MYKOLO ROMERIO UNIVERSITETAS

ISSN 1822-8038 (online)
INTELEKTINĖ EKONOMIKA
INTELLECTUAL ECONOMICS
2021, No. 15 (2), p. 113–130.

DETERMINATION OF THE AMOUNT OF HEALTHCARE PUBLIC FUNDING: THE LATVIAN CASE

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DOI: 10.13165/IE-21-15-2-06

Abstract. *Decisions on public funding allocation are significant challenges for any healthcare system. The Latvian health financing policy faces challenges that threaten its long-term sustainability and the values of solidarity. According to the World Health Organization, health, as a state of complete physical, mental and social well-being, is one of the fundamental rights every human, and is dependent upon the fullest cooperation of individuals and states. This also includes the task to "substantially increase health financing." Such concepts require the regular measurement of progress in order to explicate the achieved level in statics and dynamics and to make strategic decisions for the coming period, including those on public healthcare expenditure. The purpose of this article is to evaluate the necessary allocations of general government budget expenditures, ensure justification for the strategic decisions for the next planning period on healthcare expenditure, evaluate the achieved level in statics and dynamics, and provide policy recommendations for future health financing system reforms.*

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Research methodology – To achieve the goal of the research, comparative analysis and methods of theoretical research were used. Intelligent data mining methods were employed for the discovery of and the creation of knowledge on existing regularities in health system expenditure based on mutually comparable factual cases – the declared statistical indicators of the EU27 countries.

Findings – Using data mining analytical tools, the minimum of the general government health expenditure in EU countries was computed in this study: around €1,500 per capita in 2018. The optimal segmentation of general government health expenditure according to the COFOG classification was also computed.

Research limitations – The minimum expenditure calculated is especially relevant for low-expenditure Central and Eastern European countries, while the total public health expenditure segmentation is applicable for any EU country. The benchmarking algorithms are well-suited for comparing aspects of the health sector, identifying leaders with the best performance and best practices, and analyzing how higher performance levels are achieved. However, it should be borne in mind that some dispersion could be caused by heterogeneous environmental conditions.

Practical implications – Governments can consider making sustainable policy decisions and performing the programming process of allocating public resources. This would also help to balance cross-sectoral links between public healthcare and the economy during post-COVID-19 recovery.

Originality/Value – The use of the data mining analytical tools in this study answered a question that is very important for society: What is the minimum amount an EU country should spend on health? The processing of financial data shows that the widespread assumption of the necessary general government health expenditure of 5% of the GDP is not substantiated.

Keywords: *healthcare sector, treatable mortality, health expenditure, benchmarking algorithms.*

JEL Codes: *C21, I18, H51.*

1. Introduction

Decisions on the allocation of public funding are some of the most significant challenges for any healthcare system. The Latvian health financing policy faces challenges that threaten its long-term sustainability and the values of solidarity. According to the World Health Organization (WHO), health, as a state of complete physical, mental, and social well-being, is one of the fundamental rights every human, and is dependent upon the fullest cooperation of individuals and states. This also includes the task to "substantially increase health financing." Such concepts require the regular measurement of progress to explicate the achieved level in statics and dynamics and to make strategic decisions for the coming period, including those on public healthcare expenditure. The purpose of this article is to evaluate necessary allocations of general government budget expenditures,

ensure justification for the strategic decisions for the next planning period on healthcare expenditure, evaluate the achieved level in statics and dynamics, and provide policy recommendations for future health financing system reforms.

In the scientific literature, the policy debate on health systems has been dominated in recent decades by concerns about sustainability and the system's ability to fund itself in the face of growing cost pressures. The accumulation and management of prepaid financial resources to ensure universal health coverage, for example, means that all people can access health services of good quality without experiencing financial hardship (Abiiro & De Allegri, 2015; Hao et al., 2020; Kluge et al., 2017; Kutzin, 2013; Mathauer et al., 2020). The 2009–2015 period saw a general drop in health spending in many countries, but since then, expenditure on health systems has been rising again across the region (Karanikolos et al., 2013; Reeves et al., 2014). Some recent research has been devoted to the impact of the COVID-19 pandemic on public health system funding (see, e.g., Blondel & Vranceanu, 2020).

Another research direction relates to the funding sources of the health system. There is a policy trend in initiating and expanding social health insurance through labor taxes in low- and low-middle-income countries that goes against available empirical evidence. However, very little evidence exists to justify the pursuit of labor-tax financing for healthcare in these countries, and persistent evidence suggests that such policies could lead to increased inequality and fragmentation of the health system. Other authors (Barroy et al., 2018; Belsky et al., 2015) suggest that the successful expansion of resources to health comes mainly from the other three sources in the domestic fiscal space (macroeconomic, reprioritization, and efficiency enhancement), and not from earmarked taxes such as payroll taxes.

Within the scientific literature, investigations into the link between health expenditures and health outcomes can also be found. Berger and Messer (2002) showed that health expenditures, among other factors, had a significant impact on mortality rate. Crémieux et al. (2005) considered a particular type of expenditures – pharmaceutical spending, with more pharmaceutical spending correlating with higher life expectancies. Elola et al. (1995) showed that the impact of health expenditures changed depending on the type of healthcare system in place: national health services seemed to be more efficient than social security systems. Jaba et al. (2014) used life expectancy and health expenditures from the World Development Indicators (WDI) that covered 175 countries from 1995 to 2010, and found a strong correlation between the input and output of the healthcare system across countries with different income levels and geographical locations. The correlation between public financing and health system outcomes was also discussed by Balabanova et al. (2012), Ortiz-Ospina and Roser (2017), and Petersone et al. (2019).

Countries with higher expenditures on healthcare per person tend to have populations with higher life expectancies. It can also be observed by looking at changes over time that as countries spend more money on health, the life expectancy of the population increases. Recently, Luonga (2020) discussed the role of health expenditures in health outcomes, showing that health expenditures significantly affected the fatality rate resulting from a COVID-19 outbreak. For example, in the case of the Latvian

health financing system, the focus was on applying different systemic approaches to the financing scheme and acute resource and hospital infrastructure issues. The Latvian healthcare financing system and its reforms were analyzed by Araja and Kruzs (2016), Bankauskaite and O'Connor (2008), Mitenbergs et al. (2014), and Vane (2018). The recent development of the Latvian health system is represented by Behmane et al. (2019) and the OECD (2019). The topicality of research into Latvia is also related to its relatively recent adoption, in December 2017, of the Healthcare Financing Law. This law was devoted to changing the principles of the national healthcare financing system, with the aim of converting the current system from a general tax revenue funded National Health Service system into a Compulsory Health Insurance system by linking entitlement to health services to the payment of income-related mandatory social insurance contributions. This also raises the problem of the minimum amount an EU country should spend on health. Based on research presented earlier in this paper (Petersone et al., 2018), the authors believe that the revenue pooling of health expenditures should be financed from general budget revenues rather than earmarked social contributions to simultaneously improve market labor outcomes and equity while simplifying the tax system. However, there is a lack of research determining the adequate and necessary amount of funding required to ensure financing of universal health coverage in specific European Union countries, e.g., Latvia. There are some country-specific forecasts of the necessary health expenditures considering ageing-related expenditure components, and non-demographic factors are estimated to be the main drivers of health spending (European Commission, 2015; Przywara, 2010). Demand for healthcare is likely to increase with higher economic prosperity, as a better standard of living changes people's attitudes to their health. Since advances and improvements in medical technology, techniques, and pharmacology are critical factors in delivering quality care, they are also increasingly expensive. With a focus on high-cost products, medicine and technology are major factors driving health system expenditure.

2. Methodology

According to the WHO, health, as a state of complete physical, mental, and social well-being, is one of the fundamental rights of every human, and is dependent upon the fullest cooperation of individuals and states (WHO, 2006). In turn, target 3c of United Nations (UN) Sustainable Development Goal 3 includes the task to "substantially increase health financing" (UN, 2015).

Such concepts require the regular measurement of progress to explicate the achieved level in statics and dynamics and to make strategic decisions for the coming period, including those on public healthcare expenditure. At the same time, it is practically impossible to directly calculate the adequate level of funding required for the efficient and sustainable functioning of the national health system.

This study used intelligent data mining methods for discovery and knowledge creation on existing regularities in health system expenditure based on mutually comparable factual cases – the declared statistical indicators of the EU27 countries.

Although the EU healthcare system is not tightly regulated, the activities of the European Commission aim to harmonize various aspects of national legislation to increase the performance of national health systems: "Union action, which shall complement national policies, shall be directed towards improving public health, preventing physical and mental illness and diseases, and obviating sources of danger to physical and mental health" (European Union, 2008, Article 168). In general, it can be assessed that the EU countries operate in a relatively single regulatory environment with a uniformly defined scope of statistical data.

Therefore, benchmarking algorithms can be used for computation as they are well-suited to: comparing aspects of the health sector; identifying the leaders with the best performance and best practices; analyzing how higher performance levels are being achieved; and assessing how the less successful and those that are lagging behind could progress faster. Nevertheless, it should be borne in mind that some dispersion could be caused by heterogeneous environmental conditions, particularly climatic conditions, which in some countries are certainly more favorable to an individual's health than in other countries.

3. Indicators of the performance of the health system

Determination of the dependent (output) variable, which best describes the performance and efficiency of the national health system and reflects the progress achieved, is the first task for benchmarking. The reliable possibility of using one specific quantified indicator for this purpose is significant for analytics. Several indicators are used in practice to describe the performance of the health system.

Life expectancy at birth is a widely used indicator, and adequate access to healthcare is associated with longevity, especially among older adults (Hao et al., 2020). At the same time, it is acknowledged that alongside health services, the individual's lifestyle, early prevention, social services, and the surrounding socio-economic environment have an impact on longevity (see, e.g., OECD, 2021).

The healthy life years of an individual is also a frequently used indicator. Nevertheless, various individual lifestyle factors, financial and social stress, and harmful habits strongly influence the intensity of biological processes in the body. Accelerated biological ageing has been identified in 30+ and 40+ year-olds (see, e.g., Belsky et al., 2015); they have not been diagnosed with age-related diseases, and they do not visit doctors, but there are significant disturbances in respiratory, digestive, circulatory, renal, hepatic, and immune functions.

The self-perception of one's health is a statistical indicator in which the subjective factor plays a huge role. Some unfavorable processes in the body can develop and have a hidden effect, but the individual still feels good or even very good. In these cases, health examinations are often performed irregularly, and the diagnosis of diseases is incidental. Self-perception is a component of an individuals' quality of life; its objectivity in assessing the efficiency of the health system is questionable.

The complex Euro Health Consumer Index (EHCI) is Europe's leading comparative indicator measuring the efficiency of national healthcare systems (Health Consumer Powerhouse, 2019). This two-level index integrates 46 indicators grouped into 6 clusters according to expertly-defined weighting factors, which makes the index quite complicated for practical calculations. The EHCI includes many important indicators but is less related to healthcare – e.g., patients' rights, individual lifestyles, etc.

Indicators of avoidable mortality have become popular in recent years as "a general 'starting point' to assess the effectiveness of public health and healthcare systems in reducing deaths before 75 years of age from various diseases and injuries" (OECD & European Union, 2020). Treatable mortality (TM) indicates the number of individuals (Fig. 1a – 2018 is currently the latest available year) who could be cured if the health sector functioned perfectly (Eurostat & OECD, 2021). Preventable mortality (PM) rates are also significantly influenced by the efficiency of healthcare services, but various factors of an individual's lifestyle and prevention are also important (Eurostat & OECD, 2021). Lists of preventable and treatable causes of death are strongly defined; therefore, statistical indicators are highly reliable. The inter-correlation between the avoidable mortality indicators is very strong (Fig. 1b), which means that healthcare plays a crucial role in PM.

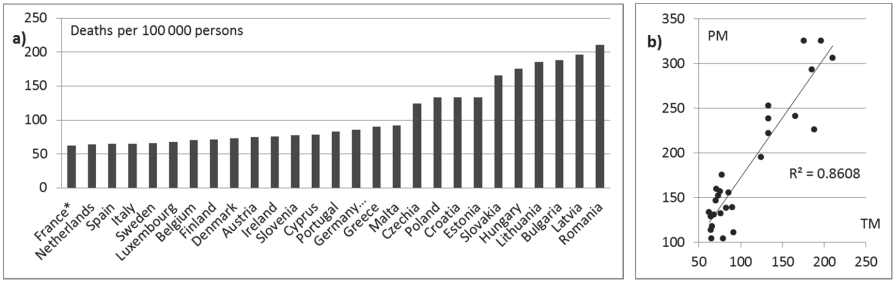

Figure 1. *a) Treatable mortality rates; b) relationship between treatable and preventable mortality.*
EU27 countries, 2018.

*estimated. Source: *Eurostat & OECD (2021).*

The above shows that TM is the indicator that best illustrates the performance and efficiency of the health system in its purest form (Allin & Grigon, 2014). TM is a *hard* statistical indicator; it does not include predictions and/or subjectivity, so it is definitely more reliable compared to others. All other indicators also more or less depend on some aspects (public and/or private) that are only indirectly related to healthcare; the impact of these aspects can be well illustrated by the relationships between TM and other indicators (see, e.g., Schober et al., 2018).

The correlation between TM and life expectancy is very strong. The impact of healthcare performance on longevity plays a dominant role; the importance of other factors is incomparably minor. This means that if TM readings are not available, the use of life

expectancy at birth is justified. Correlations between TM and other indicators are only weak or moderate. This is understandable due to the significant impact of all other factors shown above.

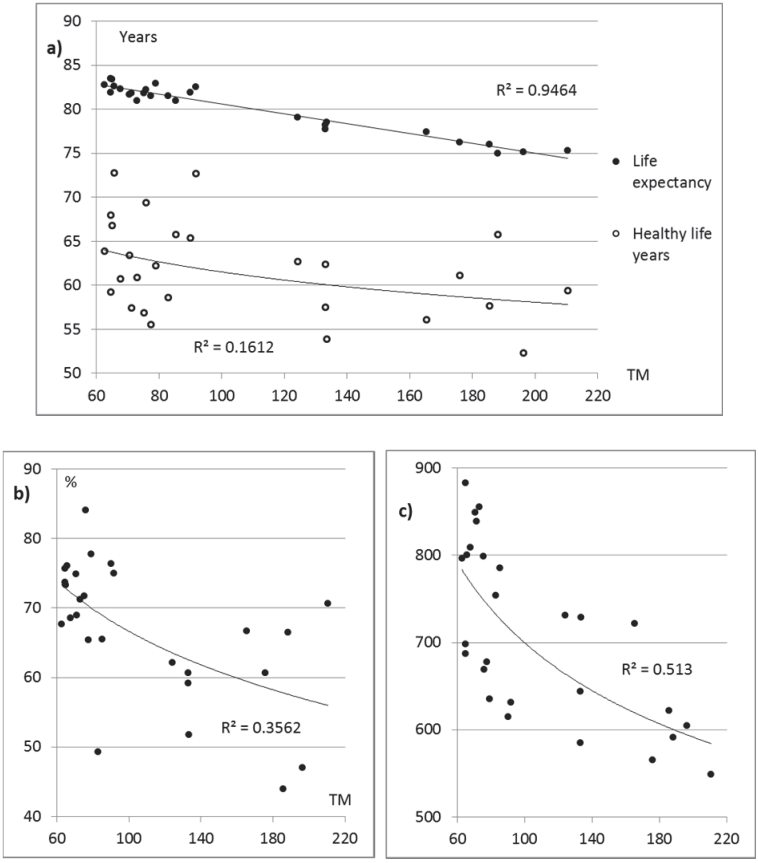

Figure 2. *Relationships between treatable mortality and: a) life expectancy at birth and in healthy life years; b) the share of people with good or very good perceived health; and c) the EHCI. EU27 countries, 2018.*

Sources: *Eurostat & OECD (2021); Health Consumer Powerhouse (2019).*

This study used TM as an output indicator for computing procedures; TM directly reflects the efficiency and performance of the national health systems in EU countries.

4. Public health expenditure

It is widely assumed that when general government health expenditure reaches a certain percentage of GDP, the health system can function adequately. The most commonly cited proportion is 5%, with a reservation in the WHO's recommendations but without reference to a specific source. In reality, however, the WHO provides comprehensive advice on how to finance the health system, saying nothing about the adequate amount of funding required (WHO, 2017, 2021). Moreover, the WHO itself points out that "it is also apparent from frequent references to an alleged WHO 'recommendation' that countries should spend 5 per cent of GDP on health, a recommendation which was never formally approved and which has little basis" (WHO, 2003).

Analysis of the financial data shows that this widespread assumption of the necessary public expenditure for the health system is not substantiated. The trendline in Figure 3 strongly indicates a reduction in TM accompanying an increasing proportion of general government health expenditure as a percentage of GDP, but the correlation is so weak ($R^2 = 0.1933$) that the 5% level cannot be considered as a statistically significant one.

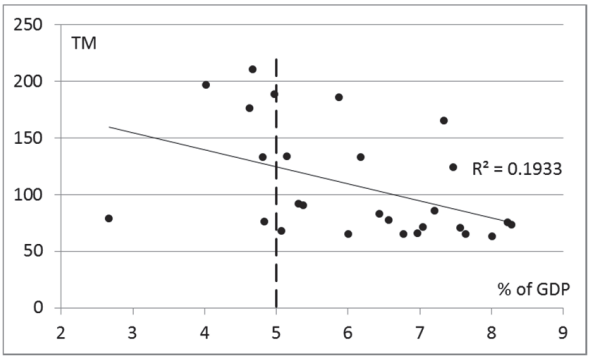

Figure 3. *The relationship between general government health expenditure as a % of GDP and treatable mortality. EU27 countries, 2018.*

Source: *Eurostat & OECD (2021); OECD (2019).*

The EU27 countries have a relatively different approach to national budgeting:

- total general government expenditure as a share of GDP is different in various EU countries (from 25.7% in Ireland to 55.6% in France – the EU27 average was 46.6% in 2018), depending on the national tax policy;
- health expenditure as a share of total general government expenditure is, in turn, different (from 6.2% in Cyprus to 18.8% in Ireland – the EU27 average was 15% in 2018), mainly reflecting the rank of public health in the list of government priorities.

Healthcare services are mainly focused on the individual, taking into account each person's specifics; "health must always be seen in reference to individuals" (Danzer et

al., 2002). Over 90% of general government health expenditure is used for outpatient and hospital services, as well as for medical products and equipment.

However, the above setting of 5% of GDP is directly aimed at so-called population health "as the health outcomes of a group of individuals, including the distribution of such outcomes within the group" (Silberger et al., 2019). Both substantial input variables of the health system – the amount of GDP from which the financing is calculated, and the size of the group of individuals relative to the country's population – are completely ignored. It is clear that even with the same proportion of health expenditure as a share of GDP, the set, quality, availability, and accessibility of health services will depend directly on both GDP and the number of patients.

These shortcomings can be remedied by using general government health expenditure per capita as an indicator of the actual amount of public health funding (Fig. 4). The correlation between general government health expenditure per capita and TM is strong ($R^2 = 0.6853$).

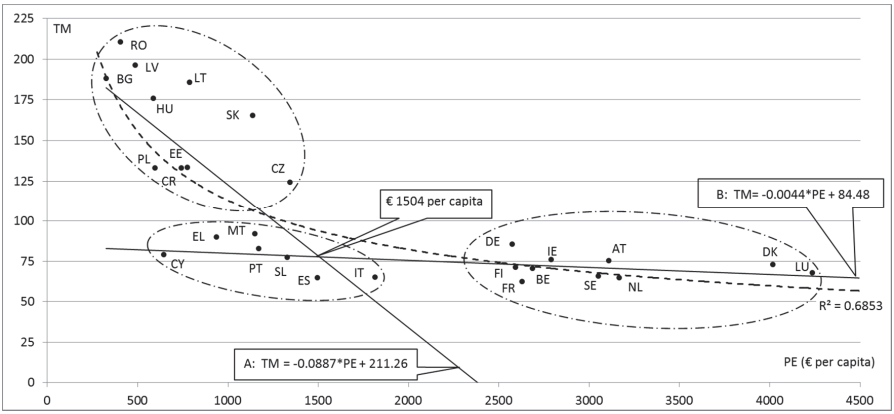

Figure 4. *The relationship between general government health expenditure per capita and treatable mortality.*

EU27 countries, 2018. Authors' calculation based on Eurostat data.

Three national clusters are clearly identifiable:

1. Western and Northern European countries with a general government health expenditure of more than €2,500 per capita and a TM of less than 90 per 100,000 persons aged under 75 years. In these countries, further increases in public health expenditure lead only to an insignificant reduction in TM. Active R&D, increasing the efficiency of medicines and medical technologies, and digital transformation of the health processes and system are the keys to further progress.
2. Central and Eastern European countries, where general government health expenditure is less than €1,500 per capita and TM exceeds 120 per 100,000 persons. In these countries, the healthcare sector is underfunded, the salaries of medical

staff are too low, and in many regions, infrastructure and technologies are outdated. The increase in general government health expenditure effectively reduces TM even without the serious advancement of the health system.

3. Southern European (Mediterranean) countries form the connecting cluster, which is positioned below the trendline. TM in these countries is comparable to Western and Northern European countries, while only Italy provides slightly higher public health funding than Central and Eastern European countries. At least two reasons can be given for this seeming contradiction: (1) it has been known for centuries that the healthy climate, the specific menu, the lifestyle (long lunches, active communication, and the balance between work and leisure reducing stress in general), and the environment (both natural and in terms of ancient heritage) in this region positively affect health; and (2) traditionally high out-of-pocket (private) health expenditure in this region significantly complements low public expenditure.

These features of the clusters of countries confirm the previously-expressed conclusion that the health status in a particular country is also influenced by national specifics (see, also, Jaba et al., 2014).

The location of the data points and the significantly different slopes of the trendline at low and high public health expenditure show that for further analysis it is expedient to create, in the common data area, two partially overlapping data sub-areas, and to develop trendlines for the data points in each sub-area:

- all data points of countries where the TM is less than 100 persons per 100,000 population (the first and third clusters of countries) are included in one sub-area;
- the data points of countries where general government health expenditure is less than €2,000 per capita (the second and third clusters) are included in another sub-area.

The intersection of the two trendlines shows the minimum health expenditure of the general government sector per capita which is necessary to reduce TM in the country to the value at which the low-TM trend begins to occur: around €1,500 per capita in 2018.

The year-on-year TM dynamics at changing levels of general government sector health expenditure are influenced by contradictory factors. A comparison of 2011 and 2018 data shows that politicians in the EU27 countries have mostly decided that the positive impacts of innovation and digitalization outweigh the negative impacts of the shortcomings of the health system and increased costs. In 19 EU countries, general government sector health expenditure grew more slowly than GDP; in five, public expenditure even decreased (Fig. 5).

Nevertheless, TM reduction was achieved in all countries; naturally, in the low-expenditure segment the changes were higher. The achievement of progress shows that there have been structural and/or functional improvements in the health systems of all EU countries.

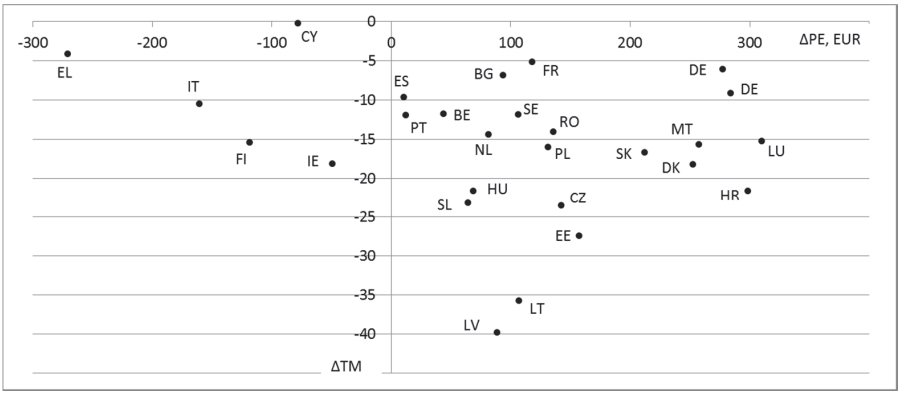

Figure 5. *TM decrease (ΔTM) to the changes of general government health expenditure per capita (ΔPE), 2011–2018. EU27 countries.*
Authors' calculation.

5. The segmentation of public health expenditure

In addition to the assessment of the required general public health expenditure, the distribution of general government health expenditure between segments (functions) is also important. A more detailed analysis of general government expenditure, using the generally accepted COFOG classification, indicates the optimal distribution of public expenditure between functions. Reviewing the segmentation of public health expenditure in each EU country reveals functions that are relatively underfunded.

The authors applied the above-described methodology for determining health expenditure to the relatively large segments of expenditure (medical products, appliances and equipment – Fig. 6a; outpatient services – Fig. 6b; and hospital services – Fig. 6c.), which together account for over 90% of total public health expenditure. If there are good regularities among the data points of the high-expenditure countries, then there are large dispersions among the low-expenditure countries. Therefore, for each expenditure segment, a trendline was developed that, better than others, corresponds to the distribution of data points of this specific segment.

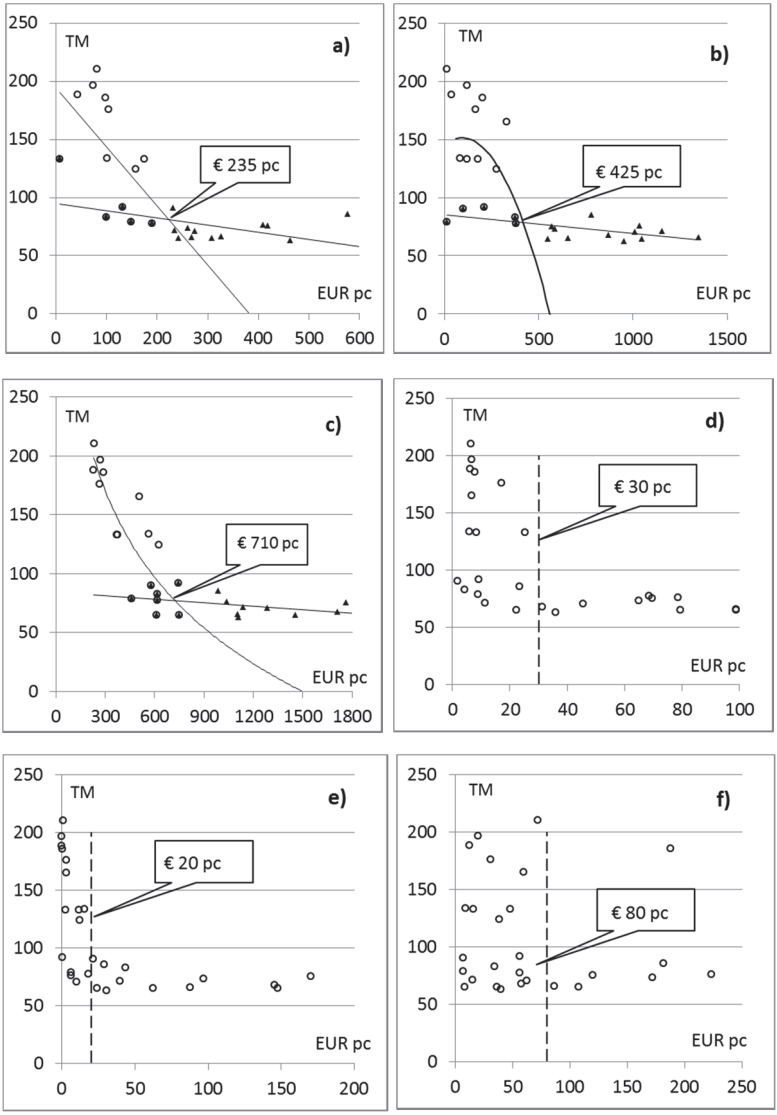

Figure 6. *Relationships between treatable mortality and general government health expenditure per capita for: a) medical products, appliances, and equipment; b) outpatient services; c) hospital services; d) public health services; e) R&D health; and f) health n. e. c. EU27 countries, 2018.*

Source: *Eurostat.*

For the small expenditure segments (public health services – Fig. 6d; R&D health – Fig. 6e; and health n. e. c. – Fig. 6f), uncertainties among the low-expenditure countries were too high. Therefore, for these segments a 10–15% increase in the maximum value of expenditure by low-expenditure cost countries was taken as the required minimum.

The health sector is not currently heavily regulated at the EU level, and the priorities of national strategies naturally differ. In addition, the allocation of expenditure by COFOG sections is treated differently. As a result, the large dispersion of data points (even outliers) shows the segmentation of general government health expenditure at the national level. However, the number of EU countries is large enough to compare the computed segmentation with the statistically reported distribution of EU27 average general government health expenditure (Fig. 7).

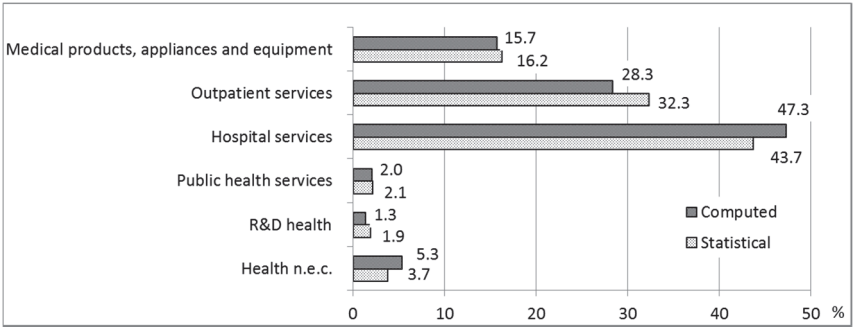

Figure 7. *The distribution of general government health expenditure by function, EU27, 2018.*
Source: *Eurostat*

It can be seen that, in general, there are no serious differences between statistical and computed segmentations. The experience of the COVID-19 pandemic has shown weaknesses in the health system at the EU and the Member State level (in fact, also globally). Hospital capacity proved to be insufficient in a critical situation, as "… money does help to provide the best treatment, and also to allow hospital admissions on lighter indications, which might not be cost-effective but does provide better outcomes" (Health Consumer Powerhouse, 2019).

At the same time, it must also be borne in mind that improving the quality and availability of outpatient services will reduce the workload of hospitals, which is in fact similar to an increase in funding. Potential regular mass vaccination will require increased investment in public services, and the absence of this investment may hamper the further advancement of the health sector, health R&D (i.e., innovation), and digital transformation.

6. Discussion and conclusions

The use of analytical data mining tools in this study answered a very important question for society: What is the minimum amount an EU country should spend on health? Financial data processing shows that the widespread assumption of the necessary general government health expenditure of 5% of GDP is not substantiated.

This computation should be based instead on expenditure per capita, corresponding to a sector in which over 90% of total expenditure is focused on services for an individual. Treatable mortality was used as the indicator of the outcome of the health system as it best shows the performance and efficiency of the health system in its purest form.

Comparing the regularities of countries with low health expenditures and countries with low treatable mortality, the minimum general government health expenditure per capita which is necessary to reduce treatable mortality in a country towards a currently achievable value was computed: around €1,500 in 2018. The mathematical computation used ensured the most objective possible definition of minimum public health expenditure in EU countries. Out-of-pocket expenditure on healthcare was not analyzed as it is determined by the free market and shortages of public healthcare services.

The optimal segmentation of general government health expenditure according to the COFOG was computed using a similar algorithm. It should be noted that the COFOG's apparently different treatment varies from country to country.

The computed minimum expenditure is especially relevant for low-expenditure Central and Eastern European countries. Public health expenditure in 2018 varied considerably between these countries, but in only three (Czechia, Slovakia, Slovenia) did it exceed €1,000 per capita. It will not be possible to bridge such a gap by leaps and bounds; increasing health expenditure by reducing funding to other general government functions is not compatible with the principles of structuring general government expenditure. Our recommendation is to gradually increase health expenditure. As total general government expenditure increases overall year-on-year, most of this increase should be channeled towards health expenditure, setting the EU27 average proportion of 15% of total expenditure as the first target; only four Central and Eastern European countries had reached this level in 2018 – Czechia, Lithuania, Slovakia, Slovenia.

Pre-COVID regularities show that even this increase would ensure significant progress in the proper functioning of the health system; thus, in Latvia, this measure would reduce total mortality by 10–14%. A reduction in preventable mortality and an increase in the general level of health in society could result in an increase in life expectancy of 3–4.5 years.

After reaching the EU27 average, the next goal should be set: to reach the figure that was €1,500 per capita in 2018, adjusted for the impact new treatments and technologies and inflation. The last is by no means insignificant (e.g., an increase of around €100 in 2017 compared to 2011).

The calculated segmentation of total general government health expenditure can be recommended as a guideline for any EU27 country. Although the statistical average distribution in the EU27 is quite close to the calculated one (Fig. 7), the current segmentation in countries is quite different. It is not possible to make a general recommendation as to

which segment funding should increase as a matter of priority; in any case, the step-by-step approach mentioned above should also be applied. Thus, in Latvia the largest comparable expenditure deficit is for outpatient services, while hospitals are in a relatively better position. It should also be borne in mind that improving the quality and availability of outpatient services will reduce the workload of hospitals, which is in fact similar in effect to an increase in funding.

It has to be strongly emphasized that the COVID-19 crisis is currently having a huge impact on regularities: despite rising public health expenditure, mortality rates have also risen sharply. Expenditure in the public health services segment has comparatively increased the most due to expenditure on anti-COVID measures. National governments need to realize that increased levels of general health expenditure must be maintained after the COVID-19 outbreak, as the impact of a pandemic on mortality can be long-lasting.

Despite the current, hopefully short-term, derogations from the general regularities, we urge governments to take these regularities into account, making sustainable policy decisions and performing the programming process of allocating public resources. It would also help to balance cross-sectoral links between the economy and public healthcare during post-COVID recovery.

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Acknowledgment

This work has been supported by the European Regional Development Fund within the Activity 1.1.1.2 "Post-doctoral Research Aid" of the Specific Aid Objective 1.1.1 "To increase the research and innovative capacity of scientific institutions of Latvia and the ability to attract external financing, investing in human resources and infrastructure" of the Operational Programme "Growth and Employment" (No.1.1.1.2/VIAA/2/18/330).