors state that too often providers do not realize the total costs of providing care (9), while others argue that measures such as efficiency and financial performance should be a priority for hospitals (10). More often hospital administrators raise the questions how much this medical service or surgical procedure costs the hospital to provide and what the most efficient way for resource allocation is. Hospitals are discovering that they do not have appropriate answers to these crucial questions (11). The hospital as a complex human service organization must adapt to continuing pressures for change from its internal and external environments. Internal pressures include a changing patient population with new patterns of illness and age structures, as well as revised clinical treatment protocols, and new technology. External pressures include governmental efforts to rein back state health care budgets, of which hospitals generally consume more than a half (12,13).

In developed health care systems hospitals evaluate costs and expenses routinely, especially in systems, where payment to hospitals is based on Diagnosis Related Groups (DRG) (14). DRG classifies patient care by relating common characteristics such as diagnosis, treatment and age to an expected consumption of hospital resources (15). Cost containment has been central to discussions of reform and regulation of health care in almost all countries. Various strategies have been adopted in order to contain costs and different approaches are appropriate in different health care systems (16). Hospitals are making considerable effort to improve both hospital and staff performance by introducing incentives to optimise clinical performance, to improve the organizational environment, and supply-side incentives associated with payment mechanisms (12). New payment mechanisms have been introduced as well as considerable work has been done to refine case-mix or diagnosis related groups funding (12,17,18). Case-mix is defined as a mix of patients served by a provider, and classified by one or more salient characteristics (age, sex, diagnosis, acuity, etc.) (3). It has already been recognized that "crude hospital statistics can be dangerously misleading and need adjusting for case-mix" (19), that "effects of case-mix are large" (20) and that the analysis of a hospital's financial situation can be significantly enhanced by adding several non-financial measures, such as case-mix adjusted admissions and case-mix adjusted admissions per beds in service (21).

In Lithuania hospitals are financed on the basis of the number of discharges, weighted by the type of a clinical category, level of in-patient care and "in-patient service groups" (approved by the order of Ministry of Health) within the contract limits with Sickness Fund. Rational resource allocation among departments and evaluation of hospital costs is a concern of hospital managers and in most cases does not attain much attention.

As no previous hospital cost study has been announced in Lithuania so far, the results obtained from the study could be useful in developing more rational allocation of resources within the hospital. This research aims to evaluate the average cost per case in hospital departments and measure the possible impact of in-patients case-mix to hospital costs.

Purpose

The purpose of this study is to evaluate hospital costs in Kaunas Medical University Hospital.

Objectives

1. To assess inputs and outputs of each in-patient department.
2. To estimate the average costs per case and the structure of costs in each in-patient department and clinical category.
3. To predict the costs per case according to case-mix dimensions of each in-patient department and clinical category.
4. To analyse potential usage of hospital costs estimation for decision making at a hospital level.

Research Questions

- Are hospital costs consistent throughout in-patient departments?
- Can case-mix dimensions explain any observed differences in costs?
- Can hospital costs of different in-patient (treating patients with different diagnosis) departments be compared by using "in-patient service groups" as a proxy of diagnostic categories?

Scientific Theories

Hospitals and their Functions

At the outset, it is necessary to describe definitions of "hospital", in order to clarify its characteristics and measurable outcomes. WHO defines a hospital as a "residential establishment with inpatient facilities for 24 hours medical and nursing care, diagnosis, treatment and rehabilitation of the sick and injured, usually for both medical and surgical conditions, and staffed with at least one physician, and which may also provide outpatient services" (24). Hospital has also been defined as "an organized effort to provide a specific set of health care services, usually located in one or several buildings, and related to specialized cure (diagnosis and treatment) and care (as opposed to primary care) with the input of health professionals, technologies, and facilities, aimed at meeting patient needs." (25) or just simply "institutions with an organized medical staff which provide medical care to patients"(26).

All of these definitions refer to multifunctional characteristics of the hospital as well as multidimensional outputs (27):

1. Patient Care
    1.1. Inpatient, outpatient and day patient
    1.2. Emergency and elective

    1.3. Rehabilitation
2. Health System Support
    2.1. Source of referrals
    2.2. Professional leadership
    2.3. Base for outreach activities
    2.4. Management of primary care
3. Employment
    3.1. Inside hospital: health professionals, other health care workers
    3.2. Outside hospital: suppliers, transport services
4. Societal
    4.1. State legitimacy
    4.2. Political symbol
    4.3. Provider of social care
    4.4. Base for medical power
    4.5. Civic pride.

In economical terms, four broad categories of hospital output have been distinguished (28):

1. In-patient treatment is the treatment of patients who are admitted to stay in hospital while being treated;
2. Out-patient treatment is the treatment of patients without admission to hospital;
3. Teaching is the provision of doctor and/or nurse education;
4. Research is a systematic inquiry aimed at expanding the stock of knowledge in medicine.

In terms of this categorization of hospital outputs, the study has been carried out regarding the provision of in-patient treatment to be the defining characteristic, since remaining types of output can each be produced in institutions other than hospitals.

Hospital Performance Measurement and Hospital Efficiency

WHO defines performance as "the level of attainment of a goal in comparison to a given effort." (29) Applying the notion of performance to a hospital entails actual descriptions of valid aspects of hospital functions, structure, and objectives that are at least quantifiable (or measurable) and amenable to change. These valid aspects comprise the relevant dimensions of hospital performance. The WHO project on hospital performance assessment (30) has conceptualized six major dimensions of hospital performance: clinical effectiveness, patient-centeredness, production efficiency, safety, staff orientation, and responsive governance.

Hospital performance can be monitored by external authorities using a variety of methods as well as by hospitals themselves. These among others include the assessment of hospital performance against a set of indicators. Performance indicators might rank hospital performance in terms of responsiveness to patients, cost efficiency and clinical outcomes (31).

The evaluation of hospital performance is one of the main issues. Sicotte C, Champagne F, Contandriopoulous AP, Barnsley J et al. (32) describe the conceptual framework of health care organizations' performance using a set of different functions and dimensions of performance and its evaluation questions, some of which are directly related to hospital inputs, outputs and costs (Table 1):

Table 1. Some dimensions of hospital performance

Function	Dimensions of performance	Evaluation questions
Goal attainment function	Effectiveness (production of outcomes)	Is the organization contributing to health outcomes?
	Efficiency	Is hospital an efficient organization? Is allocation of resources efficient in terms of outcome improvements?
Service production function	Service volume	What is the output production of the health care organization?
Strategic alignment	Appropriateness of adaptation processes in relation to goals	Is allocation of resources adequate in regard to targeted goals?

Microeconomic efficiency refers to both allocative and technical efficiency in various parts of health sector. The goal is to achieve a combination of services that minimizes costs while maximizing health outcomes within the resources available. It requires a search for technological innovations, organizational configurations, and combinations of inputs that can increase efficiency to the greatest extent. (33).

"Efficiency" is one of the key dimensions for assessing hospital performance, which entails such indicators as unit costs, the length of stay (adjusted for differences in case-mix), bed occupancy rate, the structure of costs, etc. (34) Organizational efficiency is described as the capacity of an organization, institution, or business to produce the desired results at a minimum cost of energy, time, money, personnel, material, etc.(35) or the capacity to produce the maximum output for a given input (36). Efficiency measures whether healthcare resources are used to get the best value for money. Furthermore, it is concerned with the relation between inputs (costs, in the form of labor, capital or equipment) with either intermediate outputs (numbers treated, waiting time, etc.) or final health outcomes (lives saved, life years gained, etc.). Efficiency is a hospital's optimal use of inputs to yield maximal outputs, given its available resources. WHO classically defines efficiency as "the capacity to produce the maximum output for a given input."(29). Traditionally, there are three types of efficiency (30,55): technical efficiency, allocative efficiency, and cost-effectiveness. Despite the unclear use of the term efficiency, the goal of efficiency is to get the most out of scarce resources, usually by avoiding resource waste (i.e. technical efficiency), producing each output at the least cost (cost-effective efficiency), and producing types and amounts of outputs that people value (allocative efficiency). When all these are met, there is an efficient allocation of resources. "Not wasting resources" and "producing each output at least cost" refer to production; "producing types and amounts of outputs that people value" relates to consumption, thus integrating the supply and demand sides of the output exchange. In summary, efficiency is all about "doing the right things" (i.e. allocative efficiency), and "doing things right" (i.e. technical efficiency and cost-effectiveness). In a hospital technical efficiency may be concerned with the necessary staffing levels relative to anticipated or actual patient service needs. In addition, one may be interested in looking at the cost-effectiveness of alternative ways of doing things (e.g. mix of providers) in the hospital relative to attaining a specified performance level. When the service outputs conform to patients' preferences [and legitimate needs], the hospital strives for allocative efficiency. Considerable challenges also confront the operationalization of efficiency as cost per unit service, and the broader relationship of performance and costs.

Hospital Inputs and Outputs

Generally, patients are admitted to hospital because they are ill or are suspected of being so. The hospital then combines various inputs – diagnostic tests, nursing services, drugs, meals and so on – in producing a treatment of the patient's condition. A treatment is then defined as the service arising from the combination of these inputs to provide a diagnosis of an illness or suspected illness together with an attempt to cure that illness and/or alleviate its symptoms if its presence is confirmed. For practical applications, some authors have suggested that the appropriate unit of output is a treatment of an episode of an illness, while others emphasize the same issue from another point of view, defining the hospital product as the number and categories of episodes of an illness.

A unit of measurement, which is more easily identified, is an episode of hospitalization, which begins when the patient is admitted and ends when the patient is discharged. Consequently, the production of a unit of output is complete each time a patient is discharged, giving rise to a treated case as a unit of measurement. While an episode of hospitalization provides an operational unit of account for output measurement, it may not be a homogeneous unit across hospitals. Even for the treatment of identical patients with identical illnesses admission/discharge policies may differ among hospitals as well as individual characteristics of patients (28).

In the economic analyses of the health care industry factor inputs are usually classified as labor, capital, and supplies (1,37,38), which are defined in monetary terms. In the concept of hospital output, two approaches are distinguished:

1. the hospital output is improvement in the health status of its patients,

2. the hospital output is treatment, and hospitals produce treatments, which may or not may improve a patient's health status.

Since changes in health status are difficult to measure as well as the contributions of multifarious factors which influence health status are difficult to disentangle (28), the latter approach has been adopted in this study.

In studies of hospital costs two units of output measurement have been generally adopted:

1. the number of cases treated;

2. the patient day, with the total output over a given time period then being taken as a total number of patient days provided over that time period.

Both of them are closely related: the number of days over which a treated case is produced, or the length of stay, indicates the time period over which the treatment takes place. It could be decided to treat more cases more intensively over a shorter time span or less intensively over a longer time span. In either situation, the same quantity of output may be produced.

It is evident that any given average cost per case can be obtained by a range of combinations of the average cost per day and the average length of stay. Since the treated case has been argued to be a "more defensible" unit of output than the patient day (28), this study takes into account both average costs per case. One aspect of hospital output, i.e. quality, is not measurable, and the approach assumes that on average this is relatively constant across clinical departments.

Hospital Costs and their Evaluation

There are different approaches to costing, ranging from complex econometric studies using large data sets to bottom-up analysis of the cost structures of a limited number of facilities. Cost information may be obtained through budgetary or expenditure data or through examination of actually observed resource utilization (5). In this study the expenditure data of clinical departments have been used.

Variables investigated in this study are showed in Table 2.

Table 2. Variables and their definitions

Variables	Variable name	Definitions
Input variables	the number of beds	the total number of in-patient beds in an in-patient department
Output variables	In-patient cases	the number of cases in an in-patient department
	Bed-days	the total number of bed-days
Cost variables	Labor costs	the total costs of staff salaries (taxes included) of an in-patient department
	Medication costs	the total costs of medicines and caring means of an in-patient department
	Laboratory, Radiology and Anaesthesiology services	the costs of Laboratory, Radiology and Anaesthesiology services, including salaries of their personnel, the costs of medications and supply, respectively
	Running costs of medical equipment	the running costs of medical equipment, used in an in-patient department, but not including costs of equipment itself;
	Other costs	the costs of in-patients' meal, laundry, transportation, communication, auxiliary services, heating, electricity, water, buildings maintenance and repair, etc.of an in-patient department
	Total department costs	Net operating costs of an in-patient department

The analysis of costs may be undertaken for a number of reasons. Although cost analyses are not economic evaluations per se, they are tools that can provide useful insight on how the projects function. Managers may want information for one or a combination of the following objectives:

- to improve budgeting by monitoring costs;
- to improve the efficiency of the intervention by identifying potential costs savings;
- to estimate the resources required to sustain the intervention by seeking an accurate estimate of the budget necessary to maintain it;
- to estimate the resources required to expand the intervention (39).

According to Drummond MF, Stoddart GL and Torrance GW (40), there are several types of economic health care evaluations, which may be distinguished according two questions:

1. is there a comparison of two or more alternatives?
2. are both costs (inputs) and consequences (outputs) examined?

Table 3 represents six-cell matrix for economic evaluation situations.

Table 3. Distinguishing characteristics of health care evaluations

	Are both costs (inputs) and consequences (outputs) examined?			
		No		Yes
		Examines only outputs	Examines only costs	
Is there a comparison of two or more alternatives?	No	Outcome description	Cost description	Cost-outcome description
	Yes	Efficacy or effectiveness evaluation	Cost analysis	1. Cost-minimization analysis (CMA) 2. Cost-effectiveness analysis (CEA) 3. Cost-utility analysis (CUA) 4. Cost-benefit analysis (CBA)

In cells “Outcome description”, “Cost description” and “Cost-outcome description”, there is no comparison of alternatives – just a single service or programme is being evaluated:

- Outcome description – only the consequences (outputs) of the service or programme is being evaluated;
- Cost description – only the costs are examined;
- Cost-outcome description – both outcomes and costs of a single service or programme are described.

Cells “Efficacy or effectiveness evaluation” and “Cost analysis” entail the evaluation of the situations in which two or more alternatives are compared, but in which the costs and consequences of each alternative are not examined simultaneously:

- Efficacy or effectiveness evaluation – only the consequences of the alternatives are compared;
- Cost analysis – only the costs of alternatives are examined.

The above listed economical evaluation situations are called partial evaluations, since they do not fulfill both of the conditions of the economical evaluations.

The techniques, listed in the last cell - Cost-minimization analysis, Cost-effectiveness analysis, Cost-utility analysis, and Cost-benefit analysis are called full economic evaluations and require much more complex techniques (40-44), in order to assist decision making when choices have to be made between several courses of action (45).

This study sets out to analyse both outcomes and actual costs of a single service however two or more alternatives of spending cost are not taken into account as the study is the ”cost-outcome description”. Of course, the usual measurement of the costs of the services will not inform us whether it is cost effective (46), but it will give a possibility to estimate hospital costs and provide background for further hospital cost analysis.

According to M.Linna (37), the total costs of hospital are set up from expenses of medical staff, materials, capital and other services, which are described as hospital inputs. The number of cases is used as hospital outputs (28,37) in this study. A case is defined as one treatment episode in a particular in-patient department. Having estimated expenditures and outputs (number of cases) in each clinical category of KMUH, the average expenditures per case will be estimated.

In-patients Case-mix

Undoubtedly, there is a wide range of variations in the cost per unit of output among clinical departments. In his article of 1975 Dowling W (47) proposed a general model of 11 cost-influencing variables that determine expenditure levels in hospitals:

1. Number of cases treated.
2. Length of stay.
3. Complexity of case-mix.
4. Intensity of services:
   4.1. changes in employee skill mix;
   4.2. productivity;
   4.3. patient case-mix complexity;
   4.4. intensity of services;
   4.5. non-labor factors.
5. Scope of services.
6. Amenity levels.
7. Quality level.
8. Efficiency.
9. Input prices.
10. Investment in human and plant resources.
11. Teaching programs.

Other authors conclude on importance of a single variable to hospital costs. J.R.G.Butler (28) states that "case mix has been found to exert a statistically significant influence on inter-hospital variation in the average cost per case", others (48) maintain that "comparisons of performance should take case mix into account, as failure to do so could significantly bias results".

Although in health care cost functions have been used for several reasons (to identify the characteristics of the "optimal" hospital – returns to scale, capital level, diversification of services; to identify performance differences across ownership structures), this approach has also been relied upon to suggest optimal budget allocation (50).

The complexity of what hospitals do makes such measurement difficult even in the narrow specialty of acute care, not least because of the resources used, and the observed results are so dependent on the sorts and conditions of patients admitted – the hospital case-mix (20). Diagnosis Related Groups is the best classification system used to measure hospital case-mix and it is probably most widely applied (37). In this study variations of expenditures inside the hospital have been assessed and evaluated according to the average number of cases and case-mix dimensions. Since in the clinical category different specialised in-patient departments have patients with different diagnosis and thus will never be comparable according to the clinical diagnostic category, the traditional diagnostic category (ICD-10) measurement will not give any reasonable explanations. Therefore, this study has used “in-patient service groups” as a proxy of a diagnostic category. Other case-mix dimensions, such as sex, presence or absence of surgery, age and separation status (51), have been applied in this study as well. A detailed description of case-mix dimensions and variables is given in Table 4.

The length of stay is an important indicator of efficiency for inpatient care but it does not achieve an adequate performance if it is not adjusted for the case mix of the patients hospitalized during the period considered (52). From another point of view, when hospital financing depends on a budget which in turn depends on the pathologies being treated, it is necessary to detect hospital stays which show discrepancies between the resources they consume and the medical characteristics they present (53).

Expenditures and costs have been analyzed and estimated in Lithuanian currency – Litas, which rate to Euro is: 1 Euro is equal to 3.4528 Litas (this rate has been fixed in Lithuania).

Methodology

Study Design

Cross-sectional study

Study Subjects

In-patient departments of Kaunas Medical University Hospital.

Sampling and Sample Size

Inputs (1995 beds), outputs (84926 in-patients cases and 587763 bed-days) and expenses (in totally 77 765 249.50 Litas) of all 26 specialised in-patient departments of Kaunas Medical University Hospital per year 2002 have been investigated. The data have been collected from KMUH and National Sickness Fund data basis.

During the year 2002 there have been 84926 in-patients cases and the total number of bed-days was 587763. The number of in-patients beds – 1995. The total expenditures of Kaunas University Medical Hospital for in-patient care were 77 765 249.50 Litas (22 522 373.0 Euro).

Ethical Considerations

Since this research study will not directly refer to the patients and will not have any impact on the individuality and health of the patient, ethical considerations do not need to be accepted by ethical committee.

Settings

Kaunas Medical University Hospital is the largest hospital in Lithuania. KMUH has 1995 in-patient beds and 26 specialised in-patient departments provide a wide range of in-patient services (except bone marrow transplantation). The total number of staff is 5130, including 960 physicians and 2130 nurses. Per year 2002 the total number of in-patient admissions was 67538, the number of surgical operations constituted 38684, childbirths reached 2535. KMUH has a limited annual budget, based on contract with Sickness Fund. Payment is provided according to number of in-patients, classified into groups of level of care, clinical categories (surgery, therapy, child care, obstetrics-gynaecology, intensive care, etc) and newly introduced "in-patient service groups". Resource allocation to in-patient departments is based on budgeting according to historical expenditure and the number of discharges, weighted by the type of specialty and in-patient service groups. Such criteria are criticized, since they are unprecise indicators of the expenses and favour the biggest consumers (14). Therefore, the information on costs is inevitable for the management to enable control of costs and to ensure financial viability of departments by rational resource allocation.

As it is stated by Feldman and Lobo (22), one of the features of global budget systems is that the hospital itself exercises budget control. The allocation of the hospital's budget between quantity and resources intensity is controlled by administrators, who maximize their own utility function. The total budget represents a spending ceiling for providers, while per-case reimbursement ensures the revenues from each treated case and gives the incentive to maximize profit for each admitted patient. Even though global budgets control over total costs is proper, there is little incentive to use resources efficiently. Prospective per-case payment gives incentives for hospitals to treat more cases and to reduce costs per case, but the control over total costs is less efficient. However, sometimes hospitals may be encouraged to treat the "optimal" number of in-patients in order to reach the ceiling of "global budget" (increase productivity; or simulate provider-induced demand) or may be forced to reduce costs per case treating the patients beyond the limit of "global budget" and thus to decrease costs per case.

Physicians are important individual participants in health service. Much of the resource consumption is performed by the decision of a physician. Despite a few methods of remuneration of physicians and combination of different payment methods, in most cases physicians are paid on salary basis in Lithuania, as well as in Kaunas Medical University Hospital (KMUH). Empirical data suggest that salaried physicians treat patients with lower utilization of resources, fewer diagnostic and treatment procedures comparing with those fee-for-service paid. There is no possibility of over-pricing and the control of total costs is performed appropriately. However, in such a case reduced productivity could be a problem (23).

Statistical Analysis

Having primary information on basic performance indicators of in-patient departments, such as the total number of in-patient cases, the total number of bed-days, the average lenght of stay has been measured in each in-patient department:

$ALS_i = d_i/n_i$ (equation 1)

where ALS_i stands for the average length of stay, n_i - the total number of cases treated, and d_i - the total number of patient days for the i^{th} hospital.

The average cost per case can be measured using the following equation:

$TC_i = ACC_i \times n_i = ACD_i \times d_i$ (equation 2)

where TC_i stands for total costs, ACC_i –the average cost per case, ACD_i – the average cost per day for the i^{th} hospital.

Total costs (TC_i) can be expressed as the product of the average cost per unit of output (ACC) and the total number of units of output produced (n), or as the product of the average cost of inputs used per day (ACD) and the total number of patient days provided (d). Rearranging the above equation gives:

$ACC_i = ACD_i \times ALS_{i\,,}$ (equation 3)

where ALS_i is the average length of stay in the i^{th} hospital, given by d_i/n_i.

In this study the following equation has been used to estimate the average cost per case:

$ACC_i=TC_i/n_{i,}$ (equation 4)

The average cost per bed-day has been calculated by the following equation:

$ACD_i = TC_i/d_{i,}$ (equation 5)

In this study the coefficient of variation has been calculated in order to compare the relative variation or spread of distributions of different series, samples or of distributions of different characteristics of single series. The coefficient of variation is the ratio of the standard deviation of a series to the arithmetic mean of the series:

$CV=SD/x$, (equation 6)

where CV is the coefficient of variation, SD – standard deviation and x- arithmetic mean.

In order to explain variations in cost per unit of output among hospital clinical departments (49), a very simple linear specification has been used. Given data on total costs and the number of cases treated in each clinical department, the following total cost equation can be estimated using a multiple regression analysis:

$$C_h = \alpha_0 + \sum_{i=1}^{n} \alpha_i x_{ih} + \varepsilon \text{, (equation 7)}$$

where C_h denotes the cost per discharge (or the cost per case) in the *h*th hospital, α – coefficient, ε – standard error. As regressors (x_{ih}) the following variables, for which the causal relationship to hospital cost is supposed, have been used (Table 4):

Table 4. Case-mix dimensions and variables

No	Dimension	Variables
1.	In-patient service group	IA-Clinical pathologies (based on the diagnosis), which need to be treated at a hospital, and providers are not able to influence the demand. Payment, provided by Sickness Fund, is 100% of the estimated price per case without any limits.
		IB - Clinical pathologies (based on the diagnosis), which need to be treated at a hospital, but providers can hardly influence the demand. Payment, provided by Sickness Fund, is 100% of the estimated price per case within the contract limits. Each case over the contract limit is paid depending on the total number of cases within this group.
		II - Clinical pathologies (based on the diagnosis), which need to be treated at a hospital, but providers can influence the demand. Payment, provided by Sickness Fund, is 100% of the estimated price per case within the contract limits. Each case over the contract limit is paid 25% (when a surgical operation has been performed) or 15% (when a surgical operation has not been performed) of the estimated price.
		III- Clinical pathologies (based on the diagnosis), which do not need to be treated at a hospital (or which have to be treated by ambulatory services). Payment, provided by Sickness Fund, is 50% of the estimated price per case within the contract limits. Each case over the contract limit is paid 25% (when a surgical operation has been performed) or 15% (when a surgical operation has not been performed) of the estimated price.
2.	Sex of an in-patient	Male
		Female
3.	The surgery performed	the presence of a surgical operation, which is described by Ministry of Health
		the absence of a surgical operation
4.	The age of an in-patient	0-14 years old
		15-44 years old
		45-64 years old
		65 years and over
5.	Separation status of an in-patient	Discharged from hospital home
		Transferred to another clinical department or hospital
		Died

All listed case-mix variables were used as regressors in equation 7, giving in total 192 different combinations of in-patient case-mix. The full list of in-patient case-mix variables is presented in Annex 1.

In order to measure the relation between the variables, the correlation analysis method has been used. Correlation is a measure of correspondence between two variables and denoted by the coefficient of correlation. The most widely used type of correlation coefficient is Pearson's, also called linear or product-moment correlation. In this study Pearson's correlation coefficient has been used in order to determine the relation between the variables, and expressed by the letter r, can vary from +1.0 and -

1.0. When r = +1.0 there is a perfect positive linear relationship in which one variable varies directly to the other; when r = -1.0 there is a perfect negative linear relationship between the variables. The measure can be generalized to quantify the degree of linear relationship between one variable and several ones, in which case it is known as the multiple correlation coefficient.

In this study the interpretations of correlation coefficients (r) have been used in the following range:

from -1.0 to -0.7 – a strongly negative correlation;
from -0.69 to -0.3 – a medium negative correlation;
from -0.29 to -0.01 – a weakly negative correlation;
0.0 – lack of correlation;
from 0.01 to 0.29 – a weakly positive correlation;
from 0.3 to 0.69 – a medium positive correlation;
from 0.7 to 1.0 – a strongly positive correlation.

Even though correlation is useful as one of the determinants of causality, correlation by itself is not an equivalent to causation. Therefore, the interpretation of correlated variables has been used just for possible explanations of some results, but not treated as direct factors of causations even in a case of significance.

In order to predict the cost per case according to case-mix dimensions, the multiple regression analysis method has been applied. The general purpose of multiple regression is to determine the relationship between several independent or predictor variables and a dependent or criterion variable. Given the data on a dependent variable and data of independent variables, regression analysis involves finding the "best" mathematical model to describe a dependent variable as a function of independent variables, or, as it is in this case, to predict the dependent variable cost per case (in this study – the cost per case) from independent variables (in this study – in-patient service groups, sex, age, absence or presence of surgical operation and separation status; see Table 4).

The ridge regression analysis is used when independent variables are highly intercorrelated, and stable estimates for the regression coefficients cannot be obtained via ordinary least squares methods. Specifically, a constant (lambda) has to be added to the diagonal of the correlation matrix, which is then re-standardized so that all diagonal elements are equal to 1.0 (and the off-diagonal elements are divided by a constant). The constant (lambda) is between 0 and 1.0 in value. In other words, ridge regression artificially decreases the correlation coefficients so that more stable (yet biased) estimates (beta coefficients) can be computed. Using ridge regression analysis, the contribution of each case-mix dimension to the predicted average cost per case has been calculated.

Defining the multiple regression, the following criteria have been used:

- the intercept – a value in the regression line, used by the option. Regression with the intercept is used in analyses, in cases when the regression line describing the relationship between some variables would be predicted to have not a zero intercept. The intercept is calculated automatically." the coefficient of multiple correlation

(Multiple R), which is the positive square root of the coefficient of multiple determination (R-square). This statistics are useful in multivariate regression, when the relationship between the variables is described.

- the coefficient of multiple determination (R-square), measures the proportion of the total variation. The higher coefficient of multiple determination is, the closer regression line is to the experimental data.
- the adjusted R-square. The R-square is adjusted by dividing the error sum of squares and the total sums of square by their respective degrees of freedom.
- the standard error of estimate. This statistic measures the dispersion of the observed values about the regression line. The lower value of standard error of estimate is, the less dispersion from the regression line is.
- the regression coefficient (Beta coefficient) represents the independent contributions of each independent variable to the prediction of the dependent variable. However, their values may not be comparable between variables because they depend on the units of measurement or ranges of the respective variables.
- Adjusted Beta coefficients are the regression coefficients, which would have been obtained had first standardized all variables to a mean of 0 and a standard deviation to 1. The advantage of Adjusted Beta coefficients (to compare with B coefficients, which is not standardized), is that the magnitude of these Adjusted Beta coefficients allow to compare the relative contribution of each independent variable in the prediction of the dependent variable. Adjusted Beta coefficient can range from -1.0 to +1.0.
- Cook's distance. This is another measure of the impact of the respective case on the regression equation. It indicates the difference between the computed B coefficient values and the values one would have obtained, had the respective case been excluded. All distance should be of an equal magnitude; if not, then there is a reason to believe that the respective cases biased the estimation of the regression coefficients.

In order to perform analytic comparisons, statistical significance (or significant difference) has been calculated. The statistical method allows an estimate to be made of the probability of the observed or greater degree of association between the independent and dependent variables under the null hypothesis. From this estimate in a sample of given size, statistical significance of a result can be stated. Therefore, it can be concluded that a difference between the variables is due to factors other than chance. Usually statistical significance is stated by the P-value.

P (probability) value indicates the probability that a test statistic would be as extreme as or more extreme than observed if null hypothesis were true. The latter p, followed by the abbreviation n.s. (not significant) or by the symbol < (less than) and a decimal notation, such as 0.01 and 0.05, is a statement of probability that the difference observed could have occurred by chance if the groups were really alike. The study result which probability value is less than 5% ($p<0.05$), is considered sufficiently unlikely to have occurred by chance to justify the designation "statistically significant".

All data have been analysed using software Statistica, version 5.5. in this study.

Results

Inputs and Outputs in In-patient Departments

Inputs of in-patient departments were measured by the number of beds, while outputs were counted by the total number of cases and bed-days. Table 4 represents inputs and outputs and the average length of stay of each in-patient department.

Table 4. Inputs and outputs of in-patient departments

Clinical departments	Inputs	Outputs		The average length of stay
	No of beds	No of cases	No of bed-days	
Surgery profile				
Ophtalmology	150	9483	47563	5.02
Otorhinolaryngology	50	2533	14993	5.92
General surgery	135	6307	40508	6.42
Cardiosurgery	72	1632	19966	12.23
Neurosurgery	220	5875	63239	10.76
Thoracic surgery	25	666	6468	9.71
Urology	35	1459	13120	8.99
Orthopedics-traumatology	20	1235	10450	8.46
Face and maxilar surgery	40	1920	7349	3.83
Therapy profile				
Endocrinology	112	3345	34655	10.36
Gastroenterology	40	1263	12658	10.02
Haematology	30	934	10325	11.05
Cardiology	135	4808	43238	8.99
Nephrology	30	1015	8992	8.86
Neurology	120	3343	36654	10.96
Dermatovenerology	20	433	4652	10.74
Oncology	40	716	13853	19.35
Psichiatry	85	866	22576	26.07
Pulmonology	50	1597	16544	10.36
Rheumatology	30	840	8799	10.47
Newborn and child care				
Pediatrics	105	4331	26665	6.16
Child surgery	75	4058	22472	5.54
Neonatology	110	2626	26261	10.0
Obstetrics-gynaecology				
Obstetrics-gynaecology	170	10658	48354	4.54
Intensive care				
Obstetrics-gynaecology intensive care	6	2876	2876	1.0
Central intensive care	15	2085	4914	2.36
Cardiosurgery intensive care	6	816	2523	3.09
Cardiology intensive care	12	3132	4414	1.41
Newborn intensive care	12	477	3395	7.18
Neurosurgery intensive care	18	2256	6507	2.88
Child intensive care	12	1374	2880	2.09
KMUH totally	***1995***	***84926***	***587763***	***6.92***

Table 4 shows that the number of in-patient beds within in-patient departments ranged considerably, i.e. from 6 in Obstetric-gynaecology and Cardiosurgery intensive care departments to 18 beds in Neurosurgery intensive care department and from 20 in Dermatovenerology department to 220 in Neurosurgery department.

The number of cases treated differed even more, i.e. from 477 in Newborn intensive care to 3132 in Cardiology intensive care and from 433 in Dermatovenerology to 10658 in Obstetrics-gynaecology.

The number of bed-days differed also, i.e. from 2523 in Cardiosurgery intensive care to 6507 in Neurosurgery intensive care and from 4652 in Dermatovenerology to 63239 in Neurosurgery.

Intensive care departments had a shorter average length of stay comparing to other clinical categories. The average length of stay ranged from 1.0 in Obstetrics-gynaecology intensive care to 7.18 days in Newborn intensive care; and from 3.83 in Face and maxilar surgery to 26.07 days in Psichiatry.

In KMUH, the total number of beds was 1995, the total number of in-patient cases was 84926, the total number of bed-days was 587763. The average length of stay was 6.92 days per case.

Hospital Costs and Expenditures

All costs were collected at a clinical in-patient department level. In the study the following five input groups were used and defined in monetary terms for each in-patient department:

- Labor (salaries and taxes) costs;
- Medication (drugs and caring means) costs;
- Laboratory, Radiology and Anaesthesiology (for surgical clinics) services costs (including salaries of its personnel, costs of medications and supply, respectively);
- Running costs of medical equipment supply (do not include costs of equipment itself);
- Other costs (including costs of patients' meal, laundry, transportation, communication, auxiliary services, heating, electricity, water, buildings maintenance and repair, etc.).

The total costs of clinical departments were estimated by the sum of the above listed expenditures.

Costs did not include capital and capital investment costs in this case.

Table 5 represents total expenditures, the average cost per case and the average cost per bed-day in in-patient departments.

Analysing the total expenditures of in-patient departments, striking differences were observed, ranging from 362403.99 Litas in Obstetrics-gynaecology intensive care to 7084020.38 Litas in Neurosurgery per year 2002. Correlation analyses of the total expenditures and the number of beds, the number of cases, and the number of bed-days showed strong positive and significant ($p<0.05$) correlations: 0.90, 0.85 and 0.90 respectively. It proved that by increasing the number of beds, the number of cases and the number of bed-days the total expenditures increased as well.

Table 5. Total expenditures, the average cost per case and the average cost per bed-day in in-patient departments

In-patient departments	Total expenditure (Litas)	The average cost per case (Litas)	The average cost per bed-day (Litas)
Surgery category			
Ophtalmology	5 670 363.62	597.95	119.22
Otorhinolaryngology	1 592 878.03	628.85	106.24
General surgery	6 386 663.34	1012.63	157.66
Cardiosurgery	2 982 123.63	1827.28	149.36
Neurosurgery	7 084 020.38	1205.79	112.02
Thoracic surgery	1 413 341,74	2122.13	218.51
Urology	2 359 627.65	1617.29	179.85
Orthopedics-traumatology	1 023 259.69	828.55	97.92
Face and maxilar surgery	1 184 051.32	616.69	116.12
Therapy category			
Endocrinology	2 747 469.42	821.37	79.28
Gastroenterology	1 312 537.29	1039.22	103.69
Haematology	1 067 629.11	1143.07	103.40
Cardiology	4 375 451.87	910.04	101.19
Nephrology	2 212 653.71	2179.95	246.07
Neurology	2 969 262.19	888.20	81.01
Dermatovenerology	460 880.11	1064.39	99.07
Oncology	1 400 918.45	1956.59	101.13
Psichiatry	2 154 004.34	2487.30	95.41
Pulmonology	1 698 779.39	1063.73	102.68
Rheumatology	738 988.23	879.75	83.99
Newborn and child care category			
Pediatrics	2 863 123.31	661.08	107.37
Child surgery	2 938 954.23	724.24	130.78
Neonatology	3 401 455.83	1295.30	129.52
Obstetrics-gynaecology category			
Obstetrics-gynaecology	7 021 736.06	658.82	145.21
Intensive care category			
Obstetrics-gynaecology intensive care	362 403.99	126.01	126.01
Central intensive care	2 252 131.25	1080.16	458.31
Cardiosurgery intensive care	1 697 065.62	2079.74	672.64
Cardiology intensive care	1 227 614.41	391.96	278.12
Newborn intensive care	1 646 452.10	3451.68	484.96
Neurosurgery intensive care	2 250 975.40	997.77	345.93
Child intensive care	1 268 433.84	923.17	440.43
KMUH totally	***77 765 249.50***	***915,68***	***132.31***

The average cost per case differed among in-patient departments, ranging from 126.01 Litas per case in Obstetrics-gynaecology intensive care to 3451.68 Litas per case in Newborn intensive care. Correlation analyses of the average cost per case and the number of beds as well as the number of bed-days showed negative correlations (-0.2; and -0.23 respectively). The correlation between the average cost per case and the number of cases was also negative -0.46 ($p<0.05$).

The average cost per bed-day differed less, comparing to the average cost per case in in-patient departments. The range of the average cost per bed-day was between 126.01 Litas in Obstetrics-gynaecology intensive care and 672.64 Litas in

Cardiosurgery intensive care and between 79.28 Litas in Endocrinology and 246.07 Litas in Nephrology. Correlation analyses of the average cost per bed-day and the number of cases, the number of beds, and the number of bed-days showed negative correlations (-0.25; -0.46 and -0.46 respectively; $p<0.05$ for correlations between the average cost per day and the number of beds and the number of bed-days).

Table 6 represents the structure of expenditures per case in in-patient departments according to five major groups – salary costs; medication costs; laboratory, radiology and anaestesiology service costs; running costs of medical equipment supply and other costs.

Analysing the structure of the average expenditures per case, notable differences were observed across in-patient departments, i.e. salary costs ranged from 17.61% in Urology to 68.70% in Newborn intensive care; medication costs varied from 1.34% in Neurosurgery to 29.95% in Cardiosurgery intensive care. A relatively high proportion of laboratory, radiology and anaesthesiology services costs was observed in Obstetrics-gynaecology intensive care, Urology and Thoracic surgery clinical departments (59.99%; 49.42% and 39.34%, respectively), while Psichiatry and Oncology departments showed the lowest percentage – 3.49% and 4.52%, respectively. The proportion of running costs of medical equipment supply in clinical departments varied relatively little, i.e. from 0.0% in Psychiatry to 9.98% in Oncology. The proportion of other costs also showed a statistical variation, with the exception of intensive care departments. The latter could be explained by a relatively small number of in-patients and bed-days, for which the number (e.g. heating, electricity, water, buildings maintenance and repair, etc.) of other costs was calculated.

Table 6. The structure of expenditures per case in in-patient departments

In-patient departments	Structure of expenditures (%)				
	Salary costs	Medication costs	Laboratory, radiology and anaesthesiology services costs	Running costs of medical equipment supply	Other costs
Surgery category					
Ophtalmology	36.5	14.11	22.28	1.44	25.67
Otorhinolaryngology	39.72	7.31	24.15	0.34	28.48
General surgery	36.1	20.96	18.22	1.85	22.87
Cardiosurgery	43.23	19.98	6.97	7.47	22.35
Neurosurgery	38.66	1.34	27.0	4.08	28.91
Thoracic surgery	29.02	14.46	39.34	0.33	16.86
Urology	17.61	9.12	49.42	7.16	16.69
Orthopedics-traumatology	36.13	9.54	23.91	2.27	28.15
Face and maxilar surgery	40.44	12.76	22.15	1.37	23.28
Therapy category					
Endocrinology	41.64	10.92	11.47	0.29	35.69
Gastroenterology	43.35	11.97	11.11	5.55	28.01
Haematology	39.70	18.61	13.87	0.32	27.50
Cardiology	43.65	11.46	10.06	6.05	28.77
Nephrology	45.28	26.95	7.25	6.40	14.13
Neurology	42.04	9.03	9.98	3.40	35.55
Dermatovenerology	58.91	3.28	8.69	0.27	28.86
Oncology	48.25	9.47	4.52	9.98	27.78

Psichiatry	61.69	4.96	3.59	0.0	29.96
Pulmonology	43.27	16.46	10.86	1.80	27.61
Rheumatology	40.80	13.63	11.37	0.44	33.77
Newborn and child care					
Pediatrics	48.39	7.81	14.19	1.59	28.01
Child surgery	41.23	12.07	20.92	1.48	24.30
Neonatology	61.24	4.87	7.26	0.30	26.33
Obstetrics-gynaecology					
Obstetrics-gynaecology	41.07	9.04	22.25	3.99	23.65
Intensive care					
Obstetrics-gynaecology intensive care	0.0*	18.58	59.99	0.0*	21.43
Central intensive care	53.19	25.66	11.51	1.57	8.07
Cardiosurgery intensive care	58.93	29.95	5.78	0.09	5.96
Cardiology intensive care	53.09	12.51	21.01	0.59	12.80
Newborn intensive care	68.70	18.76	4.12	0.27	8.15
Neurosurgery intensive care	52.94	24.72	9.80	2.17	10.37
Child intensive care	61.09	18.34	10.77	1.65	8.15

*- Costs are incorporated in Obstetrics-gynaecology clinical department expenditures. Due to internal integration of Obstetrics-gynaecology intensive care department into Obstetric-gynaecology clinical department, it was impossible to distinguish the salary costs and running costs of medical equipment supply in Obstetrics-gynaecology intensive care department.

Since KMUH provides a wide range of different in-patient services, all clinical departments were grouped into five clinical categories: surgery, therapy, obstetrics-gynaecology, newborn-child care and intensive care.

Average expenditures per case in clinical categories are represented in table 7.

Table 7. Average expenditures per case in clinical categories

Clinical categories	The number of in-patient departments within the clinical category	Arithmetic mean of average costs per case (Lt)	Standard deviation	Coefficients of variations
Surgery	9	1161,10	570,85	0,49
Therapy	11	1312,15	595,38	0,45
Obstetric-gynaecology	1	658,82	-	-
Newborn-child care	3	893,54	349,36	0,39
Intensive care	7	1292,92	1134,45	0,88

At a clinical category level arithmetic means of the average cost per case varied widely enough, i.e. from 658.82 to 1312.15 Litas. As it is seen from the coefficients of variations in table 7, the spread of distributions of average costs per case in in-patient departments from the arithmetic mean of average costs per case within a clinical category was high. An estimation, that average expenditures per case in therapy were higher than in surgery or intensive care, could be explained by the fact that this study did not aim to investigate the actual costs (it only used information about the costs) thus the amount of money allocated for the services may not be equivalent to the actual costs.

The proportion of expenditures per case was another important issue regarding the average expenditures per case (Table 8).

Table 8. The proportion of expenditures per case in clinical categories

Clinical categories	The proportion of expenditures (%)				
	Salary costs	Medication costs	Laboratory, radiology and anaesthesiology services costs	Running costs of medical equipment supply	Other costs
Surgery	33.8	12.8	27.7	3.5	22.2
Therapy	48.0	12.7	8.3	3.5	27.5
Obstetric-gynaecology	41.1	9.0	22.2	4.0	23.7
Newborn-child care	52.7	7.5	12.7	0.9	26.2
Intensive care	60.5	22.3	8.2	0.7	8.3

The proportion of average expenditures per case varied statistically as well. Salary costs ranged from 33.8% in surgery to 60.5% in intensive care; while medication costs varied from 7.5% in newborn-child care to 22.3% in intensive care. A relatively high percentage of laboratory, radiology and anaesthesiology services costs were observed in surgery, obstetric-gynaecology and newborn-child care, respectively.

The proportion of running costs of medical equipment supply varied relatively little from 0.9% to 4.0%, similarly to the percentage of other costs, with the exception of intensive care category.

The analysis of the correlations of the average expenditures per case and different costs (salary, medication, services, running costs of equipment supply and others) within clinical categories, yielded the following results (Table 9):

Table 9. Correlation coefficients of the average cost per case in clinical categories and cost groups

Cost groups	Correlation coefficients				
	Surgery	Therapy	Newborn-child care	Intensive care	Obstetric-gynaecology
Salary cost	0.11	0.13	0.96	0.60	N.c.
Medication cost	0.05	0.07	-0.67	0.34	N.c.
Laboratory, radiology and anaesthesiology services costs	0.03	-0.46	-0,77	-0.82	N.c.
Running costs of medical equipment supply	0.53	0.06	-1.0*	-0.2	N.c.
Other costs	0.04	-0.25	0.83	-0.02	N.c.

*-p<0.05

N.c. -correlations cannot be computed due to fewer than 3 valid cases (fewer than 3 in-patient departments within a clinical category)

- in the surgery category a medium positive correlation was found for the average cost per case and running costs of medical equipment supply (r=0.53), while other groups of costs correlated slightly positive with the average expenditures per case;
- in the therapy category a weak positive correlation was observed between the average cost per case and salary, medication and running costs of medical equipment supply (r=0.13, r=0.07 and r=0.06, respectively), while laboratory, radiology and anaesthesiology services and other costs correlated negatively;
- in the newborn-child care category the average cost per case expressed a strong positive correlation with the salary and other costs (r=0.96 and r=0.83, respectively),

while the other groups of costs expressed a negative correlation, including running costs of medical equipment supply ($r=-1.0$; $p<0.05$);

- in the intensive care category the average cost per case expressed a medium positive correlation with the salary and medication costs ($r=0.60$ and $r=0.34$, respectively), while the other groups of costs indicated a negative correlation.

In-Patients Case-Mix

Analysing the number of cases in each in-patient department, case-mix dimensions were introduced in order to examine the complexity of in-patients (see Table 4 and Annex 1). The proportions of case-mix in each in-patient department have been calculated.

Analysing case-mix proportions of in-patients in the departments of surgical category (case-mix structure in surgical clinical departments is represented in Annex 2), the following results were estimated:

- IA service group (most "valuable" for providers) was ranging from 0.0% in Othorhinolaryngology to 7.01% in Neurosurgery;
- III service group (most "undesirable" for providers) was ranging from 0.0% in Thoracic surgery to 5.73% in Face and maxillar surgery;
- The structure in in-patients sex varied within surgery clinical departments; the highest proportion of males showed Thoracic surgery (76.4%) and Cardiosurgery (69.1%); the highest proportion of females was observed in Orthopedics-traumatology (60.0%) and in Ophtalmology (56.9%) departments;
- The in-patients group aged 0-14 was ranging from 0.14% in Urology to 43.0% in Othorhinolaryngology;
- The group of 65 and over was ranging from 13.8% in Neurosurgery to 55.1% in Ophtalmology;
- Othorhinolaryngology (90.5%) and Cardiosurgery (89.8%) showed the highest proportion of presence of a surgical operation, while Neurosurgery and Ophtalmology departments revealed the lowest proportion (65.8% and 81.1%, respectively);
- Separation status of in-patients was very similar across all surgical departments, prevailing discharges (from 85% to 99.3% of all in-patients). The highest proportion of died in-patients was in Cardiosurgery (0.98%) and in General surgery (0.68%) departments.

Analysing case-mix proportions of in-patients in the departments of the therapy category (case-mix structure in therapy clinical departments is represented in Annex 3), the following results were calculated:

- IA service group was quite uncommon, ranging from 0.0% in Endocrinology, Gastroenterology, Psychiatry, Pulmonology and Rheumatology departments to 20.8% in Nephrology;
- III service group was also ranging from 0.0% in Nephrology and Dermatovenerology departments to 15,9% in Cardiology;

- Pulmonology (61.0%) and Cardiology (58.4%) comprised the highest proportion of males while Rheumatology (68.8%) and Endocrinology (64,6%) departments showed the highest percentage of females;
- The in-patient group aged 0-14 was barely common, ranging from 0.0% in Gastroenterology, Cardiology, Dermatovenerology, Pulmonology and Rheumatology departments to 34.3% in Neurology,
- The in-patient group aged 65 and over was ranging from 15.0% in Psychiatry to 47.8 % in Cardiology;
- The presence of a surgical operation in therapy clinical departments was ranging from 3.5% in Psychiatry to 22.5% in Gastroenterology;
- The separation status of in-patients was similar across all therapy departments, prevailing discharges (from 84 to 96.7% of all in-patients). The highest proportion of died in-patients was observed in Pulmonology (2.6%) and in Neurology (2.21%) departments.

Analysing case-mix proportions of in-patients in the newborn and child category (case-mix structure in newborn and child category clinical departments is represented in Annex 4), the following results were estimated:

- IA service group was ranging from 0.0% in Pediatrics to 20.8% in Neonatology;
- III service group was ranging also from 0.0% in Neonatology to 16.5% in Child surgery;
- The highest proportion of males was observed in Child surgery department (61.9%), while the highest proportion of females was in Neonatology department (46.4%);
- The in-patient group aged 0-14 was prevailing in all newborn-child care departments, only with 6.35% and 7.39% of in-patients of 15-44 age group in Pediatric and Child surgery department;
- The presence of a surgical operation was ranging from 0.88% in Neonatology to 65.5% in Child surgery;
- The separation status of in-patients was hardly variable across all newborn and child care departments, prevailing discharges (from 96.0% to 99.0% of all in-patients). The highest percentage of died in-patients was in Pediatrics department (0.16%).

Obstetrics-gynaecology category consisted only of one department. The structure of in-patients according to case-mix dimensions of this category is represented in Annex 4.

Analysing case-mix proportions of in-patients in the intensive care category (case-mix structure in intensive care departments is represented in Annex 4), the following results were estimated:

- IA service group was ranging from 0.0% in Obstetrics-gynaecology intensive care to 93.3% in Newborn intensive care;
- No patient was found of III service group in all intensive care departments;
- The highest proportion of males was in Cardiosurgery intensive care department (67.0%), while the highest proportion of females was in Obstetrics-gynaecology intensive care department (100.0%);

- The in-patient group aged 0-14 was ranging from 0.0% in Obstetrics-gynaecology intensive care and Central intensive care departments to 100% in Newborn intensive care;
- The group of 65 and over was prevailing in Cardiosurgery intensive care (54.0%) and Cardiology intensive care (52.0%) departments;
- The presence of a surgical operation was ranging from 2.91% in Child intensive care to 77.9% in Obstetrics-gynaecology intensive care;
- The separation status of in-patients was similar across all intensive care departments, prevailing transfers to other clinical departments or health care institutions (from 83.5% to 100.0% of all in-patients). The highest proportion of died in-patients was observed in Central intensive care department (15.1%).

The distribution of case-mix dimensions was also grouped into five clinical categories, i.e. surgery, therapy, obstetrics-gynaecology, newborn-child care and intensive care. Table 10 represents the distribution of the average number of cases according to case-mix dimensions in each clinical category.

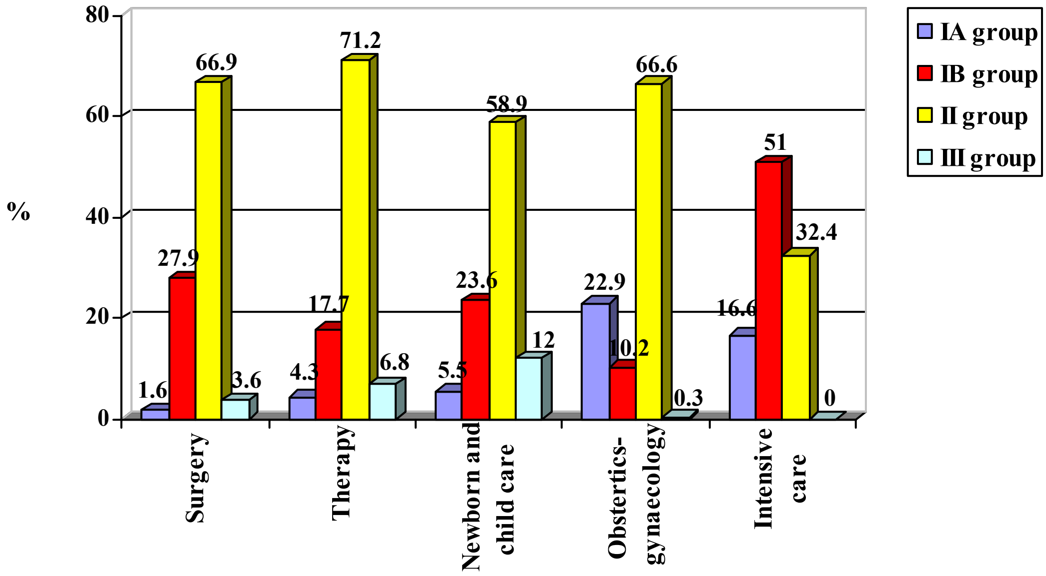
Table 10. The distribution of the average number of cases according to case-mix dimensions in clinical categories

Case-mix dimensions	The average number of cases									
	Surgery		Therapy		Obstetrics-gynaecology		Newborn-child care		Intensive care	
	n	%	n	%	n	%	n	%	n	%
In-patient service groups										
IA group	55	1.6	76	4.3	2444	22.9	202	5.5	308	16.6
IB group	964	27.9	309	17.7	1083	10.2	866	23.6	949	51.0
II group	2313	66.9	1240	71.2	7101	66.6	2162	58.9	603	32.4
III group	125	3.6	117	6.8	30	0.3	442	12.0	0	0
Sex										
Male	1780	51.5	843	48.4	0	0	2082	56.7	873	46.9
Female	1677	48.5	899	51.6	10658	100	1590	43.3	987	53.1
Age										
0-14 years	464	13.4	181	10.4	4	0.04	3480	94.8	250	13.4
15-44 years	905	26.2	404	23.2	8344	78.3	192	5.2	505	27.2
45-64 years	937	27.1	594	34.1	1681	15.76	0	0	571	30.7
65 years and over	1151	33.3	563	32.3	629	5.9	0	0	534	28.7
Surgical operation										
Presence	2816	81.5	284	16.3	7298	68.5	917	25.0	498	26.8
Absence	641	18.5	1458	83.7	3360	31.5	2755	75.0	1362	73.2
Separation status										
Transferred	132	3.8	156	8.9	3940	36.97	102	2.8	1705	91.7
Discharged	3313	95.8	1567	90.0	6715	63.0	3567	97.1	26	1.4
Died	12	0.4	19	1.1	3	0.03	3	0.1	129	6.9
Totally	3457	100	1742	100	10658	100	3672	100	1860	100

The analysis of outputs in the in-patient clinical categories, demonstrated differences both in the average number of cases within the clinical category and case-mix dimensions. High variations not only in absolute, but in relative numbers of the average number of cases according to case-mix dimensions were observed as well:

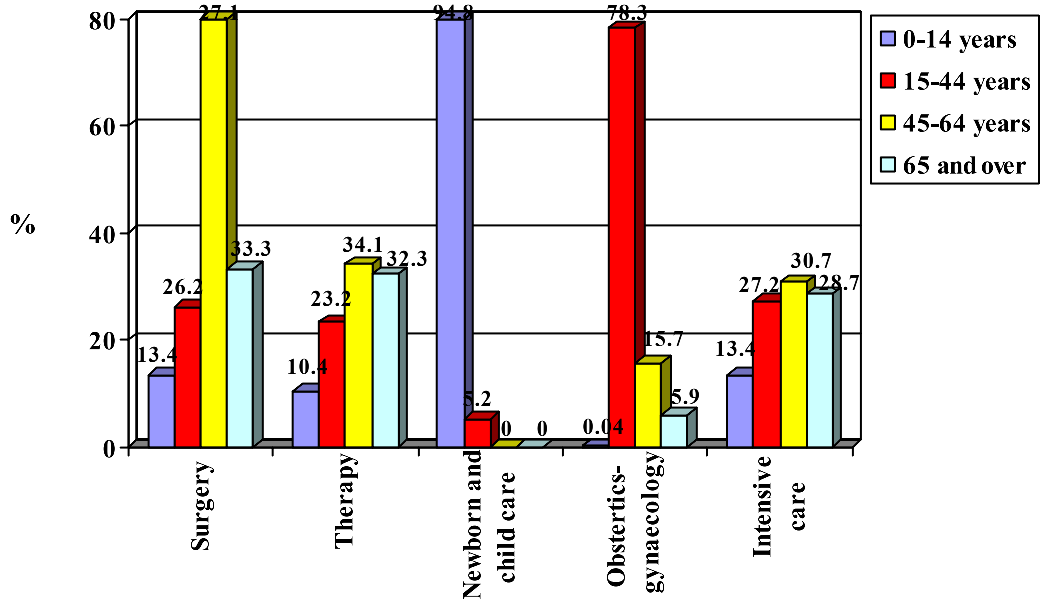
- the highest proportion of IA in-patients service was observed in obstetric-gynaecology category (22.9%), while the lowest was in surgery category (1.6%); the highest percentage of III group (within which diagnoses are not supposed to be treated at the in-patient clinic) was observed in newborn-child care category (12.0%), and the lowest – in intensive care. The above mentioned differences could be explained by the list of diagnoses within each in-patient service group, e.g. the child delivery was on the list of IA group, while in the same group there was only one case (multiple trauma, operated by two or more specialized surgeon groups) in surgery. A relatively high proportion of in-patients of III group in the newborn-child care category could be explained as a demand for specialized observation of children before clinical diagnosis was set up. Figure 1 shows the structure of the average number of in-patients according in-patient service groups in clinical categories;
- in clinical categories the differences of proportion of in-patients sex were smaller, except obstetric-gynaecology category, where only females were treated;

Figure 1. The structure of the average number of in-patients according to in-patient service groups in clinical categories



- differences in the age structure, as well as in the presence or absence of a surgical operation, were influenced by the specialization of in-patient clinics and clinical categories. Figure 2 shows the structure of the average number of in-patients according to age groups in clinical categories;
- in the separation status dimension the highest proportion of deaths was observed in the intensive care category (6.9%) while the lowest percentage was observed in the obstetric-gynaecology category (0.03%). The clinical rationale could explain it by the fact that intensive care departments dealt with the most complicated and fatal clinical cases. It was further proved by the fact no case of III in-patients service group was observed in the intensive care category throughout the year 2002.

Figure 2. The structure of the average number of in-patients according to age groups in clinical categories



The correlations between average cost per case and number of cases in each clinical category according case-mix dimensions have been calculated (Table 11). The correlation coefficients are negative in most cases:

- in the surgery category IA, IB in-patient service groups, transferred and died in-patients expressed weak positive correlations to the average cost per case (r=0.02, r=0.04, r=0.18 and r=0.25, respectively); all other case mix dimensions revealed negative correlations;
- in the therapy category all in-patients case-mix dimensions expressed negative correlations to the average cost per bed-day;
- in the newborn-child care category a strong positive correlation was observed between IA in-patient service group (r=1.0; $p<0.05$) and IB in-patient service group (r=0.96); all other case mix dimensions expressed negative correlations;
- in the intensive care category a strong positive correlation of the average cost per case was observed with IA in-patient service group (r=0.71) and a weak positive correlation with the group aged 0-14 (r=0.17), while all other case mix dimensions expressed negative correlations, including transferred in-patient group (r=-0.88; $p<0.05$).

Table 11. Correlation coefficients of the average cost per case in clinical categories and case-mix dimensions

Case-mix dimensions	Correlation coefficients				
	Surgery	Therapy	Newborn-child care	Intensive care	Obstetrics-gynaecology
In-patient service groups					
IA group	0.02	-0.34	1.0*	0.71	N.c.
IB group	0.04	-0.36	0.96	-0.71	N.c.
II group	-0.56	-0.41	-0.99	-0.71	N.c.
III group	-0.42	-0.29	-0.99	-	N.c.
Sex					
Male	-0.39	-0.42	-0.97	-0.36	N.c.
Female	-0.51	-0.49	-0.86	-0.72	N.c.
Age					
0-14 years	-0.59	-0.33	-0.99	0.17	N.c.
15-44 years	-0.41	-0.26	-0.99	-0.61	N.c.
45-64 years	-0.26	-0.42	-	-0.67	N.c.
65 years and over	-0.34	-0.39	-	-0.46	N.c.
Surgical operation					
Presence	-0.50	-0.26	-0.43	-0.58	N.c.
Absence	-0.30	-0.49	-0.18	-0.55	N.c.
Separation status					
Transferred	0.18	-0.44	-0.92	-0.88*	N.c.
Discharged	-0.49	-0.47	-1.0	-0.10	N.c.
Died	0.25	-0.25	-0.46	-0.11	N.c.

*-p<0.05; N.c. –correlations cannot be computed due to fewer than 3 valid cases

Costs per Case and Case-Mix

Finally, in order to predict costs per case according to case-mix dimensions in clinical categories, the ridge regression analysis was applied. As a dependent variable, the average expenditures per case were chosen. As independent (predictor) variables all in-patient case mix dimensions (in-patient service, sex, age, surgical operation and separation status groups) were analysed. Since independent variables were highly intercorrelated, and stable estimates for the regression coefficients could not be obtained via ordinary least squares methods, the ridge regression analysis was used to estimate the prediction of the dependent variable. Specifically, since a constant (lambda) had to be added in predicting the average cost per case three options were chosen: taking the possible minimal lambda (0.001), the medium lambda (0.5) and the possible maximal lambda (0.999), which were expressed as predicted values 1, 2 and 3 in table 12. The actual values of independent variables (in-patient service, sex, age, surgical operation and separation status groups) were used as well.

Table 12. The ridge regression results: regression analyses and predicted values of expenditures per case in clinical departments

Clinical departments	The cost per case (Litas)			
	The observed value	The predicted value (1)	The predicted value (2)	The predicted value (3)
Surgery category				
Ophtalmology	597.95	469.48	483.91	519.15
Otorhinolaryngology	628.85	1264.26	1294.48	1294.04
General surgery	1012.63	784.24	803.19	831.49
Cardiosurgery	1827.28	1512.81	1404.85	1370.68
Neurosurgery	1205.79	833.28	837.49	838.52
Thoracic surgery	2122.13	1600.57	1542.86	1504.17
Urology	1617.29	1557.81	1498.44	1464.83
Orthopedics-traumatology	828.55	1501.10	1447.08	1408.12
Face and maxilar surgery	616.69	1306.31	1397.73	1353.97
Therapy category				
Endocrinology	821.37	732.68	982.18	1045.03
Gastroenterology	1039.22	1398.89	1414.32	1398.98
Haematology	1143.07	1453.20	1452.89	1427.65
Cardiology	910.04	1221.36	909.77	884.60
Nephrology	2179.95	1381.94	1447.94	1428.16
Neurology	888.20	1325.92	1169.38	1144.94
Dermatovenerology	1064.39	1597.96	1560.09	1526.46
Oncology	1956.59	1574.83	1512.64	1483.03
Psichiatry	2487.30	1409.20	1475.36	1457.26
Pulmonology	1063.73	1263.62	1343.29	1338.30
Rheumatology	879.75	1460.85	1475.07	1453.28
Newborn and child care				
Pediatrics	661.08	262.42	674.69	782.97
Child surgery	724.24	900.90	930.45	972.58
Neonatology	1295.30	1584.20	1263.33	1223.91
Obstetrics-gynaecology				
Obstetrics-gynaecology	658.82	643.31	574.12	576.02
Intensive care				
Obstetrics-gynaecology intensive care	126.01	219.63	829.76	987.35
Central intensive care	1080.16	2358.18	1689.86	1570.53
Cardiosurgery intensive care	2079.74	1211.78	1202.59	1201.78
Cardiology intensive care	391.96	286.87	694.61	830.68
Newborn intensive care	3451.68	2094.82	1660.33	1576.61
Neurosurgery intensive care	997.77	1031.27	1107.79	1128.31
Child intensive care	923.17	1085.05	1218.23	1258.31
Regression's indicators				
Lambda	-	*0.001*	*0.500*	*0.999*
Multiple R	-	*0.7106*	*0.5573*	*0.5065*
Multiple R^2	-	*0.5049*	*0.3106*	*0.2566*
Adjusted R^2	-	*0.0098*	*-0.3788*	*-0.4868*
p	-	*0.485*	*0.933*	*0.,976*
Standard error of Estimate	-	*701.35*	*827.64*	*859.43*
Intercept	-	*1729.05*	*1636.19*	*1590.58*

The predicted values of costs per case differed from the observed values according to case-mix dimensions in clinical departments:

- The predicted costs per case were smaller in almost all surgery departments, except Orthopedics-traumatology and Face and maxilar surgery, where the predicted costs per case were higher than the observed.
- The predicted costs per case were higher than the observed in the following therapy departments: Gastroenterology, Haematology, Neurology, Dermatovenerology, Pulmonology and Rheumatology. Nephrology, Oncology and Psichiatry departments incurred fewer predicted costs per case than expected, while the predicted costs per case in Endocrinology and Cardiology departments showed positive and negative values comparing to the observed ones depending on the value of the constant (lambda).
- The newborn and child care departments Child surgery and Neonatology departments had higher costs per case according to case-mix dimensions than the observed values. Pediatrics department showed positive and negative values comparing to the observed ones depending on the value of the constant (lambda).
- In Obstetrics-gynaecology department the predicted costs per case were smaller than the observed.
- Four out of seven intensive care departments (Obstetrics-gynaecology intensive care, Central intensive care, Neurosurgery intensive care and Child intensive care) had higher costs per case according to case-mix dimensions. The predicted costs per case were smaller than the observed ones in Cardiosurgery intensive care and Newborn intensive care departments, while Cardiology intensive care department showed positive and negative values comparing to the observed ones depending on the value of the constant (lambda).

As it is seen from table 12, coefficients of multiple correlation (Multiple R) varied from 0.5065 to 0.7106. Predicted case 3 showed a stronger correlation of dependent (expenditures per case) and independent (case-mix dimensions) variables comparing to predicted cases 1 and 2. The highest coefficient of a multiple determination was observed in predicted case 1 (0.5049), while the least in predicted case 3 (0.2566). Therefore, the regression line was closer to the experimental data in predicted case 1 comparing to predicted cases 2 and 3. The adjusted R-squares varied from –0.4868 in predicted case 3 to 0.0098 in predicted case 1. Predicted case 1 showed the least dispersion (248.55) compared to predicted cases 2 and 3 (827.64 and 859.43 respectively). Cook's distances were observed of an equal magnitude in predicted case 3, and the biggest differences in magnitude was observed in predicted case 1; so in the latter one there is a reason to believe that the respective cases biased the estimation of the regression coefficients to a greater extent comparing to predicted case 2 and 3.

The analysis of the predicted values also considered the regression coefficient (Beta coefficient). However, their values may not be comparable across variables because they depend on the units of measurement or ranges of the respective variables. Therefore, Adjusted Beta coefficients, which would have been obtained having standardized all of the variables to a mean of 0 and a standard deviation to 1, and which are comparable across variables, are estimated.

Table 13 represents Adjusted Beta coefficients of each of the predicted values. As it is seen from table 13, stable positive contributions to the predicted value of the cost per case, showed only one variable – IA in-patient service group. In predicted cases 1 and 2, positive Adjusted Beta coefficients were observed in the in-patient group of 65 and over, while the in-patient age groups of 0-14 and 45-64, as well as the presence of a surgical operation, discharge and died in-patient groups give a positive contribution to the predicted value of the average expenses per case only in predicted case 1. It should be noticed that in any predicted case Adjusted Beta coefficients of the independent variables were not observed to be significant and showed p value more than 0.05. Therefore, the impact of each case-mix variable to the average expenditures per case was considered as a possible trend only.

Table 13. Contribution of case-mix dimensions to the predicted average cost per case in in-patient departments

Variables	The predicted value 1	The predicted value 2	The predicted value 3
	Adjusted Beta coeff.	Adjusted Beta coeff.	Adjusted Beta coeff.
IA group	0.841	0.232	0.130
IB group	-0.17	-0.07	-0.06
II group	-0.30	-0.13	-0.09
III group	-0.06	-0.04	-0.04
Male	-0.14	-0.03	-0.04
Female	-0.09	-0.08	-0.07
0-14 years	0.086	-0.009	-0.07
15-44 years	-0.46	-0.06	-0.04
45-64 years	0.272	-0.04	-0.04
65 years and over	0.92	0.006	-0.01
The presence of a surgical operation	0.004	-0.03	-0.03
The absence of a surgical operation	-0.30	-0.12	-0.10
Transferred	-0.39	-0.21	-0.14
Discharged	0.28	0.002	-0.01
Dead	0.009	0.006	-0.0004

The ridge regression analysis was used to estimate the predicted average cost per case in clinical categories (Table 14). It followed the same methodology as in the ridge regression analysis of the predicted costs per case in clinical departments, but in the latter case the values of independent variables (in-patient service, sex, age, surgical operation and separation status groups) were entered as the average number of cases (see Table 10). Besides, variables were presented in one block.

In clinical categories the predicted values of the average expenditures per case differed from the observed values – in surgery, therapy and newborn-child care categories higher average costs per case had been estimated on the basis of case-mix dimensions comparing to the observed ones in reality. In other clinical categories - Obstetric-gynaecology and Intensive care – the predicted average costs per case were smaller than the observed ones.

Table 14. The ridge regression results: regression analyses and the predicted values of the average expenditures per case in clinical categories

Clinical categories	The average cost per case (Lt)			
	The observed value	The predicted value (1)	The predicted value (2)	The predicted value (3)
Surgery	1161.10	1203.32	1188.0	1176.11
Therapy	1312.15	1342.95	1340.26	1326.15
Obstetric-gynaecology	658.82	643.31	574.12	576.02
Newborn-child care	893.54	915.84	956.16	993.15
Intensive care	1292.92	1183.94	1200.45	1221.80
Regression's indicators				
Lambda	-	*0.001*	*0.500*	*0.999*
Multiple R	-	*0.7106*	*0.5573*	*0.5065*
Multiple R^2	-	*0.5049*	*0.3106*	*0.2566*
Adjusted R^2	-	*0.0098*	*-0.3788*	*-0.4868*
Standard error of Estimate	-	*248.55*	*827.64*	*859.43*
Intercept	-	*1729.05*	*1636.19*	*1590.58*

Table 15 presents Adjusted Beta coefficients of each of the predicted values. As it is seen from table 15, there are almost the same results as in case of analysing in-patient departments (see Table 13). In any predicted case Adjusted Beta coefficients of the independent variables were not observed as significant and showed p value more than 0.05. The impact of each case-mix variable to the average costs per case has to be considered as a possible trend as well.

Table 15. The contribution of case-mix dimensions to the predicted average cost per case in clinical categories

Variables	The predicted value 1	The predicted value 2	The predicted value 3
	Adjusted Beta coeff.	Adjusted Beta coeff.	Adjusted Beta coeff.
IA group	0.847	0.232	0.130
IB group	-1.73	-0.073	-0.061
II group	-0.304	-0.129	-0.094
III group	-0.571	-0.383	-0.040
Male	-0.150	-0.349	-0.040
Female	-0.878	-0.083	-0.065
0-14 years	0.097	-0.088	-0.069
15-44 years	-0.475	-0.059	-0.042
45-64 years	0.288	-0.042	-0.041
65 years and over	0.091	0.006	-0.011
The presence of a surgical operation	0.052	-0.316	-0.032
The absence of a surgical operation	-0.307	-0.123	-0.096
Transferred	-0.396	-0.207	-0.142
Discharged	0.028	0.002	-0.013
Dead	0.010	0.006	-0.0004

Discussion

This study aimed at implementation of a widely used model of evaluating the average costs per case and predicting the average costs per case, as well as assessing the possible impact of case-mix dimensions in Kaunas Medical University Hospital. No similar study on hospital costs or cost groups has ever been performed in Lithuania before.

This study estimated costs per case in in-patients departments and in clinical categories according to case-mix dimensions (in-patient service, sex, age, surgical operation and separation status groups). The results of widely used calculations, such as the cost per case and the cost per bed-day, the structure of expenditures in in-patient departments and clinical categories as well as correlations between the average costs and costs groups, are right and valuable.

Before discussing the results of this study, it is important to analyse the possible limitations. An attempt to assess costs on the basis of case-mix dimensions caused more intricacy and difficulties. Therefore, some findings cannot be treated as actual due to some limitations of the study:

1. the use of "in-patients service groups" instead of diagnosis based on International Classifications of Diseases constraints comparisons of the results with other studies on hospital costs
2. sometimes a small sample size gives no chance for more accurate statistical calculations;
3. large differences between in-patient departments (such as the number of beds, staff, costs, etc.), which are beyond the control themselves, create difficulties to compare the study results across in-patient departments or even clinical categories;
4. some inaccuracies might have been caused due to the simplified use of the term "surgical operation" in the study. Since there were no possibilities to distinguish among surgical operations (for example, a complicated cardiosurgery operation from a simple ectomy of naevus pigmentosus), all surgery interventions were treated equally.

In order to avoid or minimize listed above limitations, following steps have been performed:

1. The effect of small sample size has been tried to minimize by:

- calculating number of in-patient cases, not in-patients themselves (number of in-patient cases or treatment episodes is always higher than number of in-patients);
- evaluating number of in-patient cases at the in-patient department level (in-patient department was chosen as a subject of the study), despite that there is lower level of sub-departments (some in-patient departments have two or more sub-departments) in Kaunas Medical University Hospital.
- collecting data from one year period and not using shorter period of time (one month, three months of half of year).

2. The effect of given differences between in-patient departments (of beds, staff, and therefore number of in-patient cases), which finally theoretically could have an influence to costs per in-patient case and impact of case-mix to costs due to economies of scale, has been tried to minimize by:

- avoiding comparisons of "total" numbers, using instead assessments "per case" or "per bed-day";

- performing structural analysis (i.e. structure of costs, structure of in-patients case-mix);

- calculating one group of costs – "other costs" (the costs of in-patients' meal, laundry, transportation, communication, auxiliary services, heating, electricity, water, buildings maintenance and repair, etc.of an in-patient department) according to the number of beds.

3. The effect of simplified use of the term "surgical operation", which might have had an impact on the cost per case, with possible a smaller value for a complicated case, has been tried to minimize by extracting as much as possible costs of operation theaters and anaesthesiology services and ascribing them to the specific in-patient department (i.e. costs of operation in Cardiosurgery department involves costs of operation theatres, where cardiosurgical operations are performed and costs of anaesthesiology services during cardiosurgical operations). Anyway, in order to avoid possible misinterpretations of what should mean "the surgical operation", was taken into account the unified list of surgical interventions, approved by Ministry of Health and State Sickness Fund.

Only the use of "in-patients service groups" instead of diagnosis based on International Classifications of Diseases, has not been trying to avoid, since this particular issue was one of the research questions.

Comparing this study with other studies, it should be noticed, that there are a lot of studies, described in literature, showing the assessments of the impact of different case-mix dimensions to hospital costs or the evaluation of hospital costs on the basis of case-mix dimensions. The early studies of hospital cost analysis used various criteria to classify patient cases. Feldtsein's (1967) solution was to divide patients and patient days into groups or case-mix categories according to the department into which they were admitted, and then weigh each case type by its average cost. Watts and Klastorin's research (1980) facilitated the first comparisons of the explanatory power of a variety of case-mix measures and indicated that Diagnosis Related Groups (DRG) produced the best results. Some studies have used the so called information theory index (Barer, 1982), age groups (Banker et al 1986, Conrad and Strauss, 1983) or service types (Grosskopf and Valdmanis, 1992) to describe the case-mix, but in recent research the most common approach has been to use DRG or another similar diagnosis based classification for the cases treated (37). Studies, performed in Australia, implied the average and marginal cost per case in Queensland public hospitals according to case-mix dimensions – sex, surgical status, payment status, separation status and age. They used 18 and 47 diagnostic categories, very similar to International Disease Classification categories (28). A very similar analysis of hospital costs was performed in Ontario, Canada, also using case-mix dimensions and diagnostic categories, based on International Classification of Disease (56). The research, performed in Belgium on the effect of illnesses treated, resulted in introducing DRG based payment to hospitals, and the use of 470 groups of DRG and 1100 groups of Refined DRG (RDRG). All these groups are generally dependent on diagnostic and intervention codes following International Disease Classification-9 classification (57).

The novelty of this study lies mainly in:

1. In-patient case, based on the diagnosis of an in-patient, is one of the most prevailing case-mix dimensions. But in all described studies the diagnosis has been

based on the International Classification of Disease (IDC-9 or IDC-10 version). In contrast, this study was based on “in-patient service groups”, which were introduced in Lithuania in the year 2002, in order to achieve impartiality in payment to hospitals.

2. In-patient cases, based on the diagnosis according to the International Classification of Disease, were the subjects of the described studies. The cost per case of a certain diagnostic group has been assessed in the above described studies whereas the present study took into account the cost per case in a clinical department or clinical category. Since the subjects of this study were in-patient departments, it was impossible to compare results of “cost per case” with the previous studies.

3. Studies, performed in other countries, compared issues of costs, case-mix dimensions and interactions between them in different hospitals. In contrast this study attempted to test the methodology, which could provide possibilities to compare performance of in-patient departments within a single hospital. Therefore, in-patient departments (not hospitals) were chosen as the subjects of the study.

Discussing about practical considerations, it should be noticed**,** that some results of the study, such as negative almost all case-mix dimensions’ correlations with the average cost per case, slight differences between the observed and predicted average expenses per case in clinical departments, could be inaccurate because only one hospital was studied. It is also important to note that this study did not investigate actual costs as the expenditures are much more related to the allocation of the resources rather than to actual costs. Besides, in in-patient departments actual costs per case are very similar to actual prices per case, paid to KMUH by the Sickness Fund. It could imply that administrative issues are much stronger factors for “setting” the cost in advance than other though much more real and performance-based factors, e.g. in-patient case-mix, severity of in-patients, etc.

Another important issue is that this study was based on “in-patient service groups” classification approved in Lithuania instead of a widely used case-mix category of diseases, based on the International Classification of Disease. This fact could influence the results of the study as well. Further studies are required for the investigation of case mix dimensions impact on the average cost per case in a hospital, and it is seems to be much reasonable to apply the used methodology while comparing hospitals within the system instead of comparing departments or clinical categories within a hospital.

From another point of view, the results of this study showed some trends in the development of the internal management of resources. The study has confirmed the theory that not all treatments provided within a hospital are identical. Generally, it refers to the mix of cases treated by a hospital classified on the basis of those criteria, which are significant in explaining the differences in resource usage among various cases treated (28). Therefore, even within the same category, some patients are more severely ill than others, some have more serious complications, some respond to the treatment better than others. The real problem, therefore, with case-mix costing is to identify grouping which would make both medical sense, i.e. all patients in the group are clinically similar, and in accounting sense, i.e. the treatment of each patient will require similar and predictable resources (54). It becomes obvious that allocation of resources to clinical departments should be based not only on “average patient”, but on in-patient groups according to case-mix dimensions as well. It has been partially implemented in

KMUH, where resources are allocated to clinical departments according to in-patient groups, based on the classification of in-patient service groups.

Conclusions

1. Inputs (measured in the number of beds) and outputs (measured in the number of in-patient cases and the number of bed-days) are different across in-patient departments. The number of beds varies from 6 to 220 per in-patient department; the number of in-patient cases varies from 433 to 10658; the number of bed-days range from 2523 to 63239. Number of in-patient cases, assessed according to case-mix dimensions – age, sex, in-patient service groups, the absence or presence of a surgical operation and in-patient separation status, - showed fairly high variations across in-patient departments. Most of the differences are caused by organizational and structural differences of in-patient departments (e.g. difference in the relative number of cases of IA in-patient service group (with the highest percentage in obstetric-gynaecology and intensive care departments); sex (with totally all in-patients in obstetric-gynaecology department), the group aged 0-14 (with the highest percentage in newborn and child care category departments), the presence or absence of a surgical operation (with the highest percentage in surgery category departments) and a group of died in-patients (with the highest percentage in intensive care category departments).

2. The average costs per case vary widely across in-patient departments, ranging from 126.01 to 3451.68 Litas per case. The analysis of the structure of average expenditures per case demonstrated striking differences in in-patient departments, i.e. salary costs range from 17,61% (Urology) to 68.70% (Newborn intensive care); medication costs vary from 1.34% (Neurosurgery) to 29.95% (Cardiosurgery intensive care). A relatively high proportion of laboratory, radiology and anaesthesiology services costs is observed in Obstetrics-gynaecology intensive care, Urology and Thoracic surgery departments (59.99%; 49.42% and 39.34%, respectively), while Psichiatry and Oncology departments show the lowest percentage – 3.49% and 4.52%, respectively. In in-patient departments the proportion of running costs of medical equipment supply varies relatively little - from 0.0% (Psychiatry) to 9.98% (Oncology). The proportion of other costs also varies statistically significantly, with the exception of intensive care departments.

3. The predicted costs per case, evaluating case mix impact on the average costs per case, show different values across in-patient departments, using three different prediction options – the ridge regression analysis with the constant (lambda) 0.001; 0.5 and 0.999. In all in-patient departments the predicted values of the average costs per case according to case-mix dimensions, do not differ so much comparing with observed ones. Positive contributions to the predicted value of the cost per case, shows only one variable – IA in-patient service group. In some predicted cases, the positive Adjusted Beta coefficients are observed in the in-patient group aged 65 and over, while the in-patient age groups of 0-14 and of 45-64, as well as the presence of a surgical operation, discharge and dead in-patient groups give a positive contribution to the predicted value of the average expenses per case only in one predicted case. In any predicted case

Adjusted Beta coefficients of independent variables have not been observed as significant ($p<0.05$), therefore, the impact of each case-mix variable to the average costs per case has to be considered as a possible trend only. The use of “in-patient service groups” as a proxy of diagnostic categories has failed due to a number of reasons.

4. The results of the study have proved the evidence that clinical cases treated within the same in-patient department of the hospital are not similar. Therefore, the allocation of resources to in-patient departments should be based not only on “average in-patient”, but also on in-patient groups according to case-mix dimensions. To evaluate an in-patient department of a hospital on the basis of mean cost per case or per bed-day, without taking into account the cases treated and their relative complexity, gives little useful information on internal management of hospitals. Anyway, taking into account public health approach, which involves management of health resources (hospital resources consume more than a half of resources allocated for health care), this study has emphasized a need for more accurate resource allocation in Lithuanian hospitals. The public health perspective also is important taking in mind that the management decisions are needed on evaluation of hospital performance (measuring the outcome), in which identification of in-patient groups is the most crucial factor. Identification of in-patient groups could became very important factor in developing internal financing mechanisms for in-patient departments. In addition, further investigations are essential to estimate “optimal” resource allocation criteria within a hospital.

The published article

A shorter version of this study (emphasizing expenditures per case in clinical categories) has been published as an article in a peer reviewed Lithuanian scientific journal “Medicina” (2004; 40(10): 1004-1013) which is included in Index Medicus and MEDLINE. The full-length article copy is presented as Annex 5.

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Annex 1

In-patient case-mix variables

No	Variable
1	IA service group; 0-14 years; male, operation performed, transferred to other institution
2	IA service group; 0-14 years; male, operation performed, discharged
3	IA service group; 0-14 years; male, operation performed, died
4	IA service group; 0-14 years; male, operation did not performed, transferred to other institution
5	IA service group; 0-14 years; male, operation did not performed, discharged
6	IA service group; 0-14 years; male, operation did not performed, died
7	IA service group; 0-14 years; female, operation performed, transferred to other institution
8	IA service group; 0-14 years; female, operation performed, discharged
9	IA service group; 0-14 years; female, operation performed, died
10	IA service group; 0-14 years; female, operation did not performed, transferred to other institution
11	IA service group; 0-14 years; female, operation did not performed, discharged
12	IA service group; 0-14 years; female, operation did not performed, died
13	IA service group; 15-44 years; male, operation performed, transferred to other institution
14	IA service group; 15-44 years; male, operation performed, discharged
15	IA service group; 15-44 years; male, operation performed, died
16	IA service group; 15-44 years; male, operation did not performed, transferred to other institution
17	IA service group; 15-44 years; male, operation did not performed, discharged
18	IA service group; 15-44 years; male, operation did not performed, died
19	IA service group; 15-44 years; female, operation performed, transferred to other institution
20	IA service group; 15-44 years; female, operation performed, discharged
21	IA service group; 15-44 years; female, operation performed, died
22	IA service group; 15-44 years; female, operation did not performed, transferred to other institution
23	IA service group; 15-44 years; female, operation did not performed, discharged
24	IA service group; 15-44 years; female, operation did not performed, died
25	IA service group; 45-64 years; male, operation performed, transferred to other institution
26	IA service group; 45-64 years; male, operation performed, discharged
27	IA service group; 45-64 years; male, operation performed, died
28	IA service group; 45-64 years; male, operation did not performed, transferred to other institution
29	IA service group; 45-64 years; male, operation did not performed, discharged
30	IA service group; 45-64 years; male, operation did not performed, died
31	IA service group; 45-64 years; female, operation performed, transferred to other institution
32	IA service group; 45-64 years; female, operation performed, discharged
33	IA service group; 45-64 years; female, operation performed, died
34	IA service group; 45-64 years; female, operation did not performed, transferred to other institution
35	IA service group; 45-64 years; female, operation did not performed, discharged
36	IA service group; 45-64 years; female, operation did not performed, died
37	IA service group; 65 and over years; male, operation performed, transferred to other institution
38	IA service group; 65 and over years; male, operation performed, discharged
39	IA service group; 65 and over; male, operation performed, died
40	IA service group; 65 and over years; male, operation did not performed, transferred to other institution
41	IA service group; 65 and over years; male, operation did not performed, discharged
42	IA service group; 65 and over years; male, operation did not performed, died
43	IA service group; 65 and over years; female, operation performed, transferred to other institution
44	IA service group; 65 and over years; female, operation performed, discharged
45	IA service group; 65 and over years; female, operation performed, died
46	IA service group; 65 and over years; female, operation did not performed, transferred to other institution
47	IA service group; 65 and over years; female, operation did not performed, discharged

48	IA service group; 65 and over years; female, operation did not performed, died
49	IB service group; 0-14 years; male, operation performed, transferred to other institution
50	IB service group; 0-14 years; male, operation performed, discharged
51	IB service group; 0-14 years; male, operation performed, died
52	IB service group; 0-14 years; male, operation did not performed, transferred to other institution
53	IB service group; 0-14 years; male, operation did not performed, discharged
54	IB service group; 0-14 years; male, operation did not performed, died
55	IB service group; 0-14 years; female, operation performed, transferred to other institution
56	IB service group; 0-14 years; female, operation performed, discharged
57	IB service group; 0-14 years; female, operation performed, died
58	IB service group; 0-14 years; female, operation did not performed, transferred to other institution
59	IB service group; 0-14 years; female, operation did not performed, discharged
60	IB service group; 0-14 years; female, operation did not performed, died
61	IB service group; 15-44 years; male, operation performed, transferred to other institution
62	IB service group; 15-44 years; male, operation performed, discharged
63	IB service group; 15-44 years; male, operation performed, died
64	IB service group; 15-44 years; male, operation did not performed, transferred to other institution
65	IB service group; 15-44 years; male, operation did not performed, discharged
66	IB service group; 15-44 years; male, operation did not performed, died
67	IB service group; 15-44 years; female, operation performed, transferred to other institution
68	IB service group; 15-44 years; female, operation performed, discharged
69	IB service group; 15-44 years; female, operation performed, died
70	IB service group; 15-44 years; female, operation did not performed, transferred to other institution
71	IB service group; 15-44 years; female, operation did not performed, discharged
72	IB service group; 15-44 years; female, operation did not performed, died
73	IB service group; 45-64 years; male, operation performed, transferred to other institution
74	IB service group; 45-64 years; male, operation performed, discharged
75	IB service group; 45-64 years; male, operation performed, died
76	IB service group; 45-64 years; male, operation did not performed, transferred to other institution
77	IB service group; 45-64 years; male, operation did not performed, discharged
78	IB service group; 45-64 years; male, operation did not performed, died
79	IB service group; 45-64 years; female, operation performed, transferred to other institution
80	IB service group; 45-64 years; female, operation performed, discharged
81	IB service group; 45-64 years; female, operation performed, died
82	IB service group; 45-64 years; female, operation did not performed, transferred to other institution
83	IB service group; 45-64 years; female, operation did not performed, discharged
84	IB service group; 45-64 years; female, operation did not performed, died
85	IA service group; 65 and over years; male, operation performed, transferred to other institution
86	IA service group; 65 and over years; male, operation performed, discharged
87	IA service group; 65 and over; male, operation performed, died
88	IA service group; 65 and over years; male, operation did not performed, transferred to other institution
89	IA service group; 65 and over years; male, operation did not performed, discharged
90	IA service group; 65 and over years; male, operation did not performed, died
91	IA service group; 65 and over years; female, operation performed, transferred to other institution
92	IA service group; 65 and over years; female, operation performed, discharged
93	IA service group; 65 and over years; female, operation performed, died
94	IA service group; 65 and over years; female, operation did not performed, transferred to other institution
95	IA service group; 65 and over years; female, operation did not performed, discharged
96	IA service group; 65 and over years; female, operation did not performed, died
97	II service group; 0-14 years; male, operation performed, transferred to other institution
98	II service group; 0-14 years; male, operation performed, discharged
99	II service group; 0-14 years; male, operation performed, died

100	II service group; 0-14 years; male, operation did not performed, transferred to other institution
101	II service group; 0-14 years; male, operation did not performed, discharged
102	II service group; 0-14 years; male, operation did not performed, died
103	II service group; 0-14 years; female, operation performed, transferred to other institution
104	II service group; 0-14 years; female, operation performed, discharged
105	II service group; 0-14 years; female, operation performed, died
106	II service group; 0-14 years; female, operation did not performed, transferred to other institution
107	II service group; 0-14 years; female, operation did not performed, discharged
108	II service group; 0-14 years; female, operation did not performed, died
109	II service group; 15-44 years; male, operation performed, transferred to other institution
110	II service group; 15-44 years; male, operation performed, discharged
111	II service group; 15-44 years; male, operation performed, died
112	II service group; 15-44 years; male, operation did not performed, transferred to other institution
113	II service group; 15-44 years; male, operation did not performed, discharged
114	II service group; 15-44 years; male, operation did not performed, died
115	II service group; 15-44 years; female, operation performed, transferred to other institution
116	II service group; 15-44 years; female, operation performed, discharged
117	II service group; 15-44 years; female, operation performed, died
118	II service group; 15-44 years; female, operation did not performed, transferred to other institution
119	II service group; 15-44 years; female, operation did not performed, discharged
120	II service group; 15-44 years; female, operation did not performed, died
121	II service group; 45-64 years; male, operation performed, transferred to other institution
122	II service group; 45-64 years; male, operation performed, discharged
123	II service group; 45-64 years; male, operation performed, died
124	II service group; 45-64 years; male, operation did not performed, transferred to other institution
125	II service group; 45-64 years; male, operation did not performed, discharged
126	II service group; 45-64 years; male, operation did not performed, died
127	II service group; 45-64 years; female, operation performed, transferred to other institution
128	II service group; 45-64 years; female, operation performed, discharged
129	II service group; 45-64 years; female, operation performed, died
130	II service group; 45-64 years; female, operation did not performed, transferred to other institution
131	II service group; 45-64 years; female, operation did not performed, discharged
132	II service group; 45-64 years; female, operation did not performed, died
133	II service group; 65 and over years; male, operation performed, transferred to other institution
134	II service group; 65 and over years; male, operation performed, discharged
135	II service group; 65 and over; male, operation performed, died
136	II service group; 65 and over years; male, operation did not performed, transferred to other institution
137	II service group; 65 and over years; male, operation did not performed, discharged
138	II service group; 65 and over years; male, operation did not performed, died
139	II service group; 65 and over years; female, operation performed, transferred to other institution
140	II service group; 65 and over years; female, operation performed, discharged
141	II service group; 65 and over years; female, operation performed, died
142	II service group; 65 and over years; female, operation did not performed, transferred to other institution
143	II service group; 65 and over years; female, operation did not performed, discharged
144	II service group; 65 and over years; female, operation did not performed, died
145	III service group; 0-14 years; male, operation performed, transferred to other institution
146	III service group; 0-14 years; male, operation performed, discharged
147	III service group; 0-14 years; male, operation performed, died
148	III service group; 0-14 years; male, operation did not performed, transferred to other institution
149	III service group; 0-14 years; male, operation did not performed, discharged
150	III service group; 0-14 years; male, operation did not performed, died
151	III service group; 0-14 years; female, operation performed, transferred to other institution

152	III service group; 0-14 years; female, operation performed, discharged
153	III service group; 0-14 years; female, operation performed, died
154	III service group; 0-14 years; female, operation did not performed, transferred to other institution
155	III service group; 0-14 years; female, operation did not performed, discharged
156	III service group; 0-14 years; female, operation did not performed, died
157	III service group; 15-44 years; male, operation performed, transferred to other institution
158	III service group; 15-44 years; male, operation performed, discharged
159	III service group; 15-44 years; male, operation performed, died
160	III service group; 15-44 years; male, operation did not performed, transferred to other institution
161	III service group; 15-44 years; male, operation did not performed, discharged
162	III service group; 15-44 years; male, operation did not performed, died
163	III service group; 15-44 years; female, operation performed, transferred to other institution
164	III service group; 15-44 years; female, operation performed, discharged
165	III service group; 15-44 years; female, operation performed, died
166	III service group; 15-44 years; female, operation did not performed, transferred to other institution
167	III service group; 15-44 years; female, operation did not performed, discharged
168	III service group; 15-44 years; female, operation did not performed, died
169	III service group; 45-64 years; male, operation performed, transferred to other institution
170	III service group; 45-64 years; male, operation performed, discharged
171	III service group; 45-64 years; male, operation performed, died
172	III service group; 45-64 years; male, operation did not performed, transferred to other institution
173	III service group; 45-64 years; male, operation did not performed, discharged
174	III service group; 45-64 years; male, operation did not performed, died
175	III service group; 45-64 years; female, operation performed, transferred to other institution
176	III service group; 45-64 years; female, operation performed, discharged
177	III service group; 45-64 years; female, operation performed, died
178	III service group; 45-64 years; female, operation did not performed, transferred to other institution
179	III service group; 45-64 years; female, operation did not performed, discharged
180	III service group; 45-64 years; female, operation did not performed, died
181	III service group; 65 and over years; male, operation performed, transferred to other institution
182	III service group; 65 and over years; male, operation performed, discharged
183	III service group; 65 and over; male, operation performed, died
184	III service group; 65 and over years; male, operation did not performed, transferred to other institution
185	III service group; 65 and over years; male, operation did not performed, discharged
186	III service group; 65 and over years; male, operation did not performed, died
187	III service group; 65 and over years; female, operation performed, transferred to other institution
188	III service group; 65 and over years; female, operation performed, discharged
189	III service group; 65 and over years; female, operation performed, died
190	III service group; 65 and over years; female, operation did not performed, transferred to other institution
191	III service group; 65 and over years; female, operation did not performed, discharged
192	III service group; 65 and over years; female, operation did not performed, died

Annex 2

Case-mix of in-patients in surgery departments

Case-mix dimensions	Dewpartments of Surgery Category																	
	Ophtalmology		Othorinolaryngology		General surgery		Cardiosurgery		Neurosurgery		Thoracic surgery		Urology		Orthopedics-Traumatology		Face and maxillar Surgery	
In-patient service groups	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
IA diagnostic group	1	0.01	0	0	19	0.3	5	0.3	412	7.0	15	2.3	2	0.1	1	0.08	38	2.0
IB diagnostic group	1510	15.9	115	4.5	1112	17.6	1349	82.7	2627	44.7	349	52.4	773	53.0	3	0.24	837	43.6
II diagnostic group	7651	80.7	2396	94.6	4832	76.6	269	16.5	2606	44.4	302	45.3	614	42.1	1208	97.82	935	48.7
III diagnostic group	321	3.39	22	0.9	344	5.5	9	0.5	230	3.9	0	0	70	4.8	23	1.86	110	5.7
Sex																		
Male	4089	43.1	1366	53.9	2748	43.6	1128	69.1	3484	59.3	509	76.4	1077	73.8	494	40.0	1128	58.8
Female	5394	56.9	1167	46.1	3559	56.4	504	30.9	2391	40.7	157	23.6	382	26.2	741	60.0	792	41.2
Age																		
0-14 years	1510	15.9	1088	43.0	321	5.0	3	0.2	1038	17.7	3	0.45	2	0.14	2	0.16	310	16.1
15-44 years	1031	10.9	850	33.6	2081	32.5	120	7.4	2176	37.0	254	38.1	284	19.5	459	37.2	886	46.1
45-64 years	1713	18.1	442	17.4	2276	35.5	640	39.2	1849	31.5	260	39.0	482	33.0	361	29.2	410	21.4
65 and over years	5229	55.1	153	6.0	1729	27.0	869	53.2	812	13.8	149	22.45	691	47.36	413	33.44	314	16.4
Surgical operation																		
Presence	7695	81.1	2293	90.5	5430	84.8	1466	89.8	3866	65.8	543	81.5	1246	85.4	1195	96.8	1609	83.2
Absence	1788	18.9	240	9.5	977	15.2	166	10.2	2009	34.2	123	18.5	213	14.6	40	3.2	311	16.2
Separation status																		
Transferred	64	0.67	38	1.5	256	4.0	199	12.2	464	7.9	75	11.3	42	2.9	16	1.3	33	1.7
Discharged	9419	99.33	2495	98.5	6008	95.3	1417	86.8	5375	91.5	579	86.9	1413	96.8	1219	98.7	1887	98.3
Died	0	0	0	0	43	0.7	16	1.0	36	0.6	12	1.8	4	0.3	0	0	0	0

Annex 3

Case-mix of in-patients in therapy departments

Case-mix dimensions	Departments of Therapy Category																					
	Endocrinology		Gastroenterology		Haematology		Cardiology		Nephrology		Neurology		Dermatovenerology		Oncology		Psychiatry		Pulmonology		Rheumatology	
In-patient service groups	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
IA diagnostic group	0	0	0	0	2	0.2	332	6.9	545	20.75	501	15.0	1	0.23	1	0.14	0	0	0	0	0	0
IB diagnostic group	82	2.45	100	7.92	746	79.9	1448	30.1	2079	79.17	355	10.6	4	0.92	40	5.6	12	1.37	24	1.5	430	51.2
II diagnostic group	3121	93.3	1119	88.6	124	13.3	2262	47.0	2	0.08	2332	69.8	428	98.85	674	94.12	845	97.57	1563	97.9	402	47.9
III diagnostic group	142	4.25	44	3.48	62	6.6	766	16.0	0	0	155	4.6	0	0	1	0.14	9	1.06	10	0.6	8	0.9
Sex																						
Male	1185	35.4	643	50.9	419	44.9	2809	58.4	487	48.0	1601	47.9	187	43.2	356	49.7	352	41.0	968	61.0	262	31.2
Female	2160	64.6	620	49.1	515	55.1	1999	41.6	528	52.0	1742	52.1	246	56.8	360	50.3	514	59.0	629	39.0	578	68.8
Age																						
0-14 years	772	23.1	0	0	1	0.1	0	0	3	0.3	1146	34.3	0	0	1	0.14	65	7.5	0	0	0	0
15-44 years	902	27.0	382	30.25	210	22.5	442	9.2	429	42.3	793	23.7	155	35.8	104	14.52	438	51.0	283	18.0	309	36.8
45-64 years	1051	31.4	435	34.44	330	35.3	2069	43.0	304	29.9	750	22.4	142	32.8	331	46.22	237	27.0	557	35.0	326	38.8
65 and over years	620	18.5	446	35.31	393	42.1	2297	47.8	279	27.5	654	19.6	136	31.4	280	39.12	126	14.5	757	47.0	205	24.4
Surgical operation																						
Presence	235	7.0	284	22.5	44	4.7	2041	42.5	165	16.3	104	3.1	61	14.1	55	7.7	30	3.5	73	4.6	32	3.8
Absence	3110	93.0	979	77.5	890	95.3	2767	57.5	850	83.7	3239	96.9	372	85.9	661	92.3	836	96.5	1524	95.4	808	96.2
Separation status																						
Transferred	266	7.9	127	10.1	48	5.14	595	12.4	93	9.16	256	7.66	36	8.3	19	2.6	40	4.62	206	12.89	27	3.21
Discharged	3076	92.0	1112	88.0	869	93.04	4198	87.3	905	89.17	3013	90.13	397	91.7	689	96.2	821	94.8	1349	84.47	812	96.67
Died	3	0.1	24	1.9	17	1.82	15	0.3	17	1.67	74	2.21	0	0	8	1.12	5	0.58	42	2.64	1	0.12

Annex 4

Case-mix of in-patients in newborn and child care, obstetrics-gynaecology and intensive care departments

Case-mix dimensions	Newborn and child care						Obstetrics-gynaecology		Intensive care													
	Pediatrics		Child surgery		Neonatology		Obstetrics-gynaecology		Obstertrics-gynaecology		Central intensive care		Cardiosurgery intensive care		Cardiology intensive care		Newborn intensive care		Neurosurgery intensive care		Child intensive care	
In-patient service groups	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
IA diagnostic group	0	0	61	1.5	545	20.75	2444	22.93	0	0	414	19.9	734	90.0	76	2.42	445	93.3	353	15.6	132	9.6
IB diagnostic group	451	10.4	68	1.7	2079	79.17	1083	10.16	831	28.9	924	44.3	37	4.5	2388	76.25	31	6.5	1575	69.8	854	62.2
II diagnostic group	3223	74.4	3260	80.3	2	0.08	7101	66.63	2045	71.1	747	35.8	45	5.5	668	21.33	1	0.2	328	14.6	388	28.2
III diagnostic group	657	15.2	669	16.5	0	0	30	0.28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sex																						
Male	2328	53.8	2511	61.9	1407	53.6	0	0	0	0	1235	59.2	549	67.0	1855	59.2	279	58.5	1333	59.1	855	62.2
Female	2003	46.2	1543	38.1	1219	46.4	10658	100	2876	100	850	40.8	267	33.0	1277	40.8	198	41.5	923	40.9	519	37.8
Age																						
0-14 years	4056	93.7	3758	92.6	2626	100	4	0.04	0	0	0	0	5	0.6	1	0.03	477	100	1	0.04	1267	92.2
15-44 years	275	6.3	300	7.4	0	0	8344	78.29	1840	64.0	554	26.6	55	6.7	222	7.09	0	0	759	33.64	107	7.8
45-64 years	0	0	0	0	0	0	1681	15.77	749	26.0	686	32.9	315	38.6	1279	40.84	0	0	963	42.69	0	0
65 and over years	0	0	0	0	0	0	629	5.9	287	10.0	845	40.5	441	54.1	1630	52.04	0	0	533	23.63	0	0
Surgical operation																						
Presence	70	1.6	2656	65.5	23	0.9	7298	68.47	2241	77.9	224	10.7	51	6.25	596	19.0	51	10.7	284	12.6	40	2.9
Absence	4261	98.4	1402	34.5	2603	99.1	3360	31.53	635	22.1	1861	89.3	765	93.75	2536	81.0	426	89.3	1972	87.4	1334	97.1
Separation status																						
Transferred	119	2.7	162	4.0	24	0.91	3940	36.97	2876	100	1762	84.5	754	92.4	3029	96.7	416	87.2	1884	83.51	1214	88.4
Discharged	4205	97.1	3896	96.0	2601	99.05	6715	63.0	0	0	8	0.4	1	0.1	13	0.4	14	2.9	1	0.04	140	10.2
Died	7	0.2	0	0	1	0.04	3	0.03	0	0	315	15.1	61	7.5	90	2.9	47	9.9	371	16.45	20	1.4

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