UNIVERSITY OF MISKOLC

FACULTY OF ECONOMICS

ELEMÉR HANTOS DOCTORAL SCHOOL OF ECONOMICS

AND REGIONAL SCIENCES

ERIKA HORVÁTHNÉ CSOLÁK

AN ANALYSIS OF THE MANAGEMENT OF HOSPITALS IN HUNGARY BASED ON FINANCIAL STATEMENTS

THESES FOR DOCTORAL THESIS (PHD)

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THESES FOR DOCTORAL THESIS (PHD)

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I. PRESENTATION AND SUMMARY OF THE RESEARCH TASK

Since my university studies, my research has focused on health. I became personally involved when, as an undergraduate, I spent an extended period of time in hospital for a care, and I envied the work of doctors, how beautiful their profession was, how they could help others, but it was too late to change my future profession. Then I realised that no hospital could function without an economist. I then deliberately chose a city hospital as my practice. I started to learn about the specificities of hospitals, health care financing and operations. My TDK thesis and dissertation were also about hospitals. I described the management of fixed assets in a hospital in Miskolc and examined what it would mean if depreciation were to be financed by central regulation. The focus of my PhD research was management accounting. However, it was interesting to see how different levels of controlling systems were introduced in hospitals, and later the Balanced Scorecard system was also set up under central management. However, the information in the management accounting systems is only for internal use, and the systematic processing of financial statement data available to external stakeholders is, in my opinion, incomplete. My experience is supported by the research carried out in 2023 by the State Audit Office in the institutions of the public sector, which aims to induce research in this area, as well. My interest in health care, which I developed as a student, and the research gap motivated me to work on this topic in my dissertation.

I.1 Relevance of the topic, research background

Health is important for all people. This makes health care an increasingly valued factor in society. The quality and development of the health system determines the health of the population and thus their daily lives, not forgetting its economic impact. In the developed countries, an increasing share of GDP is spent on health, but health is one of the largest employers and its backbone industry has a significant impact on the economy. These factors underline the importance of focusing on health systems.
János Kornai, an economist, published his ideas on health care reform in 1998, which have not been fully implemented to date. He set out 9 principles for an ideal health care system:

- The decisions are the individual's own decision;
- solidarity with others;
- competition in the sphere;
- incentives for efficient forms of ownership and regulation;
- the role of the state should be a regulatory and safety net;
- transparency in the financing of the system;
- the timeframe for reform should be assured;
- harmonious growth,
- balance in the use of resources;
- - and last but not least, sustainable funding (Kornai, 1998).

These general principles, which are not country-specific, are supported by arguments and data. A 2018 OECD study also sets out expectations for health systems that need to be built in to increase efficiency. These include: strengthening prevention, operating more efficient and people-centred health systems that take into account health risk factors, improving access to health systems, and creating more flexible health systems that are adapted to a rapidly changing environment (OECD, 2018).

Péter Takács, Minister of State for Health at the Ministry of the Interior, said in a programme in January 2023 that Hungary has not yet reformed its health care system, and coronavirus (COVID 19) epidemic has shown the strengths and weaknesses of the system, which suggests that it is time to implement reforms. They want to intervene in the system in a number of areas, not only to reallocate resources and rationalise, but also to focus on prevention, as the OECD study mentioned above (HVG Kiadó, 2023).

One of the most urgent problems in Hungary is to improve and make better the health system. The system can be examined at two levels, the level of the governing institutions and the level of the provider institutions. In both areas there have been significant changes over the last 30 years.

As of 1 January 2021, the National General Directorate of Hospitals (OKFŐ) took over the right of ownership of state-owned assets used for the provision of specialised healthcare in Hungary from the State Health Care Supply Centre (ÁEEK), which was the successor of the Institute for Quality and Organisational Development in Pharmacy and Healthcare (GYEMSZI) from 2015. The GYEMSZI was established on 1 May 2011 as part of the Semmelweis Plan and was given the right to exercise ownership rights over the former municipal hospitals from 1 May 2012 (Kormányportál, 2011) (Jobbágyi Zsófia, 2014) (MTI, 2012). Before that, hospitals belonged to some level of local or central government.

The Health Insurance Fund is managed by the National Health Insurance Fund Management Company (NEAK) from 1 January 2017. The tasks of its predecessor, the National Health Insurance Fund (OEP), have been reduced and are typically related to financing, coverage and the capacity of specialised care. It carries out its activities in accordance with the Government Decree 386/2016 (XII.2) on health insurance institute (Radics, 2018).

The main elements of the care system are the hospitals, which are the primary providers of inpatient care. The wide range of activities in the operation of hospitals should be reflected in their accounts. The balance sheet and profit and loss account data, complemented by capacity and performance data, provide an opportunity for further analysis, which I have not found any examples of in my literature search.

The inpatient care facilities contracted with NEAK were the subject of my study. The balance sheets and profit and loss accounts of these organisations for the period 2016-2020, as well as the basic capacity and traffic data available at NEAK, were used as a baseline.

Some of the contracted institutions do not have hospital beds and are only contracted for same-day care, so these institutions have been excluded from this paper. The hospitals covered by my study are those covered by general government accounting, with the exception of clinics. A future research direction may be to carry out a follow-up of the conclusions of this thesis, checking the data for clinics, private institutions, including inpatient care institutions run by foundations and associations, and religious institutions, if data are available.

Finally, in 2016, I was able to work with data from 94 institutions. These institutions have different levels of progressivity in the different specialties, and therefore different areas of care. For the sake of analysis, I examined three aspects. For the first, I classified them into three types according to their nature: urban hospital, county hospital and national institute. The second aspect of analysis was the type of care provided by the institutions: acute, chronic and mixed care hospitals. Thirdly, I also analysed the geographical location of the hospitals, according to NUTS2 classification. Of the initial 94 institutions, only 89 remained by 2020, as the healthcare system was being restructured, with institutions being merged and merged into larger hospitals. The last available report of the study interval at the start of the research was 2020, and for this I defined a 5-year interval as the medium-term study direction. Thus, the starting year 2016 already reflects the change in the approach to results under the 2013 legislation. I conducted a literature search to collate the results of my analyses. Following a keyword search, I further explored the topic using a bibliography of articles that met my criteria. In order to understand

the topic, my literature search covers three areas: a description of the characteristics of the health care system, a summary of the literature on financial statements and the way they are analysed, and, as a third area, a survey and analysis of the available analyses in the Hungarian and foreign literature on health care.

I.2 Objectives, research questions

In this paper, I first provide an international overview of major trends affecting health. Facts that have an impact on the capacity and operation of hospitals. Then I will present the Hungarian health care system, with a brief historical review and the structure and characteristics of the current care system. These are necessary to interpret the meaning and the reasons for the figures obtained in the subsequent analysis. I will then provide a literature summary of financial statements, the methodology for processing accounting data, and academic articles on analyses based on hospital financial statements.
Budgetary hospitals are subjects to public sector accounting. At the same time, Government Decree 4/2013 (I.11) on Public Sector Accounting introduced accrual accounting into public sector accounting, which allows for the use of analytical options already well known in the business sector. I have not found any examples in the literature of analyses of the annual accounts of hospitals operating as budgetary bodies, their relationship with capacity and quality characteristics.
The aim of my thesis is to answer the question of what information and conclusions an interested investor or operator can draw from public data on hospitals, classical economic analysis indicators, capacity and turnover data. Can generalisations be made about the assets, asset and resource structure, performance, financial situation of hospitals, and the various statistical methods used, by territorial unit, type of care and type of hospital? For the purpose of my research, I define hospitals as those institutions providing inpatient care (NEAK, 2021). Definitions of other related concepts are given in Annex 2.

I defined my research questions on the basis of indicators that can be calculated from financial statements, in which the object of my investigation were the:

a) assets, liabilities,
b) financial and liquidity situation,
c) income and expenditure structure,
d) profitability,
e) headline specific indicators

of hospitals.

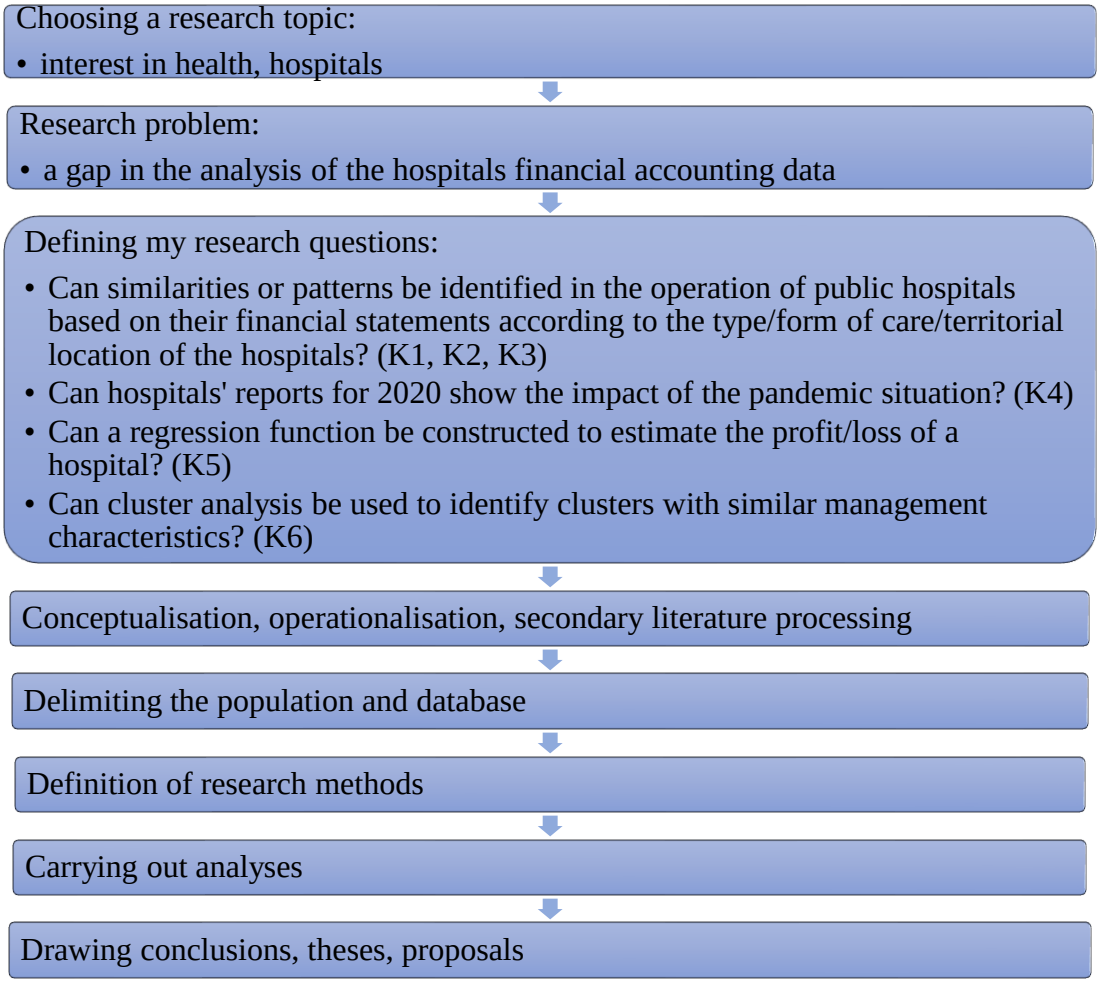

Figure 1. My research process
Source: own editing based on (Babbie, 2003; Pervez and Kjell, 2011)

My secondary research consists of two parts. Partly the compilation of a database based on financial statements and partly a literature search.
The literature review covers three areas:

- to present the health system,
- the system, characteristics and opportunity of analysis of financial statements, and
- to understand the methods and findings used in the international literature to analyse the financial statements of hospitals.

To answer the questions, I have carried out statistical and analytical tests, and based on secondary data and literature analysis, I will compare my results and formulate theses.

II. DATABASE AND METHOD

Government Decree 4/2013 (I.11) on Public Accounts introduced accrual accounting into public accounting. In this new legal environment, the audit of hospitals' annual accounts is a loophole. My quantitative analysis and secondary research is based on the period 2016-2020 for hospitals operating as budgetary institutions. For the statistical analyses, I used the available balance sheet and profit and loss account data from the public annual budget accounts. Since 1 January 2017, the National Health Insurance Fund Management Agency has been performing the activities related to the financing and capacity contracts of hospitals instead of the OEP, based on the Government Decree 386/2016 (XII.2) on health insurance bodies. The Hospital Bed Count and Patient Flow Statement for 2016 has also been prepared by NEAK. Based on these effects, I decided to start the study with the 2016 financial data and to report until 2020, which was the last report available at the beginning of 2022. The resulting 5 years formed the basis of a medium-term study. The five years of data allow for cross-sectional and longitudinal studies.
The balance sheets and profit and loss accounts of the organisations for the period 2016-2020, as well as basic capacity and traffic data, were used as a baseline. The source of the data is mainly the Crefoport company database (downloaded on 26.01.2022), for missing reports the reports listed on the hospitals' websites, in the public interest data, and in their absence the reports are obtained from public interest data requests by directly contacting the hospitals. The capacity and performance data used in addition to the financial data are taken from the annual statements available on the NEAK website (NEAK, 2020).
The available information is summarised in Table 1.

Table 1. Organisations contracted with NEAK 2016-2020

Inpatient care facilities contracted with NEAK	**2016**	**2017**	**2018**	**2019**	**2020**
Number of public hospitals with reporting data	97	93	93	93	92
- basically social institutions with some contracted beds	3	3	3	3	3
Number of budgetary institutions providing day care only	13	13	13	13	13
Universities	*4*	*4*	*4*	*4*	*4*
Judicial Observation and Treatment Institute (BVOP)	*1*	*1*	*1*	*1*	*1*
Church hospitals	*6*	*7*	*7*	*7*	*7*
Number of enterprises providing only same-day care	15	18	17	17	17
Inpatient care enterprises	31	32	32	30	32
Total	**167**	**168**	**167**	**165**	**166**

Source: own editing based on database

Then, by specifying the study, only institutions with a hospital bed operating as a budgetary body remained in the database. The following are therefore not taken into account

- private institutions, as they produce a different type of report,
- the ecclesiastical institutions, since, according to their information, their ecclesiastical leadership does not support the provision of such data, since public funding represents only a very small part of their income,
- clinics, as they do not have separate accounts from their educational activities,
- Budget institutes that do not have inpatient care have a contract with NEAK only because they provide same-day care, which is also financed in HBCS as acute inpatient care,
- budgetary institutions with few beds and providing mainly social care.

After these screenings, 94 hospitals remain in the database in 2016, falling to 89 by 2020 due to mergers. (Kemenesaljai Egyesített Kórház (2017), Semmelweis Kórház Miskolc (2017), Árpádházi Szent Erzsébet (2017), Dorogi Szent Borbála (2017), Szent Rókus (2020).)

This seems small compared to the total number of organisations contracted. But looking also at the bed numbers, the study area was around 83% of the total number of beds (Table 2.).

Table 2. Number of beds and proportion of hospitals surveyed 2016-2020

Types of hospitals	**2016**	**2017**	**2018**	**2019**	**2020**
Average number of beds in inpatient care facilities contracted with NEAK	2452,9	2533,4	2564,1	2584,3	2539,4
Average number of beds available for institutions operating on a general government accounting basis	58025,1	58311,8	58141,4	57798,5	58540,8
- basically social institutions with some contracted beds	-118	-118	-118	-118	-118
Bed numbers of missing organisations					
Clinics	*7353,7*	*7334,3*	*7346*	*7378,7*	*7923,9*
Number of beds in church budget institutions	*1432*	*1417*	*1417*	*1428,7*	*1462,8*
Judicial Observation and Treatment Institute (BVOP)	*311*	*311*	*311*	*311*	*311*
Total number of beds	69574,7	69907,5	69779,5	69501,2	70777,9
Usable data bed number / Total number of beds	83,6%	83,6%	83,5%	83,3%	82,9%

Source: own editing based on database

My analyses were conducted using IBM SPSS 28.0.1 and Microsoft Excel 365. The database was composed of externally sourced secondary data, which, being fully delimited, is thus a manifold. I assigned different qualitative characteristics to the hospitals to categorize them. I coded each category according to a nominal scale so that it could be handled in the statistical program. In this way, I computed mixed relationship tests and eta (H) relationship coefficients when analysing the calculated indicators according to different qualitative, spatial criteria, and, in conjunction with this, I used Bonferroni post-hoc tests to identify whether the groups were significantly different from each other (Sajtos and Mitev, 2007) (Székelyi and Barna, 2002) (Varga et al., 2009) (Jánosa, 2015; Pervez and Kjell, 2011).

In examining the management of hospitals, I focus on the following areas:

- analysis of professional indicators,
- asset- liability structure,
- liquidity analysis,
- income and expenditure structure,
- profitability analysis
- revenue and cost indicators per hospital bed, per full day of care and per patient discharged (Horváth et al., 2023, 2022; Musinszki, 2014, 2013).

The formulae of the calculated indicators are summarised in Annex 2.

All these indicators are observed from three perspectives.

The first line of inquiry is the nature of the hospitals' presence in the area.

Based on the nature of hospitals, a distinction is made between city, county and national organisations. I consider urban institutions as those responsible for the care of a small area, a city and its agglomeration. County institutions provide health services for a county or region. While nationally classified organisations are also referred to by their name in relation to the area they serve.

The second line of inquiry is the way hospitals deliver care. The forms of care can be chronic only, acute inpatient care only or, as a third option, both care and inpatient care at the same time, I use the term acut+chronic for this group in the charts and tables.

The third line of investigation is the location of hospitals by NUTS2 classification. I used the categories Budapest, Pest County, Central Transdanubia, Western Transdanubia, Southern Transdanubia, Northern Hungary, Northern Great Plain and Southern Great Plain. Territorial disparities have been addressed from many different approaches. According to Benedek, Hungary also fits into a spatial pattern in Central and Eastern Europe that shows a strong capital-centricity (Benedek, 2021).

I also looked at changes over time for each indicator and for each characteristic. To answer my research questions, I had conducted causal and exploratory research. The methods used are shown in Figure 2.

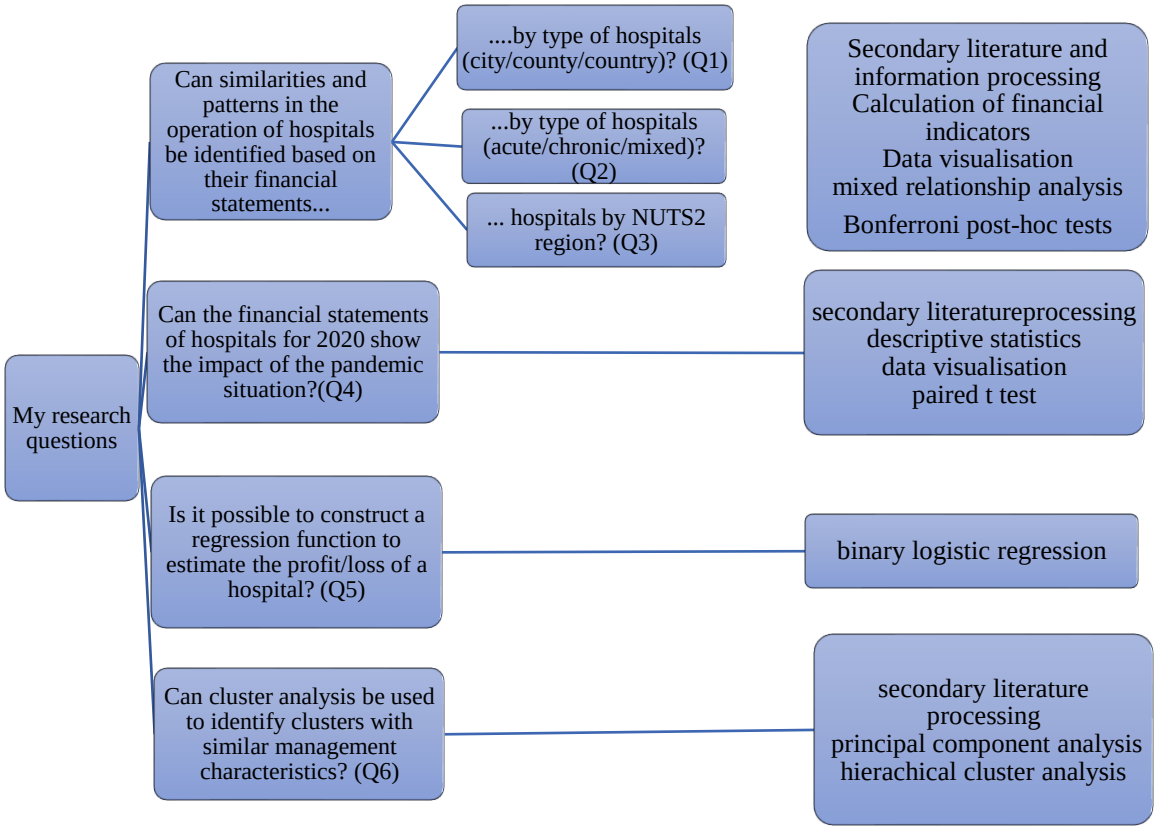

Figure 2. My research questions and methods

Source: own editing

The analysis of all three aspects follows the same logic. I calculated the indicators. I then ran analyses of variance on these qualitative criteria using the ANOVA menu in SPSS. Analysis of variance can be used for mixed relationship. Mixed relationship is when we are looking for a relationship between qualitative/spatial and quantitative variables. Based on my database, we can talk about a delimited population. The resulting significance levels only give the emphasis of my results, if we should rely on them for inference.

The indicator of linkage closeness for mixed linkage is the indicator Eta (H). This indicator can take a value between 0 and 1. A 0 indicates no relationship, a 1 indicates a functional relationship. Up to 0.3 we speak of a weak relationship, between 0.3 and 0.7 of a medium relationship and above 0.7 of a strong relationship (Varga et al., 2009).

I have prepared descriptive statistics according to the aspect under study, I have determined the indicators of correlation. I have summarised them in a table for each year. This allows changes over time to be monitored either in the form of a table or a graph.

For the analysis of mixed effects, Eta indicators and ANOVA tables were defined in SPSS. I then also examined the mixed relationships using post hoc tests, which examines whether each covariate is related to the other covariate, and this was examined in each relation using the Bonferroni test.

I wanted to produce a regression function as a new test direction. I chose the method of logistic regression, which is a multivariate statistical method that allows us to categorise cases according to the categories of the dependent variable. That is, quantitative input data can be used to identify qualitative output. My method was binary logistic regression, after identifying

hospitals in a gain (1), loss (0) fashion. A strict condition of the analysis is that there must be a Pearson correlation coefficient of less than 0.5 between the quantitative variables. This condition was checked using the SPSS program Analyze/Correlate/Bivariate.
Logistic regression aims to identify the factors that significantly distinguish groups of cases and to check whether and what percentage of the group membership can be estimated by the given independent variables. The goodness of fit of the resulting function is checked at several points:

- no correlation of more than 0.3 strength between the variables used.
- Hosmer-Lemeshow goodness-of-fit statistics: in the case of the H0 hypothesis, the higher the critical significance level, the better the fit of the binary classification function to the measured data.
- Nagelkerke R^2: shows how much of the variance of the dependent variable is explained by the combination of independent variables. The higher, the better.
- Classification Table categorization percentage should be higher than the initial, randomly classified value.
- Testing β parameters with Wald test, where our statement is in hypothesis H1 that the parameter β is non-zero. Here we observe a critical significance level less than 0.05.

I chose a factor analysis method to reduce the number of variables.
I used principal component analysis to generate the ideal factor, since my aim was to obtain a factor per indicator type. The method can provide a solution by combining variables with the highest Pearson correlation coefficient. Standardisation was necessary due to the different measurement scales of the indicators. During the runs I checked the following corner criteria:

- Pearson correlation should be at least 0.3.
- Kaiser-Meyer-Olkin Measura of Sampling, (KMO). This indicator should be as above 0.5 as possible.
- Bartlett's test, which, like KMO, measures the suitability of variables for factor analysis. In the Bartlett's test, the H1 hypothesis predicts suitability, so a critical significance level of less than 0.05 is favourable for further calculations.
- Anti-Image correlation matrix diagonal should have values above 0.5.
- Cumulative explanatory power should be at least 60 per cent.

I have removed from the model any version that did not meet this requirement. The program determined the number of factors using the Kaiser eigenvalue criterion.

The analysis was then continued with cluster analysis. The cluster analysis was based on factors per indicator group generated by factor analysis. I used the hierarchical clustering method, as in this case the number of clusters does not need to be predicted, one of the most commonly used methods, justified by the number of my elements. I used the clustering method and Ward's method and the quadratic Euclidean distance, which helps to compress small distances and make large distances even larger. Standardisation of the data was no longer necessary once the factors were standardised values. The number of clusters was decided using the dendogram and the elbow diagram obtained by plotting the coefficients of the clustering matrix. Since in each case I used more than two variables (factors), I used descriptive statistics and cross tabulation analysis with other variables from the database to characterise the clusters. For example, I looked at the percentage of clusters covering the quality criteria by hospital type, or the average number of hospital beds in each cluster (Sajtos and Mitev, 2007; Székelyi and Barna, 2002) (Jánosa, 2015). I used these quantitative characteristics to delineate the properties of the resulting clusters.
In my thesis I use the Zotero 6.0.36 citation management program with the "*Cite Them Right 12th edition -Harvard*" citation style, which also automatically creates the bibliography.

III. MY RESEARCH RESULTS

III.1 Secondary Literature Processing

The aim of my secondary research was to explore the background of the literature. I used a keyword search on Science Direct and on the pages of reputed, listed health journals, using keywords related to hospital, reporting, financial statement, financial performance, decision support, financial indicators.

For companies, it is natural that when the annual accounts are prepared, a comprehensive, qualitative analysis of the management is also made on the basis of the balance sheet and profit and loss account. This provides an insight into the organisation's assets, financial position and profitability. This type of analysis is particularly useful to those outside the business, such as potential investors, creditors, existing and prospective partners and the environment. Owners rely primarily on information from management accounting and the controlling system to make their decisions.

The operation of the health care institutions and hospitals examined by me is regulated by public accounting, but these institutions are also required to prepare balance sheets and profit and loss accounts under Government Decree 4/2013 (I. 11.) on Public Accounting (2013). The law introduced accrual accounting in the accounting of entities subject to public finance. Although there are some differences between the balance sheet and profit and loss account prepared under this Regulation and the statements prepared under the Accounting Act, they can be used to calculate and draw conclusions from the classic financial ratios. This accrual approach also allows for international comparisons in the public sector. In my literature search I could not find any studies on this subject. This was confirmed by the gap-filling research of the State Audit Office of Hungary, published in 2023 (Pulay et al., 2023). Their study also highlighted that the accrual approach at the level of public finances is spreading around the world and will be the dominant approach in the world by 2030. As a consequence, indicators derived from these financial statements will play an increasingly important role for external users of information. Care must be taken when using traditional financial indicators. Not to interpret the results mechanically, but to understand as best as possible the reasons and explanations behind the figures. While these indicators are therefore past oriented, status oriented, carry the potential for information loss, but are easily accessible, simple to calculate (Musinszki, 2016; Zéman and Béhm, 2017).

In my international literature search, I have not found any analyses that are completely parallel to my research questions, with which I can compare my results. In the course of my research I was able to identify a few main directions.

1. Studies related to hospital effectiveness. In addition to financial characteristics, some studies have used other characteristics of hospitals, such as ownership structure, location, number of admissions, number of employees, number of beds in operation, etc. Research has demonstrated the importance of information beyond financial statements (Watkins, 2000; Zeller et al., 1996). Micallef and co-authors (Micallef et al., 2022) saw efficiency in European hospitals as a result of an examination of the rationalisation of public spending on hospitals, with delays in discharging patients from hospitals contributing to this. Other researchers have linked efficiency to the fact of profitability, and have included the factors influencing this in their studies (Rosko et al., 2020; Younis and Forgione, 2005). Others considered hospitals to be efficient if their operation led to an improvement in the health of citizens, less government spending on health care, and thus higher labour productivity (Ravangard et al., 2014). Spanish researchers have linked efficiency to the market-driven operation of hospitals,

decentralisation and examined it as a function of (Garcia-Lacalle and Martin, 2010). Efficiency study in a US study where researchers looked at the impact of a grant scheme to help rural hospitals on the cost-effectiveness of hospitals (Nedelea and Fannin, 2013).

2. Exploring territorial disparities.
   Bem, a Polish researcher, has in several articles, several times with fellow researchers, examined the Polish health care system, looking at issues of accessibility, affordability, sustainability (Bem, 2013). Examined whether there is a difference in the health status of urban and rural populations, as this has an impact on the characteristics of the care system (Bem and Ucieklak-Jeż, 2014). Taking this further, they analysed the relationship between equitable health service delivery and equitable resource allocation. The utilisation of the care system is affected by geographical accessibility. Adequate resource allocation should also be reflected in the health status of the population. The relationship of non-financial resources such as the number of hospitals and health personnel per capita with different morbidity indicators was examined. An interesting finding is that men's health status is more dependent on access to health care (Anselmi et al., 2015; Bem et al., 2016b; Neutens, 2015).
3. Financial and liquidity analysis.
   In a 2014 study, Bem and his research team sought to identify the factors affecting hospital liquidity. They looked at the relationship between revenue and the liquidity ratio. They defined a positive or negative correlation in a band. No relationship was identified between the number of beds and liquidity. Additional research directions were defined as the type of hospital rather than size, ownership, management purpose and location (Bem et al., 2014a). Bem et al. have further developed their regional research on the financial situation of hospitals and their rural/urban location, and this has implications for the health status of the population (Bem et al., 2016a). Other studies have analysed the relationships between income per bed and liquidity ratio, liquidity ratio and profitability, debt ratio and liquidity ratio (Bem et al., 2014b, 2014a; Eljelly, 2004; Raheman and Nasr, 2007). Siedlecki and colleagues used the gradient method to analyse a complex set of indicators to analyse the financial situation (Siedlecki et al., 2015). Bem and his research team examined the pecking order theory based on a sample of the Visegrad four countries, according to which the retained profit should be used as a source of financing first, only then debt, credit (Bem et al., 2015). Studies have also been carried out for German small hospitals, taking into account profitability, liquidity and other qualitative characteristics. It was found that specialisation, subsidies, network affiliation, region, per capita income also play a role in financial performance (Augurzky and Schmitz, 2010).

These studies, without claiming to be exhaustive, point out that this is an area worth researching.

III.2 Analysis based on the institutions' performance indicators and financial statements

I conducted my tests according to two qualitative and one spatial criteria. I looked at hospitals by the type of hospital, the type of care and NUTS2 location.

III.2.1 Analysis by type of hospitals

By type of hospitals, distinguishing between urban, county and national hospitals (Table 3).

Table 3 Evolution of the number of public hospitals between 2016-2020 by type of hospitals

Type of hospitals	2016	2017	2018	2019	2020
urban	57	53	53	53	52
county	24	24	24	24	24
national	13	13	13	13	13
Total	**94**	**90**	**90**	**90**	**89**

Source: own editing based on NEAK data and database

The average number of beds in a county hospital is 1,200, three times that of a urban hospital. The proportion of acute beds is also higher in county hospitals, at around 70%, compared to an average of 40% in a urban hospital. Consequently, the number of patients discharged from hospital is highest in county hospitals, as is the number of days of care provided. At the same time, urban hospitals have a higher average length of stay, mainly due to their chronic care patterns. Bed occupancy has been declining in all groups, with almost similar values, but there was a significant drop in 2020 due to the pandemic, which left a depressed impact on all indicators. But it is very striking in the case of mortality rates, which are otherwise higher in urban hospitals and more favourable than in national institutions. These indicators show a medium-strength relationship with the nature of the hospitals, with the exception of average length of stay and mortality rates.

For all types of hospitals, the proportion of fixed assets is crucial. In most hospitals we see values above 75-80%. However, a slight shift in favour of current assets and financial assets can be seen in the national institutions. Fixed assets tend to be dominated by tangible assets, including real estate, but there is a visible difference in the national institutions, where the share of real estate is lowest, and machinery and investments account for a larger share than in the other groups. In terms of the ratio of current assets to cash, the national institutions show the highest ratios in the first four years under review, but will increase in 2020 for all hospitals, certainly to provide healthcare for the COVID-19 virus. In terms of claims, larger institutions than county, national hospitals had higher rates and an increasing trend is seen for all groups. At the same time, there is a shift in the balance between short-term and long-term receivables in favour of the latter. There are no significant differences in equity ratios, with only a decline in 2019, which can be explained by the particularly high level of debt in that year. The reason for the dramatic increase in the liability ratio is the delay in debt consolidation. There has also been a shift in the maturity of liabilities from 2019 onwards, with an increase in the weight of liabilities due beyond the year. The indicators related to fixed assets, cash and current assets show a medium-strong relationship with the nature of the hospitals, but a more pronounced divergence between urban and national hospitals is visible for several indicators based on post-hoc tests. Debt coverage varies widely, but in general, national institutions have the highest coverage and county institutions the lowest. For the liquidity I indicator, the years 2019-2020 should be excluded from the interpretations, as the analysis of the balance sheet structure showed that the stock of short-term liabilities was very low in these two years. For the Receivables/Liabilities indicator, we typically see values above 1, meaning that hospitals had at least as many receivables as liabilities. But 2020 shows a significant shift, with more than twice as many receivables as liabilities at the end of the year. The hospitals received average funding from NEAK due to the COVID situation, which was more favourable to the hospitals than performance funding according to the data. Narrowing down to intra-year values only, receivables and payables already typically give figures below 1, i.e. payables are higher than receivables. Relationship indicator shows only weak relationships between financial indicators and the nature of hospitals. Bonferroni post-hoc tests also show significant differences between county-national and urban-national groups for only two years, for some indicators.

When looking at the share of other revenue, the average value ranges from 93-97% in the years under review. Urban hospitals had a ratio of around 93%, while county hospitals had a ratio of 96% between 2016 and 2019. National institutions show a moderate increase to 94-95% in 2019. ut by 2020, there is a marked increase in all groups for COVID-19, following the switch to average funding in 2020, rather than performance funding. The ratio of material expenditure to total expenditure ranged between 28.5 % and 38.5 % and typically decreased year on year. The share of services purchased as a proportion of total expenditure also fell on average for all groups and collectively. Urban hospitals are more likely to purchase services, while national hospitals are least likely. The various services purchased are diagnostic services, cleaning, catering and maintenance. The figures show that hospitals are increasingly trying to cut back on these services and to manage them themselves. The combined ratio of personnel costs ranged from 52.6% to 58.1% on average. Urban hospitals spend a slightly higher percentage on human resources, while county and national hospitals spend around 50%. The share of depreciation in total expenditure shows a decreasing trend when analysed by type of hospital. It is lowest for the county institutions and highest for the national institutions, where we have seen earlier that the share of real estate is the lowest, i.e. machinery and equipment is also more important, for which hospitals can account higher depreciation. However, the difference between the county and national rates is only 1.3 percentage points. For the share of other expenditure in total expenditure, the average ratios of city and county institutions have decreased over the five years by very similar magnitudes, but the national institutions have increased over the years under review. The linkage indicator has a medium-strong relationship with several indicators over the five years studied. The Bonferroni post-hoc tests show that urban and county hospitals show significant differences in all years for all indicators, and that there is a significant difference between urban and national hospitals even for the proportion of material costs and the proportion of services used.

When looking at the ROS profitability indicator, there is a significant difference between the average values of urban and county/national institutions, roughly twofold in favour of hospitals with a larger service area. For the proportional result for personnel costs, urban hospitals lag behind the other two groups by orders of magnitude. The same is true for return on assets (ROA). The average value of urban hospitals is generally half that of county or national institutions. Based on these correlation indicators, there is a weak or very weak relationship between the indicators and the grouping by type of hospital. Using Bonferroni post-hoc tests, there is a significant difference between urban and national hospitals only in 2016 for the proportional outcome of personnel-related expenditure.

Revenue per bed shows an increase, with a larger rise in 2020. The highest value is shown by the national institutions, where the average value per bed increased from HUF 20 million to HUF 35 million. For urban hospitals, these figures are only 10-14 million HUF per bed. Material costs per bed are similar to revenues, but of a smaller order of magnitude. National institutions have the highest (5.6-9 million HUF/bed), county institutions 2-4 million HUF/bed, city hospitals only 1-1.5 million HUF/bed. National institutions not only have a high revenue per bed, but they also spend the most per bed on material costs. The unit values of the services used do not vary much between the groups, ranging between F 2 and F 2.5 million per bed, but are constantly increasing. National institutions are slightly higher. Personnel costs per bed are also similar, only between F$ 5-12 million. Depreciation per bed is already proportionally higher in the national institutions. In some years it is almost double the average specific value of the other two groups. But in terms of magnitude, the range is only about 600,000 to 1.2 million. A correlation between the nature of hospitals and per-bed indicators shows a significant relationship of medium strength. Post-hoc tests show significant differences between urban and national and between county and national hospitals, except for the specific service used.

Revenue per day worked, by type of hospital, shows an increase, with a larger jump by 2020. Here again, the highest values are seen in national institutions and the lowest in urban hospitals. The spike in 2020 is a combination of two factors. Partly due to a reduced projection base due to the viral situation and partly due to higher revenues resulting from changes in funding rules. Material costs per care day are similar to unit revenues, but of a smaller magnitude. In urban hospitals, the average cost of materials per day of care is around HUF 4,000, in county hospitals it is between HUF 7,800 and 2,700, while in national hospitals it is between HUF 24,000 and 50,000 per day. The value per day of the services used is similar to the cost of materials, with the lowest in city hospitals and the highest in national institutions.
But relative to each other, the value of specific material and specific purchased services is about double for urban hospitals, almost the same for county hospitals, and less than half for national institutions. Personnel costs per nursing day show an increase for all groups, but there is not as large a difference between groups as for the specific cost of materials. The depreciation per day of care is higher in the national institutions, in some years more than double that of the other two groups. Higher asset values, higher depreciation recorded and lower projection bases result in higher values. Other expenditure per nursing day is of a similar order of magnitude to the specific depreciation, except for the national institutions, at 2-3 million HUF/day. National institutions are between 4 and 8 million HUF/day.
When examined by the linkage indicators, the nature of hospitals showed a significant relationship of medium strength with the calculated indicators, apart from the specific services used, which was not significant. Bonferroni post-hoc tests showed a significant difference between urban and national and between county and national hospitals for revenue and material costs per nursing day. No significant differences were found for the other indicators.
Revenue per patient is lowest for county hospitals, and nearly the same for city and national hospitals until 2019. The low value for county hospitals is explained by the higher number of patients as a projection base. For county hospitals, one patient only generates revenues of 400-800 thousand HUF per year, while for national and city hospitals it is 600-1000 thousand HUF. I have already mentioned the explanation for the 2020 outlier
Changes in funding rules and a fall in the number of patients have combined to cause the high rates. In terms of material costs per patient, we see that there is not much difference between city and county hospitals, while the material costs per patient in the national institutions are almost three times higher than in city hospitals. We have seen earlier that it is worth mentioning the services used per patient in this context. The highest in urban hospitals and the lowest in county hospitals.
Looking at the two specific expenditures together, I found that the cost of materials per patient and the amount of services used per patient are almost the same in the county hospitals, 60-100 thousand HUF/person. For the national hospitals, the specific value of the service used (70-130 thousand HUF/person) is about half of the specific material cost (140-287 thousand HUF/person), and vice versa for the urban hospitals, where the specific service used is about double the specific material cost (56-95 thousand HUF/person).
The indicator of personnel costs per patient shows an increase for all groups. Urban hospitals are the highest and county hospitals the lowest. The depreciation per patient discharged is higher in the national institutions (40-60 thousand HUF/person) and only about half of this in the county hospitals. Urban hospitals are at the average level (28-40 thousand HUF/person). The correlation is weak, with a non-significant relationship with the specific indicators per discharged patient. Bonferroni tests typically show no significant difference between groups.

My first research question is related to the analyses described above.

K1 Research question:
Are there similarities and patterns in the operations and financial statements of public hospitals based on the nature of the hospitals?

In answer to my first research question, I formulated my first thesis based on my analysis above.

T1 Thesis:
A sector-specific characteristic of hospitals is the high proportion of fixed assets. The share of fixed assets in the asset structure of hospitals is lower than the national average. However, the national hospitals have a higher than average share of machinery and equipment in fixed assets and a higher share of capital expenditure over the period. At the same time, the national hospitals have an above average share of depreciation in their cost structure and a below average share of purchases of services. Furthermore, on the resource side, the national hospitals have the highest debt coverage.

III.2.2 Analysis by hospital care type

Hospitals can provide only acute, only chronic, or both acute and chronic inpatient care. Table 4 shows the distribution of the hospitals I examined by type of care. There are only three hospitals that provide only active care. These are national, specialised hospitals, namely cardiology, oncology and neurosciences.

Table 4 Differentiation of hospitals by type of care 2016-2020

Hospitals by care	**2016**	**2017**	**2018**	**2019**	**2020**
chronic	17	14	15	15	14
acute	3	3	3	3	3
acute + chronic	74	73	72	72	72
Total	**94**	**90**	**90**	**90**	**89**

Source: own editing on database

The decrease in chronic and mixed care facilities is due to the rationalisation of the number of hospitals. Institutions providing both acute and chronic care have a higher average number of beds, discharged patients, day care, and nursing days. But average days of care, bed occupancy and mortality rates are already highest in chronic care facilities. The calculated indicators tend to be associated with the type of care with a medium strength, and the Bonferroni post-hoc test shows a significant difference between the professional indicators of chronic and mixed care hospitals.

The lower ratio of fixed assets of institutions providing only acute care compared to the other groups is compensated by a much higher ratio of current assets, cash and receivables compared to the other groups. Acute-only hospitals have a lower property ratio in favour of machinery and equipment. In contrast, the largest asset of chronic hospitals is real estate. The coverage of fixed assets shows a basically balanced picture. The current asset ratios for 2020 appear to be increasing. Cash ratios show unbalanced, hectic values in all groups.

When looking at the claims ratio, the value of hospitals providing only acute care differs markedly from the other two groups. Acute hospitals, by their very nature, can generate a larger stock of claims. In terms of capital strength, there is no particular difference between the groups. However, not only is the stock of receivables higher for hospitals providing only acute care, but also the stock of liabilities. Within the liability portfolio, we also see a downgrading of current liabilities from 2019. Relationship indicators tend to be weak, with post-hoc tests finding little significant difference in the indicators.

Debt coverage varies widely between groups, but there is also variation between years within groups. Acute hospitals are the lowest, chronic hospitals the highest. There are differences between groups when looking at the liquidity ratio. Chronic care hospitals have the higher values, while the other two groups have very similar lower values. The ratio of assets/liabilities is above 1 in all groups except for one year and there is not as much difference between the groups as in the previous indicators. Looking at the short-term aspect, the assets/liabilities ratio is more likely to be below 1 in the first 3 years examined, with the most favourable figures being recorded by the active care institutions. But 2019-2020 shows almost unintelligible numbers due to the technical reclassifications already mentioned. The connectivity indicator indicates a weak to medium strength of connection. Bonferroni post-hoc tests show significant differences for some indicators, in some years, between chronic and mixed care hospitals, and in one case between chronic-acute and acute-mixed care groups. Chronic care hospitals have an increasing share of other income, but only 91-94%, while acute care hospitals have a share

of 97-98%. These are the two extremes, with mixed care hospitals falling in between. The figures also show that chronic care hospitals adjust their revenue ratios by the contribution fee for care. The ratio of material costs to expenditure is particularly high for hospitals providing only active care, at 35-40%. Chronic hospitals are only 8-9% and county hospitals are only a few percentage points higher. So the latter two groups seem to rely more on the services they use. This is supported by the proportion of services used. For chronic care hospitals, the average ratio of personnel expenditure was around 57-67%, while for acute care it was only around 30%. For mixed care hospitals it was 52-57%, similar to the combined average.

Depreciation as a proportion of total expenditure is of roughly the same order of magnitude in all supply groups, and has been steadily decreasing, from 6% to 4%. The proportion of other expenditure in total expenditure shows greater variation between supply types. Mixed care shows a relatively stable share of around 6%, while chronic care shows a decline from 7% to 4%. The relationship between the type of care and the ratio of material costs to personnel costs, the material costs to personnel costs, is strongly medium. Bonferroni post-hoc tests for the same indicators showed significant differences between all groups in all years.

This ROS indicator is very high in 2016 for institutions providing only active care, which can be explained by the data from the National Institute of Oncology. In years with positive results, the value of the indicator has typically been around 3-4%, except for the active group in 2016 with a value of 7%. The 2016 value for acute hospitals is an outlier for all indicators. The proportional result for personnel expenses ranged between -7.5% and 8.5% for each year and group. The average return on assets also shows no consistent variation between the groups, with all but the active 10% in 2016 fluctuating between -5 and 5%. Linkage ratios show very weak values. The Bonferroni post-hoc tests show significant differences between hospitals with chronic-active and mixed-active profiles only for the 2016 proportional outcome for personnel-related expenditure.

When looking at revenue per bed, I found that the specific value of acute hospitals is many times higher than that of chronic and mixed care hospitals. The explanation for this is that acute-only hospitals have a different patient population and a higher CMI, so their revenue is high, but they also have a low number of beds, so the specific value is much higher. For chronic care hospitals, the average value of revenue per bed is between 8.3 and 10.4 million HUF/bed, while for active hospitals the average value has increased from 49 million HUF/bed to 76 million HUF/bed over the 5 years under study. The average specific indicator of hospitals providing both acute and chronic care is only a few million higher than that of hospitals providing only chronic care. For material costs per bed, I saw a similar distribution, but on a smaller scale. For active hospitals, out of a revenue of close to £50 million per bed, nearly £20 million was spent on material costs alone on average in 2016, rising to over £31 million by 2020.

While the average for chronic hospitals is only 700 thousand HUF/bed. Also, the ratio of services used per bed is highest for acute hospitals only, at 5-7 million HUF/bed, while for chronic hospitals only, it is 1.5 million HUF/bed. If I consider this indicator together with the previous one, it can be concluded that in absolute terms, acute hospitals spend more on purchased services, but only about a quarter of the cost of materials, while chronic hospitals spend twice their unit cost of materials on purchased services.

Personnel expenditure per bed shows a steady increase, with a similar distribution as the previous expenditure indicators, ranging between 5-25 million. Chronic is lowest, mixed care is slightly higher and the average specific indicator for acute hospitals is highest. The depreciation per bed also shows that acute hospitals must have more machinery and equipment, as they have about four times the specific depreciation per bed of chronic or mixed care hospitals.

The projection base explains the significant difference in the other expenditure per bed indicator in favour of the acute group, as the other expenditure ratio was almost the same in all groups.

For chronic and mixed care hospitals, personnel-related expenditure accounts for the largest share of specific expenditure, while for acute hospitals, specific material-related expenditure is the dominant expenditure element.
The eta correlation coefficient with the revenue and expenditure per bed indicators shows a strong medium or sometimes strong significant relationship with the forms of care. The Bonferroni post-hoc tests indicate that the group of chronic and mixed care hospitals do not differ significantly on any of the indicators. The revenue per full day of care in acute care hospitals is about ten times higher than the average for chronic care hospitals, but also five times higher than in mixed care hospitals. The cost of materials per day of care is similar to revenue, but of a smaller order of magnitude. In chronic care hospitals, the cost of materials per day of care is around €2,000, while in active care only hospitals it was €84,000 per day in 2016, which has increased further.
The values of the services used per day of care also show that in absolute terms, acute care is the highest and chronic care the lowest, but chronic and mixed care hospitals have one and a half to two times higher values than the unit cost of materials. However, for acute-only hospitals, the specific service used is only a quarter of the specific material cost. Again, the earlier finding that active hospitals tend to be more self-sufficient and use fewer purchased services is underestimated. For the other three groups of expenditure per day of care, acute care hospitals have the highest values, followed by mixed and chronic hospitals, of course in different orders of magnitude. One of the most important, looking at the cost of human resources, shows a personnel cost per day of care of between 60 and 130 thousand HUF for an acute hospital, while for chronic hospitals it is more under 20 thousand HUF and for hospitals providing both types of care it is between 30 and 60 thousand HUF per day.
There is a medium-strength significant relationship between the type of care and the indicators per day of care, when tested by a correlation coefficient. Using Bonferroni post-hoc tests, except for two indicators (cost of materials per day, other expenditure per day), where there is no significant difference between chronic and mixed care hospitals, the other indicators and all the relations show significant differences between the values of the different types of hospitals.
Looking at the value of revenue per patient discharged, the higher specific value seen in chronic hospitals can be explained by the lower number of patients discharged from chronic wards, which is due to the nature of care. Mixed-care hospitals have the highest number of discharged patients, so their specific value is the lowest, at only 500-700 thousand HUF/person. The value of the material cost per discharged patient, as shown in the previous specific material cost indicators, is highest for acute care hospitals, typically 400-600 thousand HUF/person, rising to 850 thousand HUF/person in 2020. In chronic care hospitals this indicator is between 100-150 thousand HUF/person, while in mixed care hospitals it is between 50-100 thousand HUF/person. The value of services used is higher in chronic care hospitals, at 230-350 thousand HUF/person, while in mixed care hospitals it is 65-110 thousand HUF/person. These figures are one and a half to two times the unit cost of materials. But for active care hospitals, the value of specific purchased services is about a quarter of the value of specific material costs. In the indicator of personnel costs per discharged patient, the specific value of chronic care hospitals is several times higher than the average of the other two types of care. Looking at the specific indicators, while in 2016 the specific revenue of chronic hospitals was 1200 thousand HUF/person, of which the specific cost of materials was nearly 100 thousand HUF/person, specific services used was 230 thousand HUF/person, and specific personnel expenses were nearly 700 thousand HUF/person. In contrast, in acute care hospitals, the specific revenue was HUF 1,040 thousand per capita, specific material costs HUF 410 thousand per capita, specific services used HUF 92 thousand per capita and specific personnel costs HUF 267 thousand per capita. In short, the cost components are different for the acute and the other two types of care.

The decrease in value per discharged patient is higher than average in acute and chronic care hospitals. Hospitals with only chronic care have a low rate of depreciation when looking at the database and a low number of discharged patients, so the specific value is high. The average values of other expenditure per patient show a similar distribution and magnitude. The correlation between the type of care provided by hospitals and the indicators per discharged patient shows a significant relationship of medium strength. It is particularly strong for the specific material cost indicator. Bonferroni tests show significant differences in specific revenue and most specific expenditures between chronic and mixed care hospitals, and in specific material costs between chronic and active and between active and mixed care hospitals.

My second research question is related to the study of the way hospitals provide care.

K2 Research question:
Are there similarities and patterns in the operations and financial statements of public hospitals by type of care?

Based on my analysis, I formulated my thesis T2 in response to question K2.

T2 Thesis:
Hospitals providing only acute care are mostly specialised, and therefore have a specific patient population. Diseases have higher material costs and higher revenues for the hospitals. This requires a high level of equipment, which is reflected in the balance sheet under fixed assets and in the profit and loss account under depreciation. The share of other revenue is higher for these institutions, as they are less likely to have a net income from camel movements than a chronic hospital. The share of personnel expenses is less significant for acute care institutions, while it is the dominant cost item for chronic care hospitals.

III.2.3 Analysis of hospitals by NUTS2 location

There are also differences between regions in the hospital sector. The change of regime also brought reforms in the health sector. Since then, there have been several changes of ownership of hospitals and, in line with European trends, hospital beds are being reduced. The number of hospital beds per 10,000 inhabitants has also fallen in Hungary, in line with European trends, but is still much higher in our country than in Western European countries.
And this is just an average, there are differences between our regions. The number of hospital beds in the Central Hungary region is twice as high as in the North Hungary region (Takács, 2020). In parallel with this rationalisation, the strengthening of primary care and outpatient specialist care, and the focus on prevention, have started. At the same time, "even among hospitals with the same characteristics, there are regularly indebted and well-performing institutions", which demonstrates the role of management in successful operations (Takács, 2020).

Table 5 Grouping of hospitals by NUTS 2 classification

NUTS 2	2016	2017	2018	2019	2020
Budapest	20	20	20	20	19
Pest	7	7	7	7	7
Central Transdanubia	16	14	14	14	14
Nyugat-Dunántúl	12	11	11	11	11
Southern Transdanubia	9	9	9	9	9
Northern Hungary	13	12	12	12	12
Northern Great Plain	9	9	9	9	9
Southern Great Plain	8	8	8	8	8
Total	94	90	90	90	89

Source: own editing on database

The distribution of the hospitals under investigation by NUTS2 region is shown in Table 5.
When analysed by NUTS2 region, the Pest region has the lowest average number of beds, just behind Central and Southern Transdanubia. Lower bed numbers also mean lower numbers of discharged patients. There are also differences between regions in the number of completed days of care, but a general stagnation or decrease is seen. The average nursing day is almost the same except in the Central Transdanubian region, where it is several times higher than in the other regions. There is not such a big difference in bed occupancy, only a typical drastic decrease in 2020 is seen, while death rates show an increase in the same year. However, regional classification shows only a weak relationship and post-hoc tests do not show a significant relationship between regions.
The fixed asset ratio also varies between regions. By having a lower fixed asset ratio in Budapest and Pest, it follows that the ratio of current assets to cash and receivables should be higher. Looking at the ratio of real estate itself, there is a steady increase in fixed assets. Real estate accounts for an increasing share of fixed assets, even in Budapest, where it is the lowest. In terms of the share of financial assets, there is greater hecticness both between regions and within regions in each year. For the share of receivables, this is typically an increasing trend in all regions except Central Transdanubia. In terms of the ratio of liabilities, the Budapest and Southern Great Plain regions have the highest ratios, while the Central and Western Transdanubia regions have the lowest ratios.
In terms of accrued liabilities, the Budapest and Pest regions have significantly lower rates, while the regions of Transdanubia and Northern Hungary have higher rates. With NUTS2 classification, the closeness of relationship is of medium strength for most indicators, but with

post-hoc tests, no significant differences were found for any indicator in relation to any region. Debt coverage ranges from 10 to 20, with a few exceptions that distort the average values as a result of specific data for some hospitals. The least indebted regions are the Central and Western Transdanubia and Northern Hungary regions, while the Budapest region has the highest, followed by the Southern Great Plain. In terms of the liquidity ratio, the worst performers in 2016-2018 are the North Great Plain and South Transdanubia regions. The assets/liabilities ratio is twice as high in the Pest region, while in the West Transdanubia, North Hungary and South Great Plain regions it is more like one and a half times higher. In South Transdanubia and North Great Plain we see average values below 1. If I only compare receivables to liabilities within one year, only Budapest and Pest regions show values above 1 in the first three years. The eta correlation between the indicators and the NUTS2 classification is weak to medium strong, but Bonferroni post-hoc tests show no significant difference for any of the other indicators for any region except for one relation (2016, Liquidity, Budapest-Pest, p=0.046).

The share of other revenues, with the lowest average value, is shown by the Western Transdanubian region, fluctuating around 90%. While South Transdanubia, North Great Plain and South Great Plain have values of around 96%. By 2020, all regions will see an increase, due to the aforementioned financing reasons. The share of material costs does not vary much between regions, ranging between 32% and 35%, only Budapest is almost 5 percentage points higher than the other regions. However, when looking at the share of material costs, the share of material costs in the Budapest region is close to 20%, while in the Pest region the indicator is below 10%.

The other regions have values of 10-15%. There are no such large differences between regions in the proportion of services used. All regions show a downward trend. The figures show that institutions are trying to reduce their dependence on others. There is a slight upward trend in the ratio of staff costs, with very similar values across the regions. The Budapest region is the lowest, at only around 50%, the Pest region the highest at 55-63%, with the other regions around the average. Looking at the depreciation rate, there are differences between regions. All regions show a decrease.

The Pest and Budapest regions show the lowest rates, while the West Transdanubia and Central Transdanubia regions show the highest rates, but the average figures vary in magnitude only in a range of 3-7%. The correlation indicators show medium or close to medium strength relationships between regional classification and the profit and loss account indicators. Bonferroni post-hoc tests show significant differences between Budapest and Western Transdanubia and Budapest and Northern Hungary for only one indicator, the depreciation rate, in 2019 and 2020. In other words, there is typically no difference between the regions.

The activity result as a percentage of revenue is highest in the Southern Great Plain region with the highest positive result and lowest in the Northern Great Plain region. A similar result is obtained when looking at the ratio of personnel costs to operating income, with the Southern Great Plain region showing the highest figures and the Northern Great Plain, Central and Western Transdanubia the lowest. The asset ratio result also shows similar figures. While in years with a positive result the average for each region is below 5%, the South Great Plain region averages 8.8% and 12.7% respectively. Compared to previous years, it has achieved higher results while its asset values have not changed significantly. It is believed that the handling of the virus situation contributed to this figure. In terms of closeness of relationship, there is a medium-strong relationship between NUTS2 regions and the indicators under study for most indicators and in most years, but Bonferroni post-hoc tests show no significant difference between regions for any indicator in any year.

Revenue per bed is highest in the Budapest region, which has only the third highest average number of beds. However, the other regions show almost identical figures (HUF 10-15 million per bed), about half of the Budapest region (HUF 18-33 million per bed). The high value of the

Budapest region includes a number of specialised, high-cost but high-income care institutions. Material costs per bed are also the highest in the Budapest region, at between HUF 4.7-8.4 million/bed, while in the other regions, except for the Southern Great Plain, the value ranged between HUF 1-2 million/bed.
The Southern Great Plain region, which in my analysis means the hospitals of Baja, Hódmezővásárhely, kiskunhalas, Szentes, Kecskemét, Orosháza, Deszki and Gyula, shows values between HUF 1.5-3.2 million in the 5 years under review. The value of services used per bed shows a more even pattern across regions. The Budapest region is a few hundred thousand HUF higher than the other regions, with values typically ranging from 1.8 to 2.3 million HUF, with an increasing trend.
A similar picture is shown by the personnel expenditure per bed, with an increasing trend between HUF 5-8 million per bed, except in Budapest. Budapest has values of 7-12 million HUF/bed. Depreciation per bed is the highest in the Budapest region, reflecting its central role in the health system. The higher figure suggests that developments, constructions and renovations are concentrated in Budapest, for which the depreciation recorded is also high, combined with a projection base that is not the highest. However, the Pest region has the lowest value of the indicator.
Other expenditure per capita also shows a similar picture to the previous expenditure types. Budapest stands out, but the other regions have only HUF 500-900 thousand per bed. The relationship strength indicator shows a medium-strong relationship in most years, but only for specific revenue and specific personnel expenditure can we talk about a significant relationship. However, the post hoc tests do not show significant differences between regions for any indicator and for any relation.
In terms of revenue per care day, the Budapest region stands out compared to other regions, with double to triple the figures for the other regions. This confirms the centrality of the health system in Budapest. Material costs per care day are also the highest in the Budapest region, although it has only the third highest projection base after the North and South. While the average unit material cost in the Budapest region starts from 20 thousand HUF/day in 2016, the other regions tend to have a value below 5 thousand HUF/day. The services used per day do not show such large differences. Budapest is slightly higher compared to the other regions (10-20 thousand HUF/day), while the other regions are between 5-13 thousand HUF/day.
Similar to the other previous aspects of the analysis, the Budapest region's material expenditure per day is higher for material costs than for purchased services, while the other regions spend more on purchased services than on material costs on an aggregate basis. The Budapest region is slightly higher in terms of personnel expenditure per care day, with a value of almost 29 thousand HUF/day in 2016, while the other regions have almost the same values. Southern Great Plain values are even slightly higher compared to the other regions. The depreciation per care day is very low.
With the exception of Budapest, we typically see a value below 2500 HUF/day, which is even more lagging behind in the Pest region. But 2020 stands out in all regions. The explanation for this is the limited patient care due to the viral situation, which has led to a drastic reduction in the number of days of care provided, and thus an increase in the specific indicator. Budapest is the region with the highest capitalisation of fixed assets, while Pest is the region with the lowest capitalisation, on the basis of which depreciation is also recorded.
Other expenditure per care day is also the highest in the Budapest region. Using this correlation indicator, the indicators of revenue and expenditure per care day show a medium-strong relationship with the NUTS2 regions in most years, but only for specific revenue and specific personnel expenditure is there a significant relationship. Using Bonferroni post-hoc tests, I found that there is no significant difference between regions in any of the relations of any of these indicators.

The Central Transdanubian region stands out in terms of revenue per patient. An analysis of the database explains. There are some chronic institutions in the region with a very low number of discharged patients, but at the same time they have a revenue after a nursing day is the basis for funding. In addition, the dominance of Budapest is also evident in this indicator.
The other regions have almost identical indicators. The regions of Budapest and Central Transdanubia are also above average in terms of material costs per patient discharged. For services used per patient discharged, only the Central Transdanubian region stands out. The specific values of the chronic care institutions in the region have a distorting effect on the regional average. For specific personnel costs, specific depreciation and specific other costs, the figures for the Central Transdanubian region also stand out. The eta correlation between the indicators per discharged patient and the regions shows a weak, non-significant relationship, just as the Bonferroni tests do not show significant differences between regions for any of the indicators.
The relationship of NUTS2 classification with capacity, performance indicators and specific indicators is less strong than when looking at supply types. There is a stable medium-strong relationship with bed occupancy, and only a weak relationship with the other capacity and performance indicators. Revenue per bed, material cost, material expenditure, personnel expenditure, other expenditure have a medium-strong (0.4) relationship with the classification by region. Revenue, expenditure per day of care shows just medium strength, while revenue, expenditure per discharged patient shows only a weak relationship (0.26).

The analysis by NUTS2 region is related to research question K3.

K3 Research question:
Are there any similarities or patterns in the operations and financial statements of public hospitals according to their territorial (NUTS2) location?

Based on my analysis, I formulated thesis T3 for research question K3.

T3 Thesis:
The data from the financial statements show that hospitals in Hungary have regional specificities, but the Budapest region has a distinctive feature. National institutions are concentrated in Budapest, so the Budapest region bears the characteristics of national institutions. The Budapest region is characterised by a lower ratio of fixed assets and a lower ratio of real estate. The region is characterised by high material costs and a low proportion of services and human resources costs used, while the proportion of other revenue, which is the main source of income, is similar to that of the other regions.

For all three aspects of the analysis, it was observed that the values of the liquidity ratios varied over an extremely wide range, especially in the last two years of the period under review. There were ratios of several thousand to fourteen thousand between the highest and lowest values. Consequently, I formulated thesis T4 in general terms, irrespective of the classification criteria.

T4 Thesis:
The liquidity test is not meaningful, as the values needed to calculate it are highly hectic and unpredictable. Hospitals have reclassified their liabilities as long-term liabilities in 2019-2020, which results in distorted liquidity ratios and data for the periods are not comparable.

III.3 The problem of 2020

We have experienced the economic, social and even environmental impacts of the COVID-19 pandemic first hand. Hospitals have experienced the epidemic in a dual role as both a business entity and a health care provider. Numerous scientific articles have addressed the issue in relation to hospitals in terms of disease types and care settings. In the present research, I investigated the overall impact of hospitals on financial performance.

Many hospital performance indicators have deteriorated as a result of the pandemic. Declines in hospital admissions, outpatient turnover and elective surgery are evident across the board (Jalali et al., 2022; Morais et al., 2023)

The pandemic led to a significant reduction in hospital revenues due to the loss of non-essential services, the loss of deferrals, and increased operating costs, which caused huge losses for hospitals (Wang et al., 2022b) (Rogowski, 2022)(Rhodes et al., 2023). Operating margins down sharply in the wake of the pandemic (Rhodes et al., 2023; Wang et al., 2022a). However, despite a decline in operating margins, overall profit margins remained similar to previous years, reflecting the COVID-19 relief fund, effective offsetting of government subsidy programs (Wang et al., 2022a, 2022b) (The Wangs surveyed hospitals in California).

An Iranian study showed that named laboratory revenues, imaging revenues and hospital costs increased significantly during the outbreak (Samadi and Khalilabad, 2023). Hospital costs have increased due to the use of more, more expensive personal protective equipment and tighter patient care conditions (Cai et al., 2022; Morais et al., 2023).

The management of the hospitals has tried to manage this loss-making situation. A number of strategic solutions were implemented. For example, providing extra funding for economic stability (Jalilian et al., 2023), or an increase in the benefit rate to compensate for the loss of revenue from lost, deferred benefits (Rhodes et al., 2023). These steps were taken in the short term. In the longer term, there have been hospital closures, hospital mergers or even changes in the quality of care (Rhodes et al., 2023). The epidemic has affected performance indicators, which in turn has negatively affected the profitability index of hospitals, according to the authors of an Iranian article (Ahangar et al., 2023).

So, in short, the pandemic has left a deep imprint on the financial performance of hospitals, for which strategies have been and will continue to be developed to mitigate losses and improve financial sustainability. After the international perspective, I will look at how Hungarian hospitals have reported on their management of the epidemic.

In the 2020 annual reports, balance sheet and income statement, the impact of the COVID-19 virus was reflected at several points. Following the impact of central measures to stop some care, thus extending the ability to care for patients with COVID, there was an impact on the number of days of care completed and patients discharged from wards in hospitals. Both indicators have declined. At the same time, mortality statistics have deteriorated sharply due to the virus and its complications.

In terms of hospital performance data, we can see that mortality has increased by more than 35% compared to both 2016 and 2019 (Figure 3). This shows that the 2016-2019 matched value deteriorated significantly due to the impact of the epidemic.

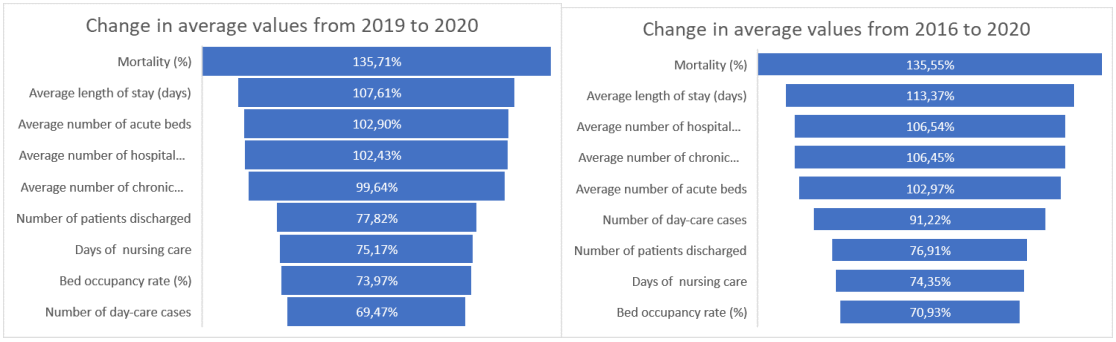

Figure 3 Evolution of hospital performance indicators compared to 2016 and 2020
Source: own editing on database

The average length of stay shows a slight increase, but the number of patients discharged from the wards, the number of days of care provided, bed occupancy and the number of day-care cases have decreased significantly.
With this knowledge, I examined how the balance sheet data of the hospitals were aligned with this. Looking at the change in the average values of balance sheet groups, we see a marked increase in current assets and other own-account items, while there is a more significant decrease in cash and liabilities (Figure 4). Within current assets (a narrower definition of current assets for general government accounting than under the Accounting Act), the dominant item is purchased inventory, which increased from EUR 11 billion in 2016 to EUR 16 billion in 2019, and to EUR 31 billion in 2020. This is clearly linked to the virus. In addition to VAT, the monthly salary for December, which was advanced in December but charged to the following financial year, should be entered in the other specific asset side accounts. While for 2016-2019, the monthly salaries and wages settlements for December totalled around HUF 600 million/year, in 2020 it will be HUF 1,382 million. For many more hospitals, a value has been reported on this line, but in many cases it certainly does not cover the total monthly salary amount. With the first working day in 2021 being 4 January, it is likely that many hospitals chose to pay their salaries at the very end of December for the first day of January. However, for several hospitals, it is clear from the magnitude that it is indeed only a case-by-case payment of wages to departing workers.

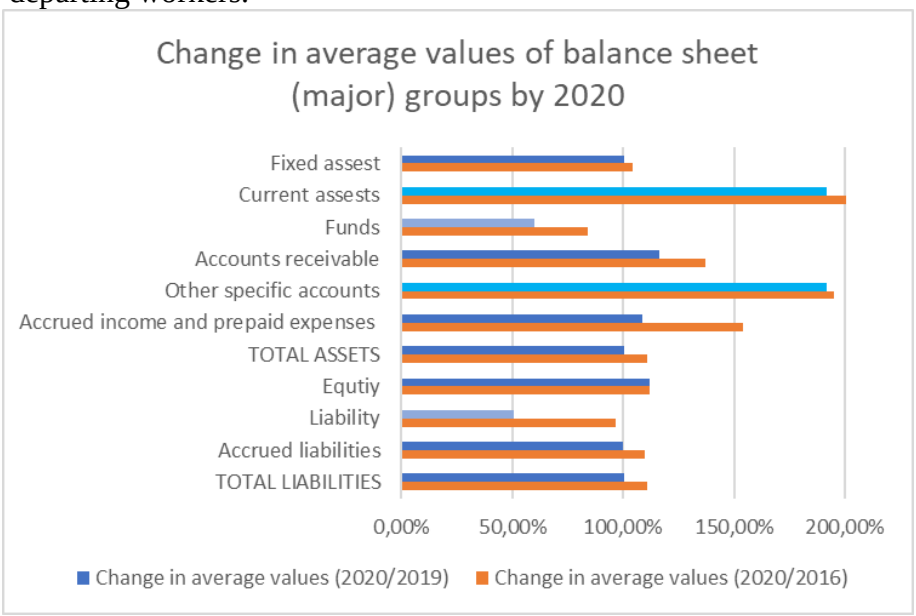

Figure 4 Change in average value of hospital balance sheet (main) groups by 2020
Source: own editing on database

With the exception of liabilities, the other three show similar changes compared to 2016 and 2019, suggesting that there was no significant difference between 2016-19. However, liabilities show a larger decrease compared to 2019. The explanation for this is that the 2019 debt consolidation was not received by the hospitals until spring 2020, so the liability was still high on the balance sheet. Another interesting point in terms of liabilities is the increase in liabilities beyond the year. This technical transfer first appeared in 2019, so compared to that it has increased to a lesser extent, while compared to 2016 it is a very large increase.
Figure 5 shows the changes in the main lines of the income statement for 2020.

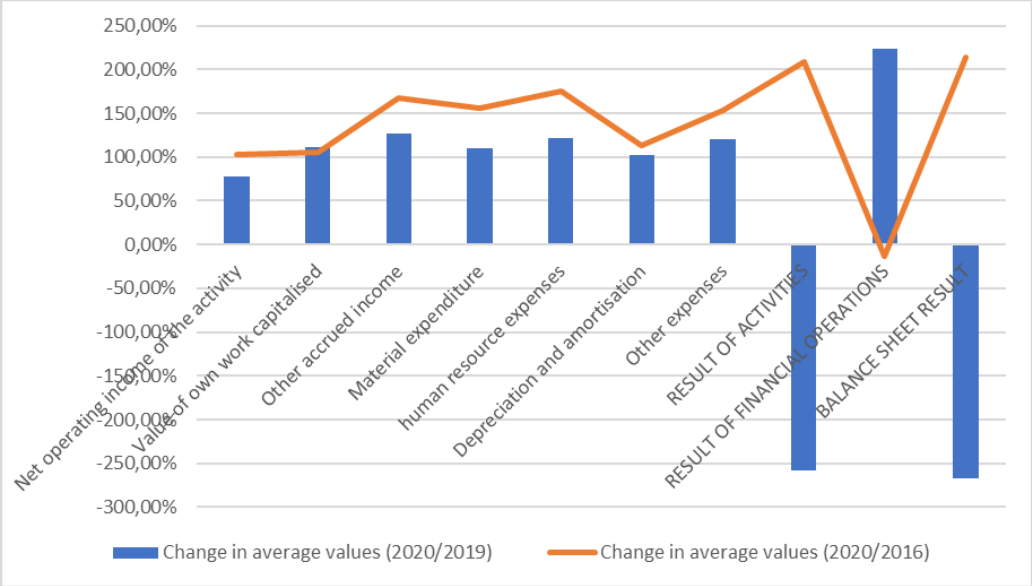

Figure 5 Evolution of the main income statement headings for 2020
Source: own editing on database

The net income of the activity decreased more from 2019 to 2020, almost as much as the increase in other accrual income.
When looking at the changes in other accrual revenue lines, operating state aid is typically the dominant item, but there is also a significant increase in other revenue compared to both 2016 and 2019. The latter includes funds received from all other budget sources other than NEAK (e.g.: subsidies for medication, non-Social Security/Treasury wage subsidies, budget-supported subsidies for other activities).
Expenditure typically shows higher increases compared to 2016, which reflects the impact of inflation. The result categories show a more hectic variation.
I looked at other income, days of care, number of patients discharged, expenses and the change in average values for the result for 2019-2020 in different groupings. By type of hospital (county/city/national), by type of care (active/chronic/mixed care) and by NUTS2 region. From these, I could conclude that there were no significant differences by quality or area except for the result (Figure 6).

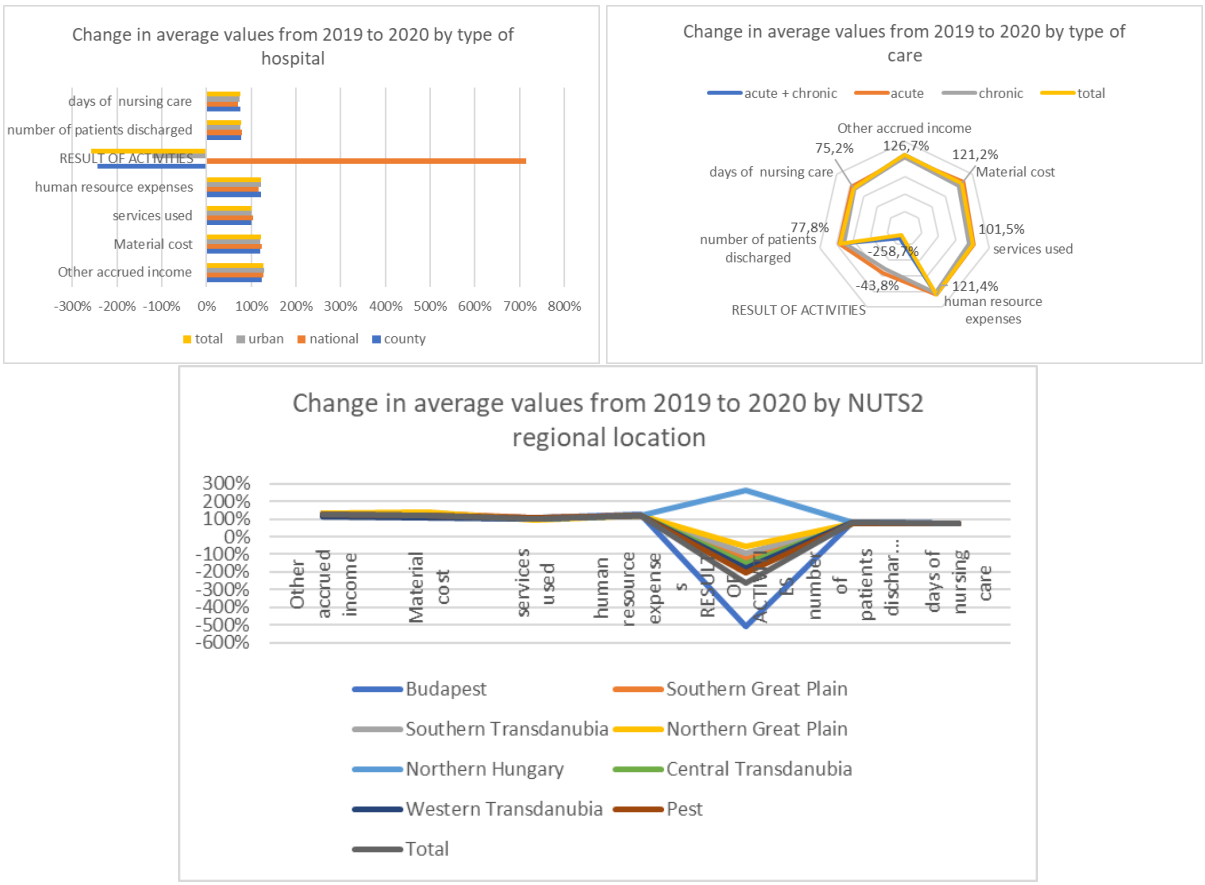

Figure 6 Changes in the average value of the main lines of the profit and loss account from 2019 to 2020 by different criteria

Source: own editing on database

Typically, the changes in the average values of the different types of hospitals were the same from 2019 to 2020, with the exception of the outcome. By type of care, chronic care shows a slightly smaller increase in costs. These institutions typically did not participate in pandemic patient care. I tested each indicator against 2020 using a paired t test.

Table 6 Paired T test values for the net revenue of the activity

Paired Samples Test

		Paired Differences							Significance	
					95% Confidence Interval of the Difference					
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	One-Sided p	Two-Sided p
Pair 1	Tevékenység nettó bevétele 2020 - Tevékenység nettó bevétele 2016	3338114,7079	170833902,79	18108357,479	-32648440,58	39324669,994	,184	88	,427	,854
Pair 2	Tevékenység nettó bevétele 2020 - Tevékenység nettó bevétele 2019	-102460648,5	278103661,07	29478929,116	-161043825,6	-43877471,46	-3,476	88	<,001	<,001

Source: based on SPSS databese

No significant difference in the data for 2020-2016 (p=0.854), but significant difference for 2019-2020 (p<0.001)

It can be seen that the impact of the virus situation resulted in a significant decrease in the institutions' net revenue from activities in 2020 compared to 2019. But compared to 2016, there is no significant difference between them. This can be explained by the fact that this revenue increased continuously from 2016 to 2019. Performing the same analysis for other income,

which is basically the funding that hospitals receive from the NECA, I found that there is a significant difference in the average for both 2016-2020 and 2019-2020. For the other indicators, I looked only for 2019-2020 (Table 7). Only for the services used, there is no significant difference between 2019 and 2020 based on the paired test.
These show that the pandemic situation in 2020 has had a statistically detectable impact on the activity of hospitals, both in terms of financial and performance indicators.

Table 7 Paired T test values for income statement data and professional indicators

Paired Samples Test

		Paired Differences					t	df	Significance	
					95% Confidence Interval of the Difference					
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			One-Sided p	Two-Sided p
Pair 1	Egyéb bevételek 2020 - Egyéb bevételek 2016	4656813309,0	6290362452,2	666777086,38	3331733963,1	5981892654,8	6,984	88	<,001	<,001
Pair 2	Egyéb bevételek 2020 - Egyéb bevételek 2019	2484981920,3	3288067974,7	348534508,25	1792342824,6	3177621016,1	7,130	88	<,001	<,001
Pair 3	Anyagköltség 2020 - Anyagköltség 2016	988651406,98	2173651257,1	230406572,44	530766760,77	1446536053,2	4,291	88	<,001	<,001
Pair 4	Anyagköltség 2020 - Anyagköltség 2019	393796442,10	927789186,87	98345457,117	198355511,92	589237372,28	4,004	88	<,001	<,001
Pair 5	Igénybe vett szolgáltatások 2020 - Igénybe vett szolgáltatások 2019	16376376,472	166428891,70	17641427,238	-18682253,08	51435006,023	,928	88	,178	,356
Pair 6	Személyi j ráford 2020 - Személyi j ráford 2019	1075482906,5	1082493633,1	114744095,62	847453128,21	1303512684,8	9,373	88	<,001	<,001
Pair 7	TEVÉK EREDMÉNY 2020 - TEVÉK EREDMÉNY 2019	799790332,73	1847776697,9	195863938,26	410551913,35	1189028752,1	4,083	88	<,001	<,001
Pair 8	Elbocsátott betegek 2020 - Elbocsátott betegek 2019	-4573,8315	4493,3093	476,2898	-5520,3574	-3627,3055	-9,603	88	<,001	<,001
Pair 9	Egynapos ellátási esetek 2020 - Egynapos ellátási esetek 2019	-810,4270	906,4235	96,0807	-1001,3672	-619,4868	-8,435	88	<,001	<,001
Pair 10	Teljesített ápolási napok 2020 - Teljesített ápolási napok 2019	-41184,0449	38311,9003	4061,0533	-49254,5350	-33113,5549	-10,141	88	<,001	<,001
Pair 11	Átlagos ápolási nap 2020 - Átlagos ápolási nap 2019	1,27978	5,69115	,60326	,08092	2,47863	2,121	88	,018	,037
Pair 12	Ágykihasználtság (%) 2020 - Ágykihasználtság (%) 2019	-19,45607	8,10214	,85883	-21,16280	-17,74933	-22,654	88	<,001	<,001
Pair 13	Halálozás (%) 2020 - Halálozás (%) 2019	1,68573	1,98713	,21064	1,26714	2,10432	8,003	88	<,001	<,001

Source: based on SPSS databese

The research question asked at the beginning of this chapter, whether the impact of the pandemic situation can be detected in the hospital reports for 2020, was answered in the affirmative.
In addition to performance indicators, there is also a significant difference in the indicators calculated from the profit and loss account between the data for 2019 and 2020. Using a paired t-test, the analysis shows a significant difference in the net revenue of the activity for 2019-2020, which is clearly due to the change in revenue structure caused by the virus situation. At the same time, other revenues increased significantly for 2020 compared to both 2016 and 2019. Also looking at the types of expenses, there is a significant difference in both material costs and personnel expenses in 2020 compared to 2016 and 2019.

K4 Research question:
Will the financial statements of hospitals in 2020 reflect the impact of the pandemic?

For my research question K4, I formulated thesis T5.

T5 Thesis:
The financial data for hospitals in 2020 show the impact of the pandemic situation. The revenue structure has changed significantly. The net accrual revenue of the activity, i.e. own revenue, decreased significantly, while other accrual revenue increased significantly compared to 2019. In addition to revenue, the cost structure also changed significantly. Material costs and personnel expenses increased significantly from 2019 to 2020.

Recalling the brief international overview presented at the beginning of this chapter, it is confirmed that the deterioration of hospital performance indicators is also evident in Hungarian hospitals (Jalali et al 2022, Morais et al 2023).
In the international literature, a decline in revenues has been described (Wang et al., 2022b) (Rogowski, 2022)(Rhodes et al., 2023). However, this was less true in the Hungarian situation, as revenues from social security sources typically increased in Hungarian hospitals. But to a lesser extent than other public funding. This may be explained by the average funding level in our country. But the loss-offsetting effect of government support (Wang et al 2022) schemes in other countries may have been offset by a larger increase in other state support in the Hungarian system.
The increase in operating costs can also be seen in the case of Hungarian hospitals, which is similar to international practice (Wang et al 2022, Rogowski 2022, Rhodes et al 2023, Cai et al 2022, Morais et al 2023).
I would have liked to include a new criterion in the analysis of this chapter, namely whether or not the hospital had a duty of care during the pandemic. I could not find any data on this, so I had to discard this direction.

III.4 Identifying the characteristics of hospitals using statistical methods

The number of indicators that I calculated from the balance sheet and profit and loss account rows, as well as the number of specific indicators that were formed, led me to try to combine the indicators into factors, to perform logistic regression and cluster analyses. I created a factor from the balance sheet, profit and loss account, financial position, profitability, specific rates per bed, specific rates per day of care and specific rates per patient for the first time in 2016. I used these factors for 2016 in my further analysis.

III.4.1 Whether a hospital will be profitable or loss-making?

With several years of data available for budget hospitals, I thought it would be possible to create a regression function in 2016 that would predict whether a hospital would be loss-making or profitable after entering certain parameters. I would then validate the resulting regression equation for the other years. However, as logical as my idea seemed, the results showed otherwise. Based on all these factors, I ran 25 logistic regressions with several variants. I looked at separate variables, I looked at factor variables. My findings, generalized, were as follows:

- 100% categorical at the end, Nagelkerke index 1, Hosmer and Lemeshow test $\chi 2$ value 0, shows the test to be significant, but the variables in the resulting function are not significant, with the factor variables I get these results (Figure 7).

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	,000[a]	,709	1,000

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	,000	3	1,000

Classification Table[a]

Observed			Predicted		
			Nyereség/Veszteség		Percentage Correct
			veszteség	nyereség	
Step 1	Nyereség/Veszteség	veszteség	29	0	100,0
		nyereség	0	65	100,0
	Overall Percentage				100,0

a. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Bef eszközök aránya Bef eszk/Eszközök (%)	-2,146	263,311	,000	1	,993	,117	,000	1,581E+223
	Kórházi ágyak átlagos száma	-,018	2,027	,000	1	,993	,983	,019	52,164
	Átlagos ápolási tartam (nap)	-1,069	107,008	,000	1	,992	,343	,000	4,181E+90
	Tárgyi eszközök aránya Befektetett eszközökön belül (%)	29,657	4498,204	,000	1	,995	7,584E+12	,000	.
	Tőkemultiplikátor Eszközök/ST (%)	,091	27,327	,000	1	,997	1,095	,000	1,995E+23
	Igénybevett szolgáltatások az összes ráfordításhoz képest (%)	-1,819	107,784	,000	1	,987	,162	,000	9,026E+90
	ROS Bev ar tevék-i eredm (Tevék ered/Bevételek) (%)	46,113	1355,972	,001	1	,973	1,063E+20	,000	.
	1 ágyra jutó egyéb bevétel (Ft)	,000	,000	,000	1	,988	1,000	,999	1,001
	Constant	-2689,846	450692,184	,000	1	,995	,000		

a. Variable(s) entered on step 1: Bef eszközök aránya Bef eszk/Eszközök (%), Kórházi ágyak átlagos száma, Átlagos ápolási tartam (nap), Tárgyi eszközök aránya Befektetett eszközökön belül (%), Tőkemultiplikátor Eszközök/ST (%), Igénybevett szolgáltatások az összes ráfordításhoz képest (%), ROS Bev ar tevék-i eredm (Tevék ered/Bevételek) (%), 1 ágyra jutó egyéb bevétel (Ft).

Figure 7 Some output tables from the logistic regression runs for the indicator Nagelkerke 1 in 2016

Source: based on SPSS databese

- for the variation of individual variables, the Nagelkerke indicator ranged from 9.8-15.4%. But the categorisation percentage in these cases also improved minimally, with 69.1% being the result of random classification and the highest value being 74.5%. But even in the latter case, the explanatory power was only 15.1 %. $\chi 2$ was basically

significant almost always. When the Nagelkerke index was successfully raised to 21.7%, the Hosmer-Lemeshow test was inadequate. The variables included in the model were almost always non-significant, i.e. there was no relationship with the profit/loss result variable (Figure 8).

Classification Table[a,b]

Observed		Predicted: Nyereség/Veszteség veszteség	Predicted: Nyereség/Veszteség nyereség	Percentage Correct
Step 0 Nyereség/Veszteség	veszteség	0	29	,0
	nyereség	0	65	100,0
Overall Percentage				69,1

a. Constant is included in the model.
b. The cut value is ,500

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	105,559[a]	,107	,150

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than ,001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	5,698	8	,681

Classification Table[a]

Observed		Predicted: Nyereség/Veszteség veszteség	Predicted: Nyereség/Veszteség nyereség	Percentage Correct
Step 1 Nyereség/Veszteség	veszteség	5	24	17,2
	nyereség	3	62	95,4
Overall Percentage				71,3

a. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	95% C.I.for EXP(B) Upper
Step 1[a]	Bef eszközök aránya Bef eszk/Eszközök (%)	-,064	,031	4,255	1	,039	,938	,883	,997
	Adósságállomány fedezettsége (ST/Kötelezettségek)	-,009	,013	,516	1	,472	,991	,966	1,016
	Likviditás I. (forgóeszköz+pénzeszk+RL követelések)/RLkötelez	-,031	,045	,484	1	,487	,969	,887	1,059
	Constant	6,255	2,539	6,070	1	,014	520,525		

a. Variable(s) entered on step 1: Bef eszközök aránya Bef eszk/Eszközök (%), Adósságállomány fedezettsége (ST/Kötelezettségek), Likviditás I. (forgóeszköz+pénzeszk+RLkövetelések)/RLkötelez.

Figure 8 Some outputs from logistic regression runs for low Nagelkerke indicator in 2016
Source: based on SPSS databese

- in some cases SPSS did not give any results, no function could be produced.

Based on all this, I have come to the conclusion that I cannot produce a function that can categorize hospitals based on inputs, that can tell you whether they will be profitable or unprofitable, based on the report and the performance indicators. This must be influenced by other factors.

Based on my international literature search, many have used a linear regression model.

Nedelea és Fannin (Nedelea and Fannin, 2013) examined cost-effectiveness with environmental independent variables using regression analysis for a group of US hospitals. Augurzky és Schmitz (Augurzky and Schmitz, 2010) examined hospitals with less than 200 beds in Germany and regressed the probability of EBITDA or default as outcome variables on dependent variables such as type of owner, hospital chain, region, average per capita income, degree of hospital specialisation. Their results suggest that private hospitals perform better, that urban/rural location has not affected hospitals' performance, but that rural hospitals may have problems with financial stability, and suggest changes in health policy. Gapenski és Vogel (Gapenski and Vogel, 1993) conducted multivariate regression analyses of the profitability of private acute care hospitals in Florida.

Answering my research question required a different type of regression, as it involved generating a nominal outcome variable.

K5 Research question:
Can a regression function be developed to estimate the profit/loss of a hospital?

It has not been possible to produce a regression function using binary logistic regression that would have given good results when the resulting function is tested. The data on reporting and performance indicators are not sufficient to produce such a correlation.

T6 Thesis:
With the factor variables generated from the financial statements of the hospitals studied, it is not possible to produce a regression function that can estimate the profit/loss of a hospital.

III.4.2 Hospital typology using cluster analysis

Cluster analysis proved to be a frequently used method in my literature search of the articles examined. However, it can be noted that these articles mostly report the results of clinical trials. Such as the effects of diseases, treatment methods, psychological consequences (for example (Dong et al., 2022)). In my previous study, I myself categorised European OECD countries using cluster analysis to examine the health sector based only on average health expenditure per country and number of beds per capita. I could definitely identify the different financing schemes in the clusters (Horváthné Csolák, 2017). The study of economic indicators, clusters calculated from data from financial statements, was less common in my secondary research in the health sector. One of these was looking at innovation capacity, looking at whether countries could be grouped according to their health innovation performance and whether these groups differed in the factors describing the health system. A multi-indicator approach was used to compare the health innovation performance of 30 OECD countries, and four clusters were created using cluster analysis. A cluster of Nordic countries, the Netherlands and Switzerland showed the highest innovation performance in terms of knowledge generation and commercialisation of knowledge. Surprisingly, these countries - with the exception of Switzerland - are only in the middle group when looking at the overall national innovation system. This article was a valuable contribution to the field of health innovation research (Proksch et al., 2019). Another study grouped 195 countries according to the Global Health Security Index (GHSI), based on 2019 data. The index has been proposed to raise awareness among governments and health institutions of the gaps in national health systems in detecting and addressing biological threats (Pereira et al., 2022).
Then, based on the indicators calculated from the financial statements, I conducted a cluster analysis of Hungarian budget hospitals, with the aim of identifying hospitals with the same characteristics in Hungary. From my calculated indicators I created factors per indicator group using principal component analysis. Using these factors and following the rules of cluster analysis, I generated my clusters using hierarchical cluster analysis, first in 2016, then in 2019 and 2020. Four clusters were considered suitable (Table 8).

Table 8 Four clusters created in 2016 based on balance sheet, income, specific day and specific patient factors

Clusters	n	Average / FAC1_balance sheet	Average / FAC1_profitability_1	Average / FAC1_per_day_1	Average/ FAC1_per_patient_1
1	61	-0,079	-0,187	-0,061	-0,217
2	14	-0,799	-0,942	-0,557	0,066
3	12	0,420	1,877	-0,379	0,164
4	4	0,732	0,161	2,353	0,171
Total	91	-0,088	-0,016	-0,073	-0,106

Source: own editing based on SPSS

Cluster 1 – Fast mass healing

Based on this, the first cluster includes those hospitals that show rather unfavourable scores for all factors (factors are standardised scores). All factors show negative values. Other characteristics aside, it appears that county hospitals typically fall into this factor. As with mixed care institutions, they are most likely to fall into this cluster (58 out of 73). In terms of the number of elements, 61 out of 91 hospitals belong to this cluster, which is why all NUTS2 regions are represented in this cluster.

In terms of performance indicators, this cluster has the highest average number of beds, the highest average number of patients discharged (although with a large variance, i.e. smaller institutions are also included), and a relatively favourable average length of stay of 9 days. The cluster shows an average ratio of fixed assets to total assets, while its activity result as a percentage of revenue is below average, although still positive. Based on my profit/loss coding, there are more profitable hospitals in cluster 1.

Cluster 2 -Long-term healers

All variable factors in cluster 2 show the most unfavourable figures. Urban hospitals are the most likely to belong to this cluster. By type of care, 8 chronic and 6 acute+chronic care hospitals are included. By region, the 14 hospitals included are found in almost all regions. In terms of performance indicators, this cluster has the lowest average number of patients and is second from the bottom in terms of average number of beds. The average length of stay is quite long, almost 22 days.

However, the average ratio of fixed assets is the highest here, as we have seen in the analytical chapter that it was mostly concentrated in chronic urban hospitals. Indebtedness is the lowest. But the average value of the activity result in relation to revenue is negative. And the average value of profit/loss also suggests the presence of loss-making hospitals with a value of 0.07.

Cluster 3 – Profitable majors

In terms of size, it is almost as large as cluster 2. It includes 12 hospitals. In terms of profitability factor, we see the most favourable numbers here, with the balance factor and the specific patient factor being the second highest, but the value of the specific day factor being the second to last. This factor is almost evenly split between county, state and city hospitals. All of these forms are included. But by type of care, there are only mixed and chronic hospitals in the cluster, with mixed being slightly more. Also regionally, all regions are represented in the cluster except for the Northern Great Plain. In terms of performance indicators, the second highest average number of beds, the number of discharged patients and the highest average number of days of care are shown here. The high average number of days of care is typical for chronic care, but the variance of this indicator is particularly high. There is a large spread of hospital days of care across the cluster. Here the lowest ratio of invested assets was found in acute care hospitals, but since there are no acute care hospitals in this cluster, mixed care hospitals may have pulled down the average. The average ROS (Return On Sales) is the highest here, with not too much variance, and thus may well characterise the cluster. And the profit/loss coding also clearly indicates profitable hospitals in this cluster.

Cluster 4 – Small number of beds "cool"

The balance sheet, specific day and specific patient factors are the most favourable in this cluster, but the profitability factor is also second in line. It includes three national and one urban hospital, with two mixed and two active forms of care. In terms of location, there are 3 hospitals in the Budapest region and one in the North-Hungary region. In terms of performance, it has the lowest average number of beds, the lowest average number of days of care and the second lowest number of discharged patients. In terms of financial indicators, the share of fixed assets is similar to cluster 2. It has the highest indebtedness and the second highest, even positive, average ROS. The average profit/loss ratio is 0.75, suggesting that most of the hospitals included here were profitable in 2016.

By mapping the initial situation in 2016, I looked at how the clusters calculated from these factors would evolve in 2019, which was still a normal year for operations, and in 2020, when the virus situation has changed a lot in the way hospitals operate.

Table 9 Attributes of individual clusters in 2016, 2019 and 2020

Cluster	2016	2019	2020
1	• unfavourable factor values (- values) • 61 hospitals out of 91 • typically county hospital, mixed care, all NUTS2 regions • highest average number of beds, number of patients discharged, favorable average nursing day • Average fixed asset ratio • highest indebtedness • 3. best, even (+) ROS • rather profitable hospitals	• rather favorable factor values (2nd-3rd places) • 29 hospitals, 13 county, 13 urban, 28 mixed-care, all regions • highest avg. number of beds, number of patients discharged, nursing days completed • 2nd lowest avg. nursing day • 2nd highest fixed asset ratio • 2nd best degree of indebtedness • 2nd best return on revenue • majority loss, but 2nd best (0.28)	• rather unfavorable factor values • 30 hospitals, 18 city+9 county+3 national, 28 mixed + 2 chronicAll except South Great Plain • 2nd largest number of beds, number of patients, nursing days, 3rd largest avg. Nursing day • 2nd highest fixed asset ratio • average indebtedness • 2nd minimum revenue ratio • more profitable than unprofitable (0.73)
2	• worst-case factor values • Typically urban hospitals, 8 chronic and 6 mixed care, all regions • 14 hospitals • lowest avg. number of patients • lower average number of beds • longer care period (22 days) • highest fixed asset ratio • lowest degree of indebtedness • worst Revenue Margin • rather loss-making hospitals (0.07)	• rather unfavorable factor values • 32 hospitals, of which 22 are urban, 12 chronic, 20 mixed all regions • minimum avg. number of beds smallest number of patients, highest avg. nursing day (17 days), almost minimum completed nursing day • highest fixed asset ratio • lowest degree of indebtedness • profit proportional to revenue 3rd (- value) • most profitable, but 0.31	• worst-case factor values • 26 hospitals, 18 urban+5 county+3 national, 18 mixed + 8 chronic, all regions • minimum avg. number of beds, number of patients, nursing days, 2nd highest average nursing day (18 days), • maximum fixed asset ratio • lowest degree of indebtedness • lowest return on revenue • half profit-loss
3	• profitability, balance and per patient factors are more favorable, per day penultimate • 12 hospitals • mixed and chronic hospitals only • 2nd highest number of beds, number of patients discharged • highest avg. nursing day (large standard deviation) • lowest fixed asset ratio • 2nd best degree of indebtedness • profit margin highest (low standard deviation) • profitable hospitals	• Best factor values • 5 hospitals, 3 county+2 national3 mixed+2 acute, Budapest, South Great Plain, Central Transdanubia regions • 2nd minimum number of beds, number of patients, minimum nursing days, average nursing days • minimum fixed asset ratio • 2nd highest indebtedness • best revenue proportional result, but (-) • rather loss-making (0.2)	• rather favorable factor values • 15 hospitals, 10 urban+5 county, 15 mixed hospitals, all regions except Western Transdanubia • highest average number of beds, number of patients discharged, nursing days, 2nd lowest average nursing day • lowest fixed asset ratio • highest indebtedness • 2nd best revenue margin • rather profitable (0.93)
4	• best factor values • 3 national + 1 urban hospital, 3 Budapest + North Hungary, 2 mixed+2 acute hospitals • lowest average number of beds, avg. nursing day, 2nd lowest number of patients discharged, • 2nd highest fixed asset ratio • highest level of indebtedness • + ROS • majority profitable (0.75)	• rather unfavorable factor values • 19 hospitals, 16 urban + 3 county19 mixed-care, almost all regions • 2nd highest number of beds, number of patients, nursing days, average nursing days • 2nd minimum fixed asset ratio • highest indebtedness • worst revenue margin • all of them are unprofitable	• best factor values • 4 hospitals, 1 county+3 national, 2 mixed + 2 acute, 4 Budapest region • 3. largest number of beds, number of patients, 2nd lowest nursing daylowest average nursing day (5.4 days) • 2nd lowest fixed asset ratio • 3rd highest positive return on revenue • all profitable
5	-	-	• Best profitability factor, other negative factor values • 9 hospitals, 3 county+ 1 national + 5 urban, 7 mixed + 2 chronic, Budapest, South Great Plain, South Transdanubia, Northern Great Plain regions • 2nd lowest number of beds, number of patients, 3rd lowest number of patients, highest average nursing days (20 days) • 3rd highest average fixed asset ratio • 2rd lowest indebtedness • best return on revenue • all profitable

Source: own editing

In 2019, the same factors could not be generated from the same indicators. One of the factor analysis conditions was violated, either the correlation was not strong enough, or the anti-image matrix had an inappropriate value for the variable, or the communalitas was below the threshold. Correcting for these, however, the factors were not the same as in 2016. Thus, starting from zero, I created the factors for each indicator group, and then based on the correlation values, I selected which factors could remain in the cluster analysis (balance sheet, income statement, specific patient, profitability), and thus I obtained four clusters. I have summarised my results in Table 9.
However, 2019 was a very negative year for the majority of hospitals, with many hospitals making losses and accumulating large debts, which also affected the composition of clusters. Although the number of clusters remained 4, the order of clusters with similar characteristics changed compared to 2016. However, clusters were formed partly on the basis of different cluster variables in 2019 than in 2016, as can be seen in the last row of Table 10.

Table 10 Names of the 4+1 clusters created in 2016, 2019 and 2020

Clusters	**2016**	**2019**	**2020**
1	Fast mass healing	Profitable majors	Profitable majors
2	Long-term healers	Long-term healers	Long-term healers
3	Profitable majors	Small number of beds "cool"	Fast mass healing
4	Small number of beds "cool"	Fast mass healing	Small number of beds "cool"
5			Small bed grooming like cool
Cluster variables	balance sheet, **profitability,** per day indicators **per patient indicators**	balance sheet, Income statement, **per patient indicators, profitability**	financial, **profitability**, per day indicators, **per patient indicators**

Source: own editing

Based on my literature search, I could not find a similar study in the international literature. Thus, referring to my own studies, I was able to formulate the following thesis based on the research conducted on my research question:
For some years, some clusters show similar characteristics for 2016, 2019 and 2020, although an additional factor has been added for 2020. But in each year I could not use the same variables, they were partially replaced. Two variables that appeared as variables in the cluster analysis in all three years were the factor variables "profitability" and "specific patient". I also ran the cluster analysis for only those two variables.
Thus, I conclude from this cluster analysis that I cannot generalize the results in the form of inputting financial data to see what type of hospital it is.
So, based on the analysis in this chapter, I wanted to answer my research question K6.

K6 Research question:
Can cluster analysis be used to identify clusters with similar management characteristics?

In response to my research question K6, I formulated thesis T7.

T7 Thesis:
Clusters can be formed in each year of the period under study, but it is not possible to define clusters that use the same variables in each year of the period under study. A general conclusion cannot be drawn on the basis of a cluster analysis carried out on the basis of data from a single year.

I will carry out further research to find indicators that will allow generalisation and use the financial data of budget hospitals for forecasting.

III.5 Conclusions, proposals

Based on my literature research, I was typically unable to compare these findings, I could not find a suitable precedent for them. Thus, my results can be the best starting point for similar studies, as a basis for comparison.
I carried out my research under limited conditions.
For comparability, I have limited my analysis to budgetary institutions. I had to exclude the clinics as they do not report separately from their educational activities. The churches also refuse to disclose data of public interest, claiming that they are essentially maintained by church funds.

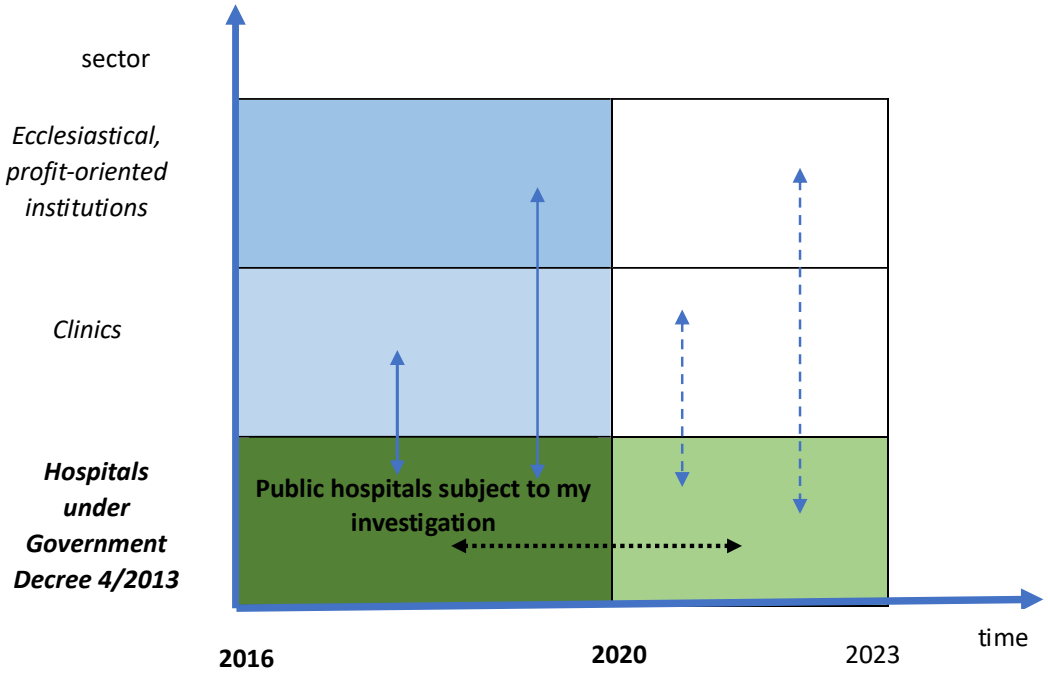

Figure 9 Further research directions
my own editing

I consider the following areas as further research directions:

- time interval extension. To examine what has changed in the financial reporting data of hospitals after the virus situation.
- analysis and comparison of the data of private service providers with my present results.
- analysis of clinics. The comparability of financial reports is a problem due to the change of university model.
- analysis of church institutions, the data of which I did not have access to at the moment.
- compare data from regional analyses with health status statistics.

IV. PUBLICATIONS ON THE TOPIC OF MY DISSERTATION

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Appendix

1. Database

NUTS 2 code	NUTS 2	Settlement	Type code	Type of hospital	Form of care code	Form of care	Name
21	Central Transdanubia	Székesfehérvár	2	county	3	acute + chronic	Saint George University Teaching Hospital of Fejér County
33	Southern Plain	Baja	1	urban	3	acute + chronic	St. Rókus Hospital in Baja
32	Northern Plain	Nyíregyháza	2	county	3	acute + chronic	Szabolcs-Szatmár-Bereg County Hospitals and University Teaching Hospital
12	Pest	Visegrád	1	urban	1	chronic	St. Cosma and Damian Rehabilitation Hospital and Spa
11	Budapest	Budapest	2	county	3	acute + chronic	South Pest Centre Hospital - National Institute of Heamatology and Infectology
23	Southern Transdanubia	Dombóvár	1	urban	3	acute + chronic	St. Luke's Hospital of Dombóvár
11	Budapest	Budapest	2	county	3	acute + chronic	St Imre University Teaching Hospital
22	Western Transdanubia	Keszthely	1	urban	3	acute + chronic	Keszthely Hospital
23	Southern Transdanubia	Bonyhád	1	urban	1	chronic	Bonyhád Hospital and Clinic
31	North Hungary	Salgótarján	2	county	3	acute + chronic	St. Lazarus County Hospital
12	Pest	Cegléd	1	urban	3	acute + chronic	Ferenc Toldy Hospital and Clinic
21	Central Transdanubia	Farkasgyepű	2	county	3	acute + chronic	Veszprém County Pulmonary Institute, Farkasgyepű
21	Central Transdanubia	Tapolca	1	urban	1	chronic	Jenő Deák Hospital
22	Western Transdanubia	Zalaegerszeg	2	county	3	acute + chronic	Saint Rafael Hospital of Zala County
11	Budapest	Budapest	1	urban	1	chronic	Sándor Károlyi Hospital
33	Southern Plain	Hódmezővásár-hely	1	urban	3	acute + chronic	Csongrád-Csanád County Health Care Center Hódmezővásárhely-Makó
21	Central Transdanubia	Pápa	1	urban	3	acute + chronic	Count Esterházy Hospital and Clinic
32	Northern Plain	Kisvárda	1	urban	3	acute + chronic	Upper Szabolcs Hospital, Kisvárda
21	Central Transdanubia	Tatabánya	1	urban	3	acute + chronic	St. Barbara Hospital
23	Southern Transdanubia	Nagyatád	1	urban	3	acute + chronic	Nagyatád Hospital
22	Western Transdanubia	Nagykanizsa	1	urban	3	acute + chronic	Dorottya Kanizsai Hospital
33	Southern Plain	Kiskunhalas	1	urban	3	acute + chronic	Kiskunhalas Semmelweis Hospital, University of Szeged Medical School Teaching Hospital
32	Northern Plain	Jászberény	1	urban	3	acute + chronic	St. Elisabeth Hospital of Jászberény
33	Southern Plain	Deszk	2	county	3	acute + chronic	Csongád-Csanád County Hospital for Thoracic Diseases

32	Northern Plain	Mezőtúr	1	urban	3	acute + chronic	Mezőtúr Hospital and Clinic
23	Southern Transdanubia	Mohács	1	urban	3	acute + chronic	Mohács Hospital
23	Southern Transdanubia	Komló	1	urban	3	acute + chronic	Komló Health Center, Mining Aftercare and Night Sanatorium Medical Center
31	North Hungary	Gyöngyös	1	urban	3	acute + chronic	Pál Bugát Hospital
11	Budapest	Budapest	1	urban	3	acute + chronic	St. Margaret Hospital
31	North Hungary	Sátoraljaújhely	1	urban	3	acute + chronic	Sátoraljaújhely Elizabeth Hospital
11	Budapest	Budapest	1	urban	3	acute + chronic	Péterfy Hospital-Clinic and Jenő Manninger National Institute of Traumatology
11	Budapest	Budapest	2	county	3	acute + chronic	North Central Buda Center, New St John Hospital and Clinic
21	Central Transdanubia	Esztergom	1	urban	3	acute + chronic	Kolos Vaszary Hospital, Esztergom
22	Western Transdanubia	Sárvár	1	urban	1	chronic	St Leslie Hospital
22	Western Transdanubia	Szombathely	2	county	3	acute + chronic	Markusovszky University Teaching Hospital
22	Western Transdanubia	Hévíz	1	urban	3	acute + chronic	Hévíz Spa and St. Andrew's Rheumatism Hospital
11	Budapest	Budapest	3	national	2	acute	National Institute of Oncology
22	Western Transdanubia	Kapuvár	1	urban	1	chronic	Alexander Lumniczer Hospital-Clinic
22	Western Transdanubia	Sopron	1	urban	3	acute + chronic	Elizabeth Teaching Hospital and Rehabilitation Institute in Sopron
21	Central Transdanubia	Komárom	1	urban	3	acute + chronic	John Selye Hospital
21	Central Transdanubia	Kisbér	1	urban	1	chronic	Kázmér Batthyány Specialist Hospital
21	Central Transdanubia	ZIRC	1	urban	1	chronic	Elizabeth Hospital-Clinic in Zirc
11	Budapest	Budapest	3	national	2	acute	George Gottsegen National Cardiovascular Institute
31	North Hungary	Mátraháza	3	national	3	acute + chronic	Mátra Medical Institute
21	Central Transdanubia	Oroszlány	1	urban	1	chronic	Institute of Specialist Medicine and Nursing in Oroszlány
31	North Hungary	Edelény	1	urban	3	acute + chronic	Robert Koch Hospital and Clinic
33	Southern Plain	Szentes	2	county	3	acute + chronic	Dr. Bugyi Stefan Hospital in Csongrád-Csanád County
22	Western Transdanubia	Csorna	1	urban	1	chronic	Margaret Hospital in Csorna
31	North Hungary	Parádfürdő	3	national	1	chronic	Parádfürdő State Hospital
21	Central Transdanubia	Veszprém	2	county	3	acute + chronic	Francis Csolnoky Hospital
11	Budapest	Budapest	1	urban	3	acute + chronic	Uzsoki Street Hospital
31	North Hungary	Balassagyarmat	1	urban	3	acute + chronic	Dr. Kennesey Albert Hospital - Clinic
33	Southern Plain	Kecskemét	2	county	3	acute + chronic	Bács-Kiskun County Hospital Teaching Hospital of the University of Szeged Medical School
22	Western Transdanubia	Mosonmagyaróvár	1	urban	3	acute + chronic	Karolina Hospital - Clinic

31	North Hungary	Hatvan	1	urban	3	acute + chronic	Albert Schweitzer Hospital-Clinic
32	Northern Plain	Karcag	1	urban	3	acute + chronic	Gábor Kátai Hospital
11	Budapest	Budapest	1	urban	3	acute + chronic	Bajcsy-Zsilinszky Hospital and Clinic
21	Central Transdanubia	Balatonfüred	3	national	3	acute + chronic	State Heart Hospital Balatonfüred
12	Pest	Kistarcsa	2	county	3	acute + chronic	Pest County Francis Flór Hospital
12	Pest	Nagykőrös	1	urban	1	chronic	Nagykőrös Rehabilitation Hospital and Clinic
21	Central Transdanubia	Ajka	1	urban	3	acute + chronic	Imre Magyar Hospital
23	Southern Transdanubia	Szekszárd	2	county	3	acute + chronic	John Balassa Hospital of Tolna County
33	Southern Plain	Orosháza	1	urban	3	acute + chronic	Dr. László Elek Hospital and Clinic, Orosháza
11	Budapest	Budapest	3	national	3	acute + chronic	National Korányi Institute of Pulmonology
31	North Hungary	Ózd	1	urban	3	acute + chronic	Paul Almási Balogh Hospital
32	Northern Plain	Szolnok	2	county	3	acute + chronic	Géza Hetényi Hospital-Clinic in Jász-Nagykun-Szolnok County
31	North Hungary	Eger	2	county	3	acute + chronic	Francis Markhot Teaching Hospital and Clinic
32	Northern Plain	Berettyóújfalu	1	urban	3	acute + chronic	Count Stefan Tisza Hospital
12	Pest	Törökbálint	2	county	3	acute + chronic	Pulmonary Institute Törökbálint
31	North Hungary	Pásztó	1	urban	1	chronic	Margaret Hospital Pásztó
11	Budapest	Budapest	1	urban	3	acute + chronic	Francis Jahn South Pest Hospital and Clinic
23	Southern Transdanubia	Siófok	1	urban	3	acute + chronic	Siófok Hospital-Clinic
32	Northern Plain	Szolnok	2	county	3	acute + chronic	MÁV (Hungarian State Railways) Hospital and Clinic, Szolnok
23	Southern Transdanubia	Szigetvár	1	urban	3	acute + chronic	Szigetvár Hospital
11	Budapest	Budapest	3	national	3	acute + chronic	Pál Heim National Institute of Pediatrics
21	Central Transdanubia	Dunaújváros	1	urban	3	acute + chronic	St Pantaleon Hospital-Clinic Dunaújváros
12	Pest	Veresegyháza	1	urban	1	chronic	Mission Medical Center
22	Western Transdanubia	Győr	2	county	3	acute + chronic	Aladár Petz University Teaching Hospital
33	Southern Plain	Gyula	2	county	3	acute + chronic	Békés County Central Hospital
23	Southern Transdanubia	Kaposvár	2	county	3	acute + chronic	Mor Kaposi Teaching Hospital of Somogy County
12	Pest	Vác	1	urban	3	acute + chronic	Ödön Jávorszky Hospital, Vác
11	Budapest	Budapest	3	national	3	acute + chronic	National Institute of Sports Health
11	Budapest	Budapest	3	national	3	acute + chronic	National Institute of Rheumatology and Physiotherapy
11	Budapest	Budapest	3	national	3	acute + chronic	National Institute of Medical Rehabilitation
11	Budapest	Budapest	3	national	2	acute	National Institute of Clinical Neuroscience

11	Budapest	Budapest	3	national	3	acute + chronic	Gyula Nyírő National Institute of Psychiatry and Addiction
32	Northern Plain	Debrecen	2	county	3	acute + chronic	Gyula Kenézy Hospital and Clinic
11	Budapest	Budapest	3	national	3	acute + chronic	Hungarian Army Medical Center
31	North Hungary	Miskolc	2	county	3	acute + chronic	Borsod-Abaúj-Zemplén County Central Hospital and University Teaching Hospital
11	Budapest	Budapest	1	urban	1	chronic	Szent Rókus Hospital and its Institutions (From 01.06.2020 it is part of Semmelweis University)
31	North Hungary	Miskolc	1	urban	3	acute + chronic	Miskolc Semmelweis Hospital and University Teaching Hospital (From 01.04.2017 it merged with B.A.Z. County Hospital)
21	Central Transdanubia	Tata	1	urban	1	chronic	St. Elizabeth Specialist Hospital and Clinic of Árpádház (From 01.07.2017 it is part of St. Barbara Hospital in Tatabánya)
21	Central Transdanubia	Dorog	1	urban	1	chronic	Dorogi St Barbara Specialist Hospital and Specialist Clinic (From 01.07.2017 it is part of Vaszary Hospital in Esztergom)
22	Western Transdanubia	Celldömölk	1	urban	1	chronic	Kemenesalja Unified Hospital (From 01.01.2017 it is part of Markusovski Hospital in Szombathely)

2. Calculated indicators used in analyses

The name of indicator	Indicator formula
Professional performance indicators ***Number of beds, tcarhe number of day, number of patients discharged***	
Average nursing day (day)	$\frac{number\ of\ nursing\ day}{number\ of\ patients\ discharged}$
Bed occupancy (%)	$\frac{Number\ of\ nursing\ day\ completed}{number\ of\ nursing\ day\ that\ can\ be\ completed\ (number\ of\ bed * number\ of\ calendar\ days)} * 100$
Mortality rate (%)	$\frac{number\ of\ deaths\ in\ hospital}{Number\ of\ patients\ discharged} * 100$
Calculated balance sheet indicators	
Fixed asset ratio (%)	$\frac{Fixed\ assest}{Total\ assets} * 100$
Current assets ratio (%)	$\frac{Current\ assets}{Total\ assets} * 100$
Funds ration (%)	$\frac{Cash\ and\ cash\ equivalents}{Total\ assets} * 100$
Receivables ratio (%)	$\frac{Accounts\ receivables, net}{Total\ assets} * 100$
Share of receivables within a year (%)	$\frac{Receivables\ within\ a\ year}{Total\ assets} * 100$
Proportion of receivables over one year (%)	$\frac{\text{Receivables over one year}}{Total\ assets} * 100$
Accrued assets ratio (%)	$\frac{Accrued\ assets}{Total\ assets} * 100$
Capital strength (capitalisation) (%)	$\frac{Equity}{Total\ liabilities} * 100$
Liabilities ratio, degree of indebtedness (%)	$\frac{Liabilites}{Total\ liabilities} * 100$
Ratio of current liabilities (%)	$\frac{Current\ liabilities}{Total\ liabilities} * 100$
Accrued liabilities ratio (%)	$\frac{Accrued\ liabilities}{Total\ liabilities} * 100$
Coverage of fixed assets (%)	$\frac{Fixed\ assets}{Equtiy} * 100$
Calculated indicators on financial position	
Debt coverage	$\frac{Equity}{Liabilities}$
Liquidity I.	$\frac{(Current\ assets + cash + current\ receivables)}{Total\ liabilities}$
Receivables - liabilities ratio	$\frac{Receivables}{Liabilities}$

Current receivables-liabilities ratio	$\frac{Current\ receivables}{Current\ liabilities}$
Calculated indicators for the structural examination of income and expenses	
Other revenue ratio (%)	$\frac{Other\ revenue}{Total\ revenue}*100$
Material expenses ratio (%)	$\frac{Material\ expenses}{Total\ expenditure} * 100$
Material cost ratio (%)	$\frac{Material\ costs}{Totel\ expenditure} * 100$
Proportion of services used (%)	$\frac{Requested\ services}{Total\ expenditure}*100$
Rate of personnel costs (%)	$\frac{Personal\ expenditure}{Total\ expenditure} * 100$
Rate of depreciation (%)	$\frac{Depreciation\ and\ amortisation}{Total\ expenditure}*100$
Proportion of other expenditure (%)	$\frac{Other\ expenditure}{Total\ expenditure}*100$
Calculated indicators for the analysis of profitability	
ROS - Return on Sales (%)	$\frac{Operating\ result}{Total\ income}*100$
Personnel costs as a proportion of operating result (%)	$\frac{Operating\ result}{Personnel\ expenditure}*100$
ROI/ROA - Return on Investment/ Assests (%)	$\frac{Operating\ result}{Total\ assets}*100$
Specific calculated indicators	
Income per hospital bed	$\frac{Total\ income}{Average\ number\ of\ hospital\ beds}$
Cost of materials per hospital bed	$\frac{Material\ costs}{Average\ number\ of\ hospital\ beds}$
Value of services used per hospital bed	$\frac{The\ value\ of\ services\ used}{Average\ number\ of\ hospital\ beds}$
Value of personnel expenditure per hospital bed	$\frac{Personnel\ expenditure}{Average\ number\ of\ hospital\ beds}$
Depreciation per hospital bed	$\frac{Depreciation\ and\ amortisation}{Average\ number\ of\ hospital\ beds}$
Other expenditure per hospital bed	$\frac{Other\ expenditure}{Average\ number\ of\ hospital\ beds}$
Revenue per day of care	$\frac{Total\ income}{Days\ of\ care\ completed}$

Material costs per day of care	$\frac{Material\ costs}{Days\ of\ care\ completed}$
Value of services used per day of care	$\frac{The\ value\ of\ services\ used}{Days\ of\ care\ completed}$
Value of personnel costs per day of care	$\frac{Personnel\ expenditure}{Days\ of\ care\ completed}$
Depreciation per day of care	$\frac{Depreciation\ and\ amortisation}{Days\ of\ care\ completed}$
Other expenditure per day of care	$\frac{Other\ expenditure}{Days\ of\ care\ completed}$
Revenue per discharged patient	$\frac{Total\ income}{Number\ of\ discharged\ patients}$
Material costs per discharged patient	$\frac{Material\ costs}{Number\ of\ discharged\ patients}$
Value of services used per discharged patient	$\frac{The\ value\ of\ services\ used}{Number\ of\ discharged\ patients}$
Value of personnel costs per patient discharged	$\frac{Personnel\ expenditure}{Number\ of\ discharged\ patients}$
Depreciation per discharged patient	$\frac{Depreciation\ and\ amortisation}{Number\ of\ discharged\ patients}$
Other expenditure per discharged patient	$\frac{Other\ expenditure}{Number\ of\ discharged\ patients}$

Source: based on (Bíró et al., 1997)