UDC 614.2:336.5:[616.98:578.834COVID-19]-036.22 https://doi.org/10.26641/2307-0404.2025.2.333807

A. Sharashenidze [1],
B. Cherniavskyi [2],
M. Buleishvili [3],
T. Sanikidze [4],
N. Krasnikova [5] *

REMEDIATION STRATEGIES AND SYSTEMIC IMPROVEMENTS IN HEALTH CARE AFTER COVID-19: AN ANALYSIS OF INTERNATIONAL PRACTICES IN HOSPITAL FINANCING

Georgian Technical University [1]
M. Kostava str., 77, Tbilisi, 0160, Georgia
e-mail: sharashenidzealexandre11@gtu.ge
University of Applied Science in Konin [2]
Przyjażni str., 1, Konin, 62-510, Poland
e-mail: bohdan.cherniavskyi@konin.edu.pl
European University [3]
D. Guramushvili ave., 72, Tbilisi, 0141, Georgia
e-mail: Makabule66@yahoo.com
Tbilisi State Medical University [4]
Vazha Pshavela ave., 33, Tbilisi, 0186, Georgia
e-mail: tsanikidze@tsmu.edu
Oles Honchar Dnipro National University [5]
Gagarina ave., 72, Dnipro, 49000, Ukraine
**e-mail: nat.kras11@gmail.com*
Грузинський технічний університет [1]
вул. М. Костава, 77, Тбілісі, 0160, Грузія
Академія прикладних наук у Коніні [2]
вул. Пшиязні, 1, Конін, 62-510, Польща
Європейський університет [3]
пр. Д. Гурамішвілі, 72, Тбілісі, 0141, Грузія
Тбіліський державний медичний університет [4]
пр. Важа Пшавела, 33, Тбілісі, 0186, Грузія
Дніпровський національний університет імені Олеся Гончара [5]
пр. Гагаріна, 72, Дніпро, 49000, Україна

***Цитування:** Медичні перспективи. 2025. Т. 30, № 2. С. 255-271*
***Cited:** Medicni perspektivi. 2025;30(2):255-271*

Key words: *COVID-19 pandemic, health financing system, financial sustainability, public health sector, remediation, health development strategy*
Ключові слова: *пандемія COVID-19, система фінансування охорони здоров'я, фінансова стійкість, сектор громадського здоров'я, ремедіація, стратегія розвитку охорони здоров'я*

Abstract. Remediation strategies and systemic improvements in health care after COVID-19: an analysis of international practices in hospital financing. Sharashenidze A., Cherniavskyi B., Buleishvili M., Sanikidze T., Krasnikova N. *During the coronavirus pandemic, health care systems worldwide encountered serious challenges. Many patients were hospitalized, and hospital sectors in numerous countries struggled to handle the crisis. The pandemic caused disruptions in health care delivery and heavily impacted hospital financing. The financial sustainability of hospitals differed among countries, depending on reliance on outpatient and elective services and other features. These gaps drove health organizations to develop new crisis management plans. This review analyzed changes in hospital financing during the pandemic in Poland, Bulgaria, the Czech Republic, Slovakia, Estonia, Latvia, Lithuania, and Georgia. We selected typical post-socialist nations in Central Europe that share similar geopolitical contexts and membership in the European Union, transitioning from centrally planned to market economies with distinct health financing models, as well as Georgia, which aims to become a member of the European Union. The aim of the present study is a comprehensive analysis of international practices of hospital sector financing under the conditions of the COVID-19 pandemic, based on a comparative analysis of crisis response mechanisms in eight countries, with an emphasis on identifying effective remediation strategies and systemic healthcare improvements in the context of financial sustainability, digitalization, and integration into the public health system. Comparing these countries reveals how they adapted to pandemic pressures, employed financial regulations, and addressed challenges, offering insights for similar health systems worldwide. The analysis indicates that the strength and structure of a country's health financing, especially having an established diagnosis-related group system and comprehensive public health insurance, were crucial for*

managing the pandemic. Countries with robust systems, such as the Czech Republic, Poland, and Estonia, had better capacity to mobilize resources, adjust funding mechanisms, and support hospitals and staff. In contrast, countries with less well-funded structures, including Bulgaria, Latvia, and Georgia, experienced greater obstacles in their pandemic responses. Remediation of the public health sector within socio-ecological and socio-economic frameworks is essential. It covers a wide spectrum of pressing issues, proposing integrated solutions that safeguard health and improve social and environmental living conditions.

Реферат. Стратегії ремедіації та системні вдосконалення у сфері охорони здоров'я після COVID-19: аналіз міжнародних практик фінансування лікарень. Шарашенідзе А., Чернявський Б., Булейшвілі М., Санікідзе Т., Краснікова Н. *Під час пандемії коронавірусу системи охорони здоров'я в усьому світі зіткнулися із серйозними викликами. Значна кількість пацієнтів потребувала госпіталізації, і лікарняні сектори багатьох країн намагалися впоратися з кризою. Пандемія спричинила порушення в наданні медичних послуг і суттєво вплинула на фінансування лікарень. Фінансова стійкість лікарень відрізнялася залежно від країни, що зумовлювалося залежністю від амбулаторних і планових послуг, а також іншими особливостями систем. Ці прогалини спонукали організації охорони здоров'я розробляти нові плани антикризового управління. У цьому огляді було проаналізовано зміни у фінансуванні лікарень під час пандемії в Польщі, Болгарії, Чехії, Словаччині, Естонії, Латвії, Литві та Грузії. Вибрані країни представляють типові постсоціалістичні держави Центральної Європи, які мають схожі геополітичні контексти, членство в Європейському Союзі та перехід від централізованого планування до ринкової економіки з унікальними моделями фінансування охорони здоров'я. Грузія також була включена, оскільки прагне стати членом ЄС. Метою цього дослідження є всебічний аналіз міжнародних практик фінансування лікарняного сектору в умовах пандемії COVID-19 на основі порівняльного аналізу механізмів реагування на кризу у восьми країнах, з акцентом на виявлення ефективних стратегій ремедіації та системних удосконалень охорони здоров'я в контексті фінансової стійкості, цифровізації та інтеграції в систему громадського здоров'я. Порівняння цих країн показує, як вони адаптувалися до тиску пандемії, застосовували фінансові регуляції та вирішували виклики, надаючи цінні уроки для подібних систем охорони здоров'я в усьому світі. Аналіз свідчить, що міцність і структура системи фінансування охорони здоров'я, зокрема наявність усталеної системи груп, пов'язаних з діагнозами (diagnosis-related group system), та комплексного державного медичного страхування були ключовими для управління пандемією. Країни з розвиненими системами, такі як Чехія, Польща та Естонія, мали кращі можливості для мобілізації ресурсів, адаптації механізмів фінансування та підтримки лікарень і персоналу. Натомість країни з менш розвиненими структурами, зокрема Болгарія, Латвія та Грузія, стикалися з більшими перешкодами у своїх реакціях в процесі реагування на пандемію. Ремедіація сектору громадського здоров'я в межах соціоекологічних і соціоекономічних рамок є важливою. Вона охоплює широкий спектр актуальних проблем, пропонуючи інтегровані рішення, які забезпечують охорону здоров'я та покращують соціальні й екологічні умови життя.*

Throughout the COVID-19 pandemic, healthcare systems worldwide faced numerous challenges, resulting in significant disruptions to healthcare provision for the population [1]. A significant proportion of COVID-19 patients initially required hospitalization, however, the hospital sector in many countries could not cope with the pandemic. In 2020, during the first months of the pandemic, 40% of essential healthcare services were provided with at least partial disruptions primarily due to overburdened Health Systems; this trend continued into 2021 [2]. It became necessary to prepare for the influx (or anticipated influx) of COVID-19 patients, restructuring hospital services, expanding intensive care unit (ICU) capacity, eliminating planned inpatient hospitalizations, and reorganizing inpatient hospitalizations. These challenges have had a profound effect on the financial stability of the hospital sector worldwide. This can be attributed primarily to the fact that the substantial costs associated with the care of COVID-19 patients were not anticipated in the initial budgeting of hospital expenditures. In response to the crisis, resources were reallocated from non-COVID-19 care to address the surge in COVID-19 cases, resulting in the postponement and cancellation of elective and routine procedures [3]. This disruption in services contributed to significant revenue shortfalls. At the same time, the reallocation of resources along with fears of virus exposure led to delays and cancellations of non-COVID-related healthcare services, such as elective surgeries and routine care, resulting in exacerbated issues, long-term consequences, and negative health outcomes for the population [4].

In some countries, non-contracted emergency medical facilities (including private hospitals) were used to provide medical services for COVID-19 patients and were to receive compensation for the provided services. Hospitals faced shortages of essential equipment, such as ventilators, laboratories [5], and testing resources [5, 6], and personal protective equipment (PPE) [3]. The situation called for reactive and proactive measures, such as alternative sourcing, PPE reuse, and policy changes to fortify supply chain robustness [7]. Hospitals faced increased costs for equipment and infection control [8, 9].

Overall, the economic impact on healthcare institutions has been significant, for U.S. hospitals alone the revenue losses are estimated in the billions of dollars [8]. The financial sustainability of hospitals has varied across countries depending on their current financial position, reliance on outpatient and elective services, and hospital characteristics [9, 11, 12]. In many countries, such as Austria and Germany, the focus was on closing funding gaps and compensation mechanisms [10].

The pandemic has both revealed and exacerbated significant gaps in healthcare, particularly concerning existing health disparities among marginalized communities. These populations experienced disproportionately high rates of infection, hospitalization, and mortality, underscoring the urgent need for more equitable access to healthcare and resources [11, 12]. All this has prompted healthcare organizations to develop new plans for overcoming crises [8, 11].

The healthcare system was needed to find effective methods to finance the hospital sector during the pandemic. Each country needed to develop strategies to manage the rising costs associated with COVID-19 treatment and shortfalls in hospital revenue. Hospitals developed various financial strategies to mitigate these financial challenges, including seeking government funding and assistance, expanding telehealth services, and adjusting existing budgets to better align with emerging.

Thus, the profound challenges posed by the pandemic necessitated a reassessment of financial sustainability strategies, the adoption of digital health innovations, and the integration of emergency response mechanisms within public healthcare systems. In this context, the aim of this study is to conduct a comprehensive comparative analysis of international hospital financing practices during the COVID-19 pandemic, focusing on crisis management approaches implemented across eight countries. Particular attention is devoted to identifying effective financial mitigation strategies, promoting systemic improvements in healthcare delivery, enhancing digitalization, and reinforcing the integration of hospital services into national public health infrastructures.

MATERIALS AND METHODS OF RESEARCH

In this review analyzed changes in the financing system of the hospital system during the COVID-19 pandemic in countries, Poland, Bulgaria, Czech Republic, Slovakia, Estonia, Latvia, Lithuania, and Georgia. Authors selected these countries because they share a common post-socialist past, with similar challenges in health system financing, such as limited resources and the necessity of structural reforms.

The following research methods were applied in the study: (1) a systematic literature review (SLR) to identify relevant peer-reviewed studies and institutional reports; (2) a comparative policy analysis to contrast hospital financing responses across the selected countries; (3) qualitative content analysis of national policy documents, international guidelines, and organizational reports; and (4) descriptive synthesis of statistical indicators from verified institutional databases (e.g., WHO, OECD, national health authorities). This multi-method approach allowed for a structured evaluation of hospital funding models under pandemic pressure.

This paper presents a systematic literature review (SLR) to synthesize existing literature on the mechanisms used to finance hospital services during the COVID-19 pandemic in various countries. The review mainly analyzes and compares international financing tools or COVID-19 hospital services.

Data Sources and Search Strategy

A wide range of sources was utilized to ensure a comprehensive and rigorous review, including peer-reviewed academic articles, reports, policy documents, and other relevant literature (Academic Databases (SCOPUS), Institutional and Government Repositories (reports, policy briefs, and government publications from national health ministries and healthcare institutions provided valuable data on the funding mechanisms employed by different countries), International Organizations (Documents and reports from prominent international organizations, including the World Health Organization (WHO), World Bank, Organization for Economic Co-operation and Development (OECD), Centers for Disease Control and Prevention (CDC), and the National Health Service (NHS)).

To identify relevant studies, the specific search terms ("COVID-19 hospital financing," "healthcare funding mechanisms," "hospital reimbursement systems during COVID-19," "pandemic healthcare financing") and keywords ("health systems," "public health funding," "health insurance") were used.

Inclusion and Exclusion Criteria

The inclusion criteria for the review were as follows:

Language (only articles published in English were included to ensure consistency and accessibility).

Publication Date: Articles published between January 2020 and December 2023 were selected to capture the most up-to-date information on funding mechanisms related to the COVID-19 pandemic.

Study Type: Peer-reviewed articles, policy documents, government reports, and institutional reviews were prioritized.

Exclusion criteria

Studies that did not specifically address hospital financing or COVID-19 healthcare funding.

Non-peer-reviewed articles, grey literature, or sources lacking empirical data or clear policy analysis. Studies focusing on primary care or non-hospital healthcare settings were outside the scope of this review.

Ethical considerations

This study did not involve human participants, personal data, clinical interventions, or any sensitive health information. It is a secondary analytical review based solely on open-access publications, institutional reports, and publicly available statistical data. In accordance with international research ethics standards (ICMJE and COPE), such studies are not subject to institutional ethical review. All sources were cited appropriately, and the principles of transparency, accuracy, and academic integrity were fully observed throughout the research process.

Data Extraction and Analysis

45 articles, reports, and policy documents were systematically reviewed and met the inclusion criteria. The data extracted from these sources included the following key elements:

- funding mechanisms (types of funding systems employed during the pandemic, categorized into direct government funding, insurance-based funding, and mixed models);

- hospital capacity and service delivery (the impact of these funding mechanisms on hospital capacity; the provision of healthcare services, and the financial stability of hospitals during the pandemic);

- policy changes and stakeholder perceptions (qualitative analysis of policy changes, government responses, and stakeholder perceptions (e.g., healthcare providers, patients, and policymakers) concerning hospital funding mechanisms);

- assessment of the effectiveness of various funding mechanisms on hospital care delivery, patient outcomes, and the resilience of the overall healthcare system.

For comparative analysis, funding mechanisms were categorized into three broad types:

- direct government funding, where governments allocate fixed budgets or emergency funds to hospitals for COVID-19-related services;

- insurance-based funding, where national health insurance systems or social health insurance frameworks were adjusted or expanded to cover COVID-19 services;

- mixed models – a combination of public funding, insurance contributions, and private sector involvement for finance hospital services during the pandemic.

Each funding model was evaluated by Authors based on its effectiveness, advantages, and limitations in responding to the financial challenges posed by the pandemic. Key focus areas included the hospitals' financial stability, capacity to provide services, and equity of access to care under the different funding models.

Synthesis and summary of key findings

The data were synthesized to identify key trends, commonalities, and disparities across the selected countries. The following areas were particularly emphasized:

- best practices (innovative funding approaches that were effective in mitigating financial shortfalls or enhancing service delivery during the pandemic);

- lessons learned (common challenges faced by countries and hospitals in financing COVID-19-related hospital services, and strategies developed to overcome them);

- key differences (variations in funding strategies across countries, influenced by healthcare system structure, government spending priorities, and insurance models).

The review also identified key findings related to the impact of different funding mechanisms on hospital outcomes and overall health system resilience. Based on these findings, recommendations for improving hospital-funding mechanisms in future public health emergencies were formulated.

Limitations

While this review provides a comprehensive analysis of hospital financing mechanisms during the COVID-19 pandemic, several limitations should be noted:

- the review focused primarily on publicly available documents, which may not capture unpublished or ongoing research;

- variations in healthcare system structures, economic conditions, and policy responses across countries may limit the generalizability of certain findings to other regions or settings;

- the focus on English-language sources may have excluded important insights from non-English literature.

In conclusion, this systematic review offers valuable insights into the diverse funding mechanisms used during the pandemic, highlighting key trends, challenges, and opportunities for strengthening hospital financing in future health emergencies.

RESULTS AND DISCUSSION

The Authors examined changes in hospital financing during the COVID-19 pandemic in Poland, Bulgaria, Czech Republic, Slovakia, Estonia, Latvia, Lithuania and Georgia. These countries were chosen because of their shared post-socialist history, which has led to common problems in health care financing, such as limited resources and the need for structural reforms. Many of them rely on international funding, especially from the European Union, to strengthen hospital systems and introduce modern technologies

such as digitalization of health care. Their responses to the COVID-19 crisis, including efforts to increase hospital resilience and expand telemedicine, provide valuable insights into effective strategies and point to opportunities to improve similar health systems around the world.

Poland

Poland's healthcare system primarily operates under a social health insurance (SHI) model, which accounts for approximately 60% of the nation's total health expenditure. SHI enables patients to access a broad range of services, including primary care, outpatient specialist care, and hospital care (including inpatient pharmaceuticals), all within the publicly funded system providing at no direct cost to patients. Health insurance contributions, derived from a designated payroll tax, represent the main source of public healthcare financing, while taxation contributes about 10% of the overall spending. The system is largely centralized, with governance under the Ministry of Health and healthcare purchasing managed by the National Health Funds (NHF). The public system provides coverage to 91% of the population, ensuring near-universal access, as most uninsured individuals are registered as residents despite living abroad [13, 28].

In addition to specialized medical services and emergency medical care, the NHF directly finances various aspects of the healthcare system, including health policy development, preventive health programs, medical staff training, scientific research, and the administration of sanitary and epidemiological functions, including blood donation services. Although public institutions are the primary providers of healthcare services, the growing private sector offers services not fully covered by the NHF. This has led to a mixed model of health care in which many people choose private health care services because of shorter wait times for care and the expectation of higher quality [13, 28].

Despite comprehensive insurance coverage, OOP spending remains substantial. Patients often bear additional costs, particularly outpatient prescriptions, dental care, and specialist consultations. The use of non-prescribed over-the-counter medications is particularly high, accounting for more than three-quarters of all OOP spending on medicines [14, 25]. In 2019, OOP payments represented 20.1% of total health spending, compared to the EU average of 15.3%. Despite decreasing to 20.0% in 2021, OOP spending remains a significant concern, highlighting the growing demand for private healthcare services and the escalating cost of medical care [14, 15].

The Polish government implemented measures to reduce OOP expenditure by expanding the services covered by the NHF and enhancing access to affordable medications. In 2019, health expenditure in Poland accounted for 6.45% of gross domestic product (GDP), notably lower than the EU/EEA/UK average of 8.49% and the WHO European Region average of 7.63%. However, this percentage increased to 7.2% in 2021, largely due to the financial pressures imposed by the COVID-19 pandemic [14, 15].

Most hospitals in Poland were reimbursed based on the diagnosis-related group (DRG) system, which calculates payment based on the medical interventions performed in the previous year. Public hospitals received their usual monthly funding despite reduced activity during the pandemic. Private and non-network hospitals could apply for reimbursement based on contracted services for the year, with payments determined by the NHF according to a predefined list of covered services, including hospitalization and COVID-19-related care [16, 10].

Poland had a relatively high number of hospital beds, with 435 per 100,000 population in 2019, compared to the EU average of 387. However, the country lagged behind the EU in the availability of expensive medical equipment. Most of the equipment was housed in hospitals, and investments were usually financed by hospital budgets and external sources such as EU funds and private donations, as funding for NHF equipment is generally insufficient [17, 38].

Regarding human resources, Poland had the lowest number of practicing doctors in the EU before the pandemic, with only 238 per 100,000 population, and one of the lowest numbers of nurses, with 510 per 100,000 population. These figures have remained relatively stable over the past several years. The healthcare system was under strain due to low salaries in the medical sector, the pandemic exacerbated these challenges.

By 2020-2023, the number of practicing doctors had increased to 371 per 100,000 population, though this still fell short of the EU average of 1390 per 100,000 [18]. Financial incentives have been introduced to attract medical professionals, particularly in underserved areas.

Digital access to healthcare has been a persistent issue in Poland, particularly concerning electronic access to patient records and prescriptions. However, significant improvements have been made since the onset of the COVID-19 pandemic. Teleconsultations have become widely used, especially for initial consultations and triage in primary care settings. Since late 2021, teleconsultations have been mandatory in certain situations, such as prescription renewals [19, 23].

Czech Republic

In the Czech Republic, healthcare expenditure is primarily financed through public sources, with the compulsory SHI system playing a central role. The SHI system is funded through wage-based contributions

from employees and employers, income-related contributions from the self-employed, and state contributions for specific groups of economically inactive individuals, such as children, retirees, and the unemployed. In addition to these contributions, public health financing is supplemented by funding from state and territorial budgets, EU funds, and private expenditures. Health insurance is mandatory, ensuring near-universal access to healthcare services. The SHI system provides a comprehensive benefits package to all insured individuals, although variations in the additional services covered by different health insurance funds exist. These services may include financial contributions for optional immunization, among other offerings [20]. The dominance of the public insurance scheme determines a minimal role of voluntary health insurance in the Czech healthcare system. In 2019, public health financing accounted for a historically high share of 82% of total health expenditure in the Czech Republic, surpassing the EU average of 79.7% [21].

The proportion of OOP payments in total health expenditure has remained fairly constant in recent years, varying from around 14% from 2015 to 2019 before decreasing to 11.5% in 2020. According to data from the WHO, in 2020, OOP payments were distributed across various categories: 26% for over-the-counter pharmaceuticals, 20% for co-payments on prescription medications, 22% for above-standard medical procedures and services (both inpatient and outpatient, including spa treatments and cosmetic procedures), 18% for dental care, and 11% for medical aids and other devices [22]. These figures indicate that OOP payments represent a relatively minor proportion of total health expenditure in the Czech Republic.

Regarding overall health expenditure, in 2019 the Czech Republic allocated 7.8% of its GDB to healthcare, (in the EU – an average 9.9% of GDB); in 2021 this proportion rose to 9.5% of GDP (in the EU average increased to 11%) [23].

Despite spending a lower percentage of GDB on healthcare compared to the EU average, the Czech healthcare system is considered relatively efficient, with strong performance in areas such as healthcare workforce availability and health service provision. However, the Czech Republic has faced challenges in public health emergency preparedness, including legislation, financing, and risk communication, highlighted during the COVID-19 pandemic. In response to the financial strain imposed by the COVID-19 pandemic, the Czech government implemented several emergency measures to support healthcare providers and the population – allowed self-employed individuals to suspend their contributions to the compulsory health insurance system for up to six months (in 2020); health insurance funds were required to compensate healthcare providers for lost revenue and increased expenses resulting from the pandemic (included covering the costs of vaccinations, and testing, and providing bonuses for healthcare workers). To compensate for the significantly increased financial burden on health insurance funds, the government raised its financial contributions to the SHI system, effectively covering much of the pandemic-related costs.

The Czech Republic has one of the highest bed-to-population ratios in the EU, with 6.6 hospital beds per 1,000 inhabitants in 2019, compared to the EU average of 5.3. This dense network of public and private hospitals allowed flexibility in responding to the increased demand for healthcare services during the pandemic, with some hospital beds being temporarily repurposed to accommodate COVID-19 patients. The density of physicians in the Czech Republic was 410 per 100,000 population in 2019, slightly above the EU average of 390 per 100,000. However, the density of nurses was closer to the EU average, at 8.6 per 100,000 compared to 8.4 per 100,000 [24]. To prevent shortages of healthcare personnel during the pandemic, hospitals received higher daily reimbursements for treating patients who tested positive for COVID-19, along with a 1% increase in regular monthly funding to help cover the additional costs of PPE, significantly increased salaries for all healthcare professions [24].

The COVID-19 pandemic also accelerated the adoption of digital technologies (widespread use of electronic prescriptions, remote consultations via video and telephone, and daily data reporting tools) in the Czech healthcare system. These digital tools proved invaluable in maintaining continuity of care and improving the efficiency of the healthcare system during the pandemic, facilitating access to healthcare while minimizing physical contact [25]; advancements in digitalization have long-term benefits, enhancing the responsiveness and accessibility of the healthcare system in the future.

Slovakia

Slovakia's healthcare system is primarily funded through mandatory health insurance contributions, which form the cornerstone of its public financing structure. These contributions, collected by several public health insurance companies, represent the dominant source of funding for the country's healthcare system. Health-related expenditures in Slovakia encompass a range of costs associated with healthcare services, public health programs, and the overall administration of the health system. A substantial portion of the country's health expenditure is allocated to hospital services, including inpatient care,

surgeries, specialized treatments, and the funding of primary care services. Other significant expenditures cover the costs of medicines, medical products, and diagnostic technologies, all of which are essential for maintaining public health

The Slovakia government also plays a key role in ensuring that healthcare services not fully financed by public insurance are still available to the population. For instance, public health initiatives, emergency care, and certain preventive care programs are financed by the government. Although these sectors are vital for long-term population health, they receive a smaller share of the total health budget compared to curative services such as hospital and outpatient care. Preventive measures, including vaccination programs and health promotion activities, are crucial in reducing the overall burden on the healthcare system by mitigating the prevalence of preventable diseases. However, they tend to face budget constraints as governments often prioritize funding for services that address immediate health needs [26].

Despite the comprehensive public financing system, Slovakia still faces disparities in health outcomes and access to healthcare services. These disparities are particularly pronounced in rural areas and among economically disadvantaged populations, leading to unequal healthcare delivery across different regions. For example, individuals living in more remote areas may experience difficulty accessing specialized care, which often requires long travel distances or waiting times. Additionally, people in lower socioeconomic groups are more likely to experience poor health outcomes due to limited access to quality healthcare services. This situation underscores the importance of targeted investments in underserved areas to improve access to healthcare and reduce health inequities across the population [26].

Beyond public financing, patients in Slovakia are also required to contribute to healthcare costs through co-payments or full OOP payments for certain drugs, services, and medical treatments. OOP expenditures constitute a significant portion of private healthcare spending in the country. In 2018, OOP payments accounted for approximately 18.1% of total health expenditure [14, 25] (Table 1). However, this percentage decreased gradually to 17.4% by 2021. The reduction in the share of OOP spending is linked to an increase in public healthcare funding, particularly during the COVID-19 pandemic, when governments worldwide allocated additional resources to address the crisis. As more public funding was directed towards the healthcare system, patients saw a reduction in the financial burden of OOP payments.

Between 2015 and 2019, health expenditure as a percentage of GDP in Slovakia remained stable, fluctuating between 6.7% and 6.9% (Table 1). However, the COVID-19 pandemic exacerbated the pressures on the healthcare system, leading to a significant increase in healthcare spending, which reached 7.5% of GDP in 2020 due to the need for additional resources to combat the COVID-19 pandemic [25]. During The COVID-19 pandemic, Slovakia's government increased health expenditures for emergency care, vaccination, and public health services, and allocated additional funds to strengthen the healthcare system infrastructure and improve the quality, accessibility, and efficiency of services. A substantial portion of these funds was directed towards hospital investments, including the modernization of facilities and equipment, and the digitalization of the healthcare sector: in total, investments amounting to EUR 1.27 billion were aimed at reforming and optimizing the hospital network, especially emergency care. Moreover, the pandemic also led to an increase in the salaries of medical professionals. From 2020 to 2022, average salaries for medical doctors, including bonuses and pandemic-related incentives, increased by approximately 12-15% [26]. This increase was largely driven by emergency bonuses, overtime pay, and financial incentives for physicians directly engaged treatment of COVID-19 patients. These adjustments reflect both the immediate impact of the pandemic on the healthcare sector and the ongoing governmental efforts to improve working conditions for medical professionals in Slovakia. Following the pandemic, healthcare spending decreased slightly in 2021 and remained below the average for European Union countries, highlighting the ongoing challenges Slovakia faces in meeting the rising demand for healthcare services. The health disparities across various regions and socioeconomic groups in Slovakia emphasize the necessity for targeted investments in underserved areas.

Bulgaria

Bulgaria's healthcare system is a mix of public and private services, with most people accessing care through public channels. NHIF is the core of Bulgaria's healthcare system. The NHIF is financed primarily through payroll contributions from employees, employers, and the self-employed.

Health insurance is mandatory for all citizens; the government pays contributions for specific groups, such as pensioners, the unemployed, and children. The NHIF covers a wide range of medical services, including hospitalization, outpatient care, surgeries, medical tests, specialist consultations, and medications. However, there can be limitations on specific procedures or the number of visits to specialists.

As a percentage of GDP, health expenditure in Bulgaria has remained relatively stable over the years, with minor fluctuations and averaged approximately 8.1% (from 2015 to 2019). In 2020, this figure rose to 8.3%, reflecting the allocation of additional resources to manage the crisis during the COVID-19 pandemic; by 2021-2022, health expenditure was estimated at approximately 8.5% of GDP [25]. This gradual increase in health spending highlights ongoing investments to strengthen the healthcare sector, addressing current health system needs and mitigating the challenges posed by the pandemic [27, 28].

OOP spending as a percentage of total health expenditure in Bulgaria from 2018 to 2022 averaged around 37%. This makes Bulgaria one of the countries in Europe with the highest rates of OOP spending, indicating that a substantial portion of healthcare costs is borne directly by individuals rather than through public health insurance or collective funding mechanisms. During the COVID-19 pandemic, OOP spending slightly decreased to 36.5% due to increased government funding to address pandemic-related costs [29, 30].

Bulgaria's healthcare system heavily relies on hospital care, while primary and secondary outpatient services are underfunded and poorly resourced. The insufficient funding for primary and secondary outpatient services contributes to uneven healthcare access across regions, especially rural areas. Before the pandemic, self-reported unmet medical needs due to cost, distance, and waiting times had decreased substantially, from 10.3% in 2009 (the highest in the EU) to 1.4% in 2020 (EU average: 1.8%). However, the onset of the pandemic saw a sharp increase in unmet healthcare needs, rising to nearly 25% during the first 12 months of the crisis (compared to 21% in the EU) [29].

In terms of hospital financing, Bulgaria employed a mixed payment system. Before the pandemic, physicians were primarily compensated through a fee-for-service model, whereby payments were made based on the volume of services provided; this model encouraged the provision of services but also led to inefficiencies and the potential for over-provision of care, as payments were not linked to patient outcomes. In response to the crisis of COVID-19 was a notable increase in healthcare funding, which included extra bonuses for medical personnel and changes in payments. Post-pandemic, the focus has shifted toward maintaining and refining the DRG-based payment system, adjusting healthcare worker salaries, and implementing further reforms informed by lessons learned during the pandemic [24]. DRG hospital payment system improved cost control and efficiency. Additionally, primary care physicians are compensated through a capitation system, where they receive a fixed payment per enrolled patient, regardless of the number of visits

The COVID-19 pandemic further underscored the critical shortages in Bulgaria's healthcare workforce, an issue that was partially addressed through reforms in 2020. Before the pandemic, the number of medical doctors per 100,000 population in Bulgaria ranged from 340 to 345. During the pandemic, physicians' numbers increased slightly to 350-355 per 100,000 population and by 2022, this number had risen to approximately 360 per 100,000 population (Table). These data illustrate how Bulgaria's healthcare workforce evolved in response to the demands of the pandemic [31].

The pandemic accelerated progress in digitalization and data-sharing (electronic prescriptions, remote consultations (via video or phone), and real-time data reporting) within the healthcare sector [30]. Post-pandemic, the focus has shifted toward maintaining and refining the DRG-based payment system, adjusting healthcare worker salaries, and implementing further reforms informed by lessons learned during the pandemic [24].

While changes in Bulgaria's healthcare system show promise, they still require continued investment and reform, particularly in improving outpatient care, addressing workforce shortages, and reducing OOP spending to ensure equitable access for all citizens.

Latvia, Lithuania, and Estonia

In Latvia, Lithuania, and Estonia, the healthcare financing system operates through a combination of social insurance mechanisms, tax-funded healthcare provision, and a diverse range of public and private providers. However, the role of the state in financing healthcare varies. In Estonia and Lithuania, the primary source of financing is compulsory health insurance contributions [28], while in Latvia, the healthcare system is predominantly financed through taxation [32]. Consequently, the state plays a larger role in funding healthcare services in Latvia than in Lithuania and Estonia. Healthcare services in all three countries are largely free for citizens, although additional fees and OOP costs may apply for certain services beyond basic coverage.

Although many healthcare services in all three countries are largely free for citizens, additional fees and OOP costs may apply for certain services beyond basic coverage in all three Baltic states and vary considerably based on the healthcare services provided (the type of service and the provider (public or private)). The state partially covers payments for services like visits to general practitioners, specialists, hospital stays, and pharmaceuticals, including dental care. The co-payment amount can differ based on. Vulnerable groups, including children, pregnant

women, and low-income individuals, are eligible for reduced rates or exemptions.

Despite the availability of many free or low-cost healthcare services, OOP expenses remain significant, especially in Latvia, where OOP spending constitutes one of the highest rates in the EU. These costs are driven primarily by outpatient medicines and can vary depending on the service type and provider.

In 2018, OOP spending in Latvia accounted for 39.3% of total health expenditure, one of the highest proportions in the EU (nearly double the EU average of 21.6%), remained high through 2019 (at around 37%), and continued to account for approximately 27% of total health expenditure in 2021 (one of the highest rates in the EU) [30]. The primary course of OOP spending in Latvia is outpatient medicines [30]. In Lithuania, the share of OOP spending has remained relatively stable, fluctuating between 30% and 32%, while in Estonia, OOP spending in 2019 was lower, approximately 24% [25].

All three countries have prioritized managing OOP expenses to ensure equitable access to essential healthcare services while maintaining the financial sustainability of their healthcare systems. However, the burden of these expenses varies depending on individual circumstances and specific healthcare needs. The health sector constitutes a relatively small share of Latvia's economy, primarily due to the lower prioritization of health in the government budget. In 2019, healthcare spending in Latvia accounted for just 6.2% of total GDP (the EU average of 8.3%), trailing behind neighboring Estonia (6.7%) and Lithuania (6.6%) [30]. Furthermore, Latvia has one of the lowest numbers of practicing medical professionals in the EU, with 350 doctors and 484 nurses and midwives per 100,000 population [32] and the country faces a shortage of medical professionals.

Before the COVID-19 pandemic, all three countries had established the DRG system to allocate resources more efficiently across healthcare services, particularly in hospitals, the crisis forced adaptations in hospital funding and operations. During the pandemic the healthcare systems were forced to adapt rapidly to the influx of COVID-19 cases, necessitating adjustments in hospital operations and funding priorities. DRG categories had to be modified to accommodate the new types of cases related to COVID-19, and additional funding outside the DRG system was allocated to support hospitals during the crisis.

In response to the COVID-19 pandemic, the Estonia, Latvia, and Lithuania governments adopted similar strategies to improve coverage for outpatient drugs, vaccines, COVID-19 testing and treatment, and the procurement of necessary equipment. They also focused on increasing testing capacity, expanding the workforce by attracting new healthcare professionals, and retaining existing staff through financial incentives. To address the immediate impact of the pandemic on healthcare workers, governments introduced measures such as allowing limited overtime hours at higher pay rates and offering bonuses of 20–50% of monthly salaries to doctors, healthcare auxiliaries, and pharmacists directly involved in COVID-19 care. These initiatives were designed to enhance financial protection, especially for the most vulnerable households. In 2021, Estonia eliminated the social insurance contribution in response to the ongoing pandemic [33].

The Baltic states maintained the DRG system post-pandemic, with revisions aimed at improving the system's resilience, balancing financial sustainability and accessibility for their populations and also the ability to respond to future public health crises.

Georgia

The healthcare system in Georgia is a complex framework involving government institutions, private sector entities, and international organizations. The Ministry of Labor, Health and Social Defense of Georgia is the central authority responsible for overseeing the healthcare system, setting health policies, regulations, and strategies, and managing public health programs.

Unlike many European countries that operate under traditional SHI models, Georgia's healthcare system is primarily financed through OOP payments, voluntary health insurance, and government-funded healthcare services, with the latter primarily supported by general taxation. The Universal Healthcare Program (UHP), established in 2013, provides essential healthcare services – such as emergency care, outpatient and inpatient services, surgeries, maternity care, and primary healthcare – to the entire population. The program ensures coverage for the majority, with the government reimbursing healthcare providers for services rendered to eligible patients. Additionally, government-funded targeted programs address specific healthcare needs of vulnerable groups, including maternal and child health, vaccination efforts, and chronic disease management.

Many Georgians can access private health insurance, which offers additional coverage for services not included in the UHP. These services may encompass elective procedures and more comprehensive care. Private insurance is typically provided through employers or can be purchased independently.

Hospital financing in Georgia comes from various sources, such as the state budget, the UHP, targeted programs, employer-sponsored insurance, OOP payments, informal payments, international aid, donor funding, and revenue generated from hospital services.

This diverse financing structure highlights the multifaceted nature of Georgia's healthcare system.

The balance between public funding, private insurance, and OOP payments in Georgia's healthcare system is undergoing continuous refinement as the government adjusts its policies. Before 2017, healthcare expenditure on hospital services was relatively low, accounting for only 5-6% of GDP; OOP payments consistently exceeded public funding and private insurance contributions. From 2018 to 2019, OOP spending accounted for about 58% of total healthcare expenditure, underscoring its vital role in funding hospital services. This is especially important for services not fully covered by public or private insurance, such as elective procedures, specific medications, and advanced diagnostic tests. Additionally, patient charges are not state-regulated, and reimbursement rates for healthcare providers under the UHP vary depending on the type of service and the facility's location [33].

Healthcare spending in Georgia has shown a consistent upward trend, reaching approximately 6.5% of GDP by 2021 and rising to 7% in 2022. This increase represented around 55% of total health expenditure, significantly alleviating the financial burden on individuals [33].

In late 2010, Georgia began implementing the DRG system as part of broader health reforms to improve efficiency, transparency, and accountability in hospital financing. By 2019, the DRG system accounted for 40-50% of hospital financing, replacing the previous case-based payment system [33, 34].

During the COVID-19 pandemic, the government implemented several cost-reimbursement mechanisms to address the financial challenges faced by healthcare providers and the population. These included public financing through the UHP, which provided free COVID-19-related healthcare services – such as testing, treatment, and hospitalization – to all citizens and residents, regardless of their insurance status. Additionally, hospital reimbursements were established, involving fixed payments based on DRG codes assigned upon patient discharge. The use of the DRG system increased significantly as it was adapted to address the complexities of COVID-19 treatment, accounting for approximately 50-60% of hospital services. These fixed payments standardized the compensation process and helped ensure financial stability for healthcare providers. Furthermore, the government allocated additional resources to ensure that healthcare workers had access to necessary PPE and other supplies [35].

Private healthcare facilities have supplemented the public system, particularly during the COVID-19 pandemic, by providing additional coverage for related expenses, including hospital beds, intensive care units, and advanced diagnostic services like imaging and laboratory tests. During this period, international organizations such as the World Bank, the EU, and the WHO provided financial and technical support to enhance Georgia's healthcare infrastructure and vaccination efforts.

Before the COVID-19 pandemic, Georgia had around 340-350 doctors and approximately 1,000-1,100 nurses for every 100,000 residents. These numbers remained relatively stable during and after the pandemic, with reports indicating a slight increase in the number of medical workers. During the pandemic, the government supported healthcare workers by increasing salaries through emergency bonuses, hazard pay, and temporary adjustments. These actions were vital in recognizing the contributions of healthcare professionals on the front lines. In the post-pandemic period, some salary increases were maintained, and the government introduced broader reforms to enhance long-term compensation and improve working conditions for healthcare professionals [35].

Following the pandemic, the DRG system became more widely adopted, financing approximately 60-70% of hospital services by 2022. This integration marked a significant shift in Georgia's health financing model, but OOP spending has remained steady at approximately 55-56%, making it one of the highest rates in the region [36].

The COVID-19 pandemic significantly impacts global economics and healthcare systems, increasing care costs and operational expenditures. The widespread economic downturn associated with the pandemic reduced available funding, placing considerable financial strain on public and private healthcare systems [37].

When evaluating global practices related to hospital service funding during the COVID-19 crisis, it is crucial to assess how various countries modified their healthcare financing systems to meet the extraordinary demands generated by the pandemic. A comparative analysis of selected countries, including Poland, the Czech Republic, Slovakia, Bulgaria, the Baltic States (Estonia, Latvia, Lithuania), and Georgia, reveals the significant impact of pre-pandemic economic conditions, healthcare financing systems, and funding mechanisms on their responses to COVID-19.

Before the pandemic in 2019, health expenditure as a percentage of GDP in the countries studied was generally below the EU average of 9.9% of GDP. These expenditures varied from 5-6% in Georgia to 8% in Bulgaria. The pandemic significantly impacted health spending in all these countries, increasing from approximately 0.5% to 0.7% of GDP. The largest increases were observed in the Czech Republic and

Georgia, where health expenditures rose by 1.0% to 1.3%, reaching 8.8% and 7.5% of GDP, respectively (for the EU, it was between 10.9% and 11.2% of GDP). Bulgaria experienced the smallest increase, with health expenditure rising by only 0.2%, bringing the total to 8.3% of GDP. Post-pandemic, health expenditure as a percentage of GDP remained at or slightly above the levels reached during the crisis. In the Czech Republic, spending increased to 9.1%, whereas the EU average ranged from 10.5% to 10.8% of GDP (Table).

Healthcare System management in Poland, the Czech Republic, Slovakia, Bulgaria, the Baltic countries (Estonia, Latvia, Lithuania), and Georgia [13-35]

Aspect		Poland [13-19]	Czech Republic [20-25]	Slovakia [14, 25, 26]	Bulgaria [24, 25, 27-31]	Latvia [28, 30, 32, 33]	Lithuania [25, 28, 30, 32, 33]	Estonia [28, 30, 32, 33]	Georgia [33-36]
Health Expenditures as % from GDP	Before COVID-19	6.45%	7.5%	6.8%	8.1%	6.2%	6.6%	6.7%	5-6%
	During COVID-19	7.2%	8.8%	7.4%	8.3%	7.2%	7.5%	7.4%	7%
	After COVID-19	7.1%	9.1%	7,40%	8.5%	7.5%	7,80%	7.6%	7.5%
Healthcare System management and Financing sources		SB; NHF (60-70%); OOP; PHI; IA	SB, general HIF (80%); OOP; PHI; IA	SB; HIF (70-80%); OOP; PHI; IA	SB; HIF (55-65%); OOP; PHI; IA	SB; HIF (30-40%); OOP; PHI; IA	SB; HIF (65-70%); OOP; PHI; IA	SB; HIF (65-70%); OOP; PHI; IA	SB (UHP); OOP; PHI; IA; Targeted Programs
Private Health Insurance		ASC	ASC	ASC	ASC	ASC	ASC	ASC	ASC
Out-of-Pocket (OOP) Expenditure		~20% During pandemic - 30%	15%	20%	37%	37%	32%	24%	55-56%
Healthcare Workforce per 100,000 population		Approx. 240 doctors and 600 nurses	Approx. 400 doctors and 1,000 nurses	Approx. 350 doctors and 1,100 nurses	Approx. 350 doctors and 1,000 nurses	Approx. 350 doctors and 1,000 nurses	340-350 doctors, 1,000-1,100 nurses	Approx. 400 doctors and 1,000 nurses	340-370 doctors, 1,100-1,200 nurses
Method of Payment for Hospital Services	Before COVID-19	DRG	DRG	DRG	FFS, DRG	DRG	DRG	DRG	DRG (40-50%), CBPS
	During COVID-19	DRG	DRG, correction of monthly financing	DRG, additional support	FFS, DRG	DRG, additional support	DRG, additional support	DRG, additional support	DRG (60-70%), CBPS
	After COVID-19	DRG	DRG	DRG	primarily pay - FFS, DRG	DRG	DRG	DRG	DRG, CBPS
COVID-19 Cost-Reimbursement Mechanisms		NHF, GEF (a mode-rate adjustment of salaries, list of funded medical services expansion)	NH; GEF, (adjustment of doctors' salary including bonuses and hazard pay)	NHI, GEF, (increase salary, emergency bonuses, overtime pay, and financial incentives)	NHI, GF, (additional bonuses, and adjustments to DRG payments)	NH, direct government funding, GEF, (legal overtime hours at higher pay rates, bonuses)	NH, government interventions (legal overtime hours at higher pay rates, bonuses)	NH, government interventions (legal overtime hours at higher pay rates, bonuses)	Increase state financing (GEF)

Notes: SB – State Budget; NHF – National Health Fund; UHP – Universal Health Program; PHI – Private Health Insurance; IIA – International Aids; ASC – additional service coverage; GEF – government emergency funds; FFS – fee-for-service model; CBPS – case-based payment system.

A key indicator for assessing the efficiency of health system financing in these countries is the share of SHI in total health expenditure (Table). Before the pandemic, SHI was the primary source of health financing in the Czech Republic, Slovakia, and Estonia, covering most of their health expenditures. Poland, Lithuania, and Bulgaria supplemented OOP payments and government contributions, while SHI played a significant role. In Latvia, the share of SHI was lower, with a greater reliance on general taxation and OOP payments. Notably, Georgia employed a variety of financing mechanisms, including general taxation, private insurance, and OOP payments, rather than relying on the SHI system.

Poland's well-funded and well-organized NHF allowed the rapid mobilization of resources during the pandemic. In response to the increased demands, Poland augmented total healthcare spending through government emergency funds, which temporarily reduced the relative share of SHI. Emergency funding measures were introduced to ensure hospitals had sufficient resources, including financial incentives for healthcare workers. Poland's use of the DRG payment system was adaptable to the high costs of COVID-19 treatment, particularly as these cases were more complex. The flexibility of the Polish healthcare system, which allowed doctors to work multiple jobs, helped address the increased demand for services. However, challenges such as bureaucratic inefficiencies, regional disparities in access to healthcare, low physician density, and physician burnout posed long-term challenges for sustaining the healthcare response.

The Czech Republic, which operates a universal healthcare system funded by public health insurance, faced similar challenges. The strong financial foundation and efficiency of the DRG system allowed the Czech Republic to mount an effective response to the COVID-19 pandemic. In addition to DRG-based payments, bonus payments were implemented for healthcare workers directly involved in treating COVID-19 patients. However, the overwhelming number of cases significantly strained healthcare workers and resources, highlighting the limitations of even well-funded systems under the pressure of a public health crisis.

Slovakia's approach to healthcare financing during the COVID-19 pandemic involved increasing public spending to support hospitals, primarily through state budgets and the HIF. Slovakia had a moderate number of medical doctors compared to its neighbors, and these doctors were compensated through a combination of public sector salaries and additional payments for services, however, between urban and rural areas disparities existed. The existing DRG system modification allowed for efficient resource management in hospitals, while incentives for doctors to work in less populated or underserved regions enabled a swift adjustment in funding to meet pandemic demands. However, the country's limited healthcare infrastructure and medical staff shortages presented significant challenges in providing adequate care.

Bulgaria's healthcare system, primarily funded through public health insurance, faced notable difficulties during the pandemic. Despite relatively high health expenditure and a higher density of doctors in the country, compensation in the public sector was comparatively low, which became a critical issue during the crisis. The DRG system implemented in Bulgaria does not support quick resource mobilization. To address the pandemic, the government allocated additional funding for hospitals. However, the low physician salaries and the country's dependence on secondary income sources created challenges in retaining and utilizing healthcare workers. In this context, the deontological culture of healthcare managers, as an essential component of professional competency, played a pivotal role in shaping institutional responses to emergencies and maintaining personnel engagement under extreme conditions [38]. Despite these financial constraints, Bulgaria's high doctor density enabled a relatively strong healthcare response during the pandemic. Recent studies on Bulgaria's healthcare response further highlight the critical role of strategic innovation and the incorporation of advanced technological solutions to enhance hospital resilience during the pandemic [39].

The Baltic countries, which had a relatively high density of medical doctors, were more prepared than many of their neighbors to cope with the pandemic. Latvia's healthcare system, historically plagued by underfunding, relied heavily on OOP payments, which increased the financial burden on citizens during the pandemic. Due to the low share of compulsory health insurance and a reliance on government funding, Latvia faced significant challenges in managing the pandemic. The government increased public spending on healthcare, particularly to cover hospital costs, staffing, equipment, and protective gear. The DRG system was modified to increase reimbursements for COVID-19 cases; however, low physician compensation, chronic underfunding, and limited healthcare infrastructure in the country resulted in challenges in retaining healthcare workers and created significant pressure on resources.

Due to a robust public health insurance system and efficient DRG framework, Estonia and Lithuania were better prepared to respond to the COVID-19 pandemic. Additional government funding was allocated to cover the costs of testing, treatment, and

vaccination efforts, at the same time financial support for healthcare workers and the expansion of healthcare facilities helped meet the pandemic's demands. This allowed the healthcare systems of Estonia and Lithuania to make quick adjustments in the face of rising healthcare needs. Estonia benefited from a well-organized healthcare financing system, competitive salaries and swiftly mobilizing resource ability, that helped retain medical professionals, while the division of Lithuania's healthcare sector (public and private) created potential disparities in care.

Georgia faced unique challenges due to its mixed healthcare financing system, which relied heavily on OOP payments and had limited public funding. The country was in the early stages of implementing a DRG-based payment system, and its underdeveloped hospital financing mechanisms limited its ability to address the healthcare challenges effectively and hindered a quick and efficient response to the pandemic. Despite these challenges, Georgia increased health spending significantly during the pandemic. The government relied on general taxation and foreign aid to support the healthcare system. Additional findings for hospitals (purchasing medical equipment, expanding ICU capacity, and offering bonuses to healthcare workers) helped to mitigate some of the difficulties.

In conclusion, several key factors – such as the reliability of healthcare financing, the flexibility of financing mechanisms, the state of health infrastructure, the number of medical professionals (per 100,000 population), and their compensation methods – played decisive roles in each country's ability to respond effectively to the COVID-19 pandemic. Countries with strong healthcare financing systems, established DRG mechanisms, higher doctor densities and competitive compensation systems, such as Poland, the Czech Republic, Estonia, Lithuania, and partly Slovakia, were better equipped to meet the challenges posed by COVID-19 and were able to respond more effectively. In contrast, countries with lower doctor densities and less effective compensation structures, like Georgia, Latvia and Bulgaria, faced significant challenges due to underfunding and high OOP payments, which strained their healthcare systems and hindered their ability to mobilize resources quickly. These countries struggled more to mobilize an effective healthcare response.

The selected countries (Poland, Bulgaria, the Czech Republic, Slovakia, Estonia, Latvia, Lithuania and Georgia) have actively used international funding, especially from the European Union, to strengthen hospital systems and implement modern technologies, including the digitalization of health care. Their experience in overcoming the consequences of COVID-19, including measures to increase hospital resilience and develop telemedicine, can serve as a basis for analyzing successful strategies and identifying growth points for improving health systems for similar health systems around the world.

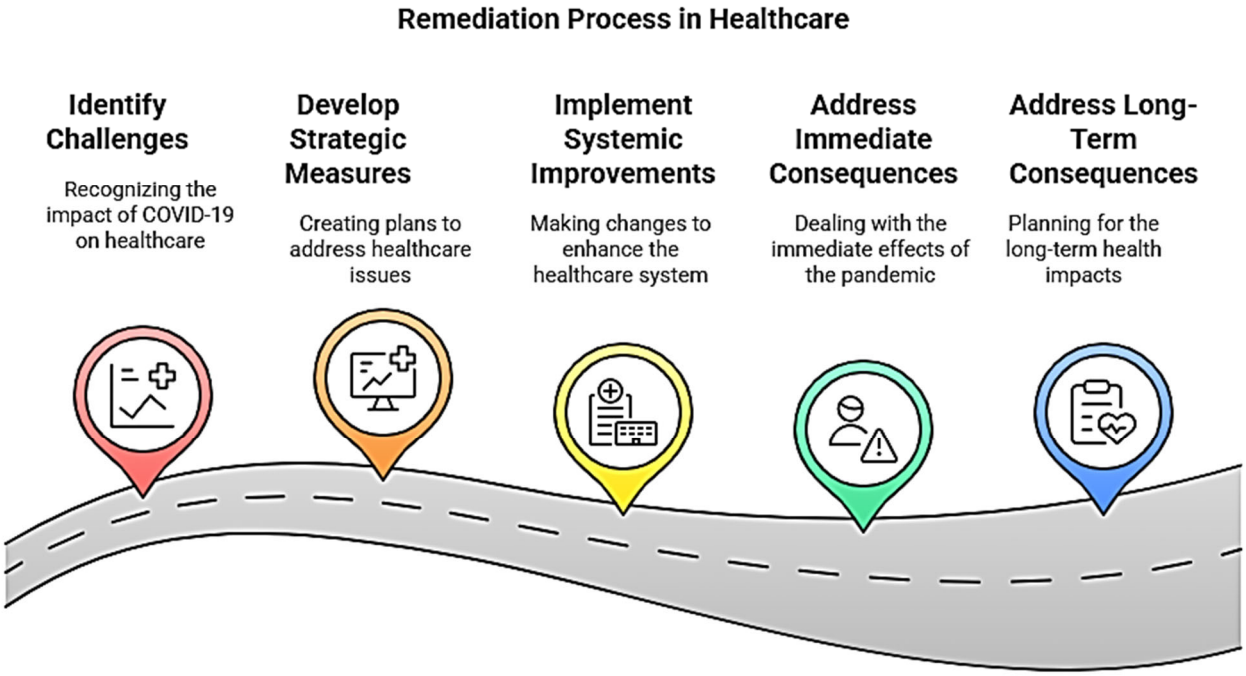
After the significant challenges posed by the COVID-19 pandemic, it is essential to develop a comprehensive set of strategic measures to restore public health and implement systemic improvements in the healthcare sector. This approach referred to as the "remediation" of the social sphere, specifically the healthcare system, is essential for addressing both immediate and long-term consequences [37].

The term "remediation," derived from the Latin "remedium" meaning "healing" or "treatment," was originally applied within legal and educational contexts to describe processes aimed at correcting or resolving issues. In recent years, particularly within the medical and environmental fields, "remediation" has been extended to encompass efforts to mitigate the harmful effects of toxins (detoxification), restore health following crises, and rehabilitate contaminated areas [40].

It is important to acknowledge that phenomena such as pandemics, climate change, industrial accidents, and armed conflicts directly affect human health, while simultaneously generating complex, multi-dimensional socio-economic and environmental challenges. The COVID-19 pandemic, in particular, highlighted the interconnection between health issues and broader socio-economic factors, such as environmental degradation and social inequality in access to healthcare. These challenges call for solutions that extend beyond basic medical care and demand systemic approaches to address long-term impacts, including genetic alterations, national health disparities, the costs of treating and recovering patients, and the restructuring of the healthcare system [41].

In the formulation of a state strategy for post-COVID healthcare recovery, it is essential to situate healthcare within a broader social and economic context. "Remediation" in this sense involves a holistic approach to problem-solving, integrating social and economic dimensions. This includes measures to address the lasting effects of the pandemic, such as financial and social support, elimination of healthcare access inequities, restoration of public trust in healthcare, and the restructuring of healthcare infrastructure to ensure financial sustainability. Moreover, the quality of healthcare delivery in the post-pandemic period is increasingly viewed through the prism of managerial decision-making, highlighting the necessity of evidence-based strategic planning and leadership responsibility in rebuilding resilient healthcare systems [42]. The

remediation of the healthcare system is not limited to its restoration following the impacts of COVID-19 but also encompasses its adaptation to a higher level of resilience against future crises. This approach, unlike "rehabilitation," which primarily focuses on medical recovery, incorporates a broader socio-economic framework. It is particularly relevant in light of escalating threats such as military conflicts and environmental disasters, which demand integrated solutions that span the intersections of medicine, ecology, and economics (Fig.) [43, 44].



Roadmap of the Remediation Process in the Healthcare Sector

According to the authors of this study, in the post-pandemic period, particular relevance is attributed not only to the remediation of the healthcare system-as a process of eliminating the consequences of the crisis and addressing systemic dysfunctions-but also to revitalization as the next, strategically higher stage of recovery. While remediation focuses on the elimination of medical, social, and economic disruptions (including, among other things, patient rehabilitation, the elimination of disparities in access to treatment, and the restoration of medical-economic chains, author's note), revitalization presupposes the formation of a new, stable, and flexible foundation. This stage encompasses medical-technological innovations, the development of preventive medicine, the implementation of digital solutions in clinical practice and state regulation, institutional reforms, as well as the restoration of public trust in the healthcare system [45]. Thus, remediation becomes the logical foundation for revitalization – a phase aimed not merely at recovery, but at a scientifically grounded transformation of the healthcare sector, drawing on the achievements of medical, economic, and computer sciences.

As practice shows, modern cross-border challenges – from pandemics and technological disasters to military conflicts-require not fragmented responses, but a systemic, interdisciplinary strategy based on the synergy of medical research, economic modeling, computer sciences, and information technologies. This is particularly important in the development of public health policy, which necessitates not only compensation for the consequences of COVID-19 but also the construction of a digital and intellectually adaptive system based on decision support systems (DSS), AI algorithms, telemedicine, biostatistics, big data processing, and geoinformation platforms [45]. In this context, revitalization acts as a catalyst for resilience, contributing to the long-term renewal of managerial, human, and digital foundations of medicine, ensuring equal access to quality services and the sustainable functioning of healthcare under conditions of global uncertainty. The above-mentioned aspects will serve as promising research

areas for the authors of this paper and will reflect current aspects and trends in the development of the healthcare sector.

CONCLUSION

1. The country's ability to respond effectively to the COVID-19 pandemic is related to several key factors:
   - the reliability of healthcare financing,
   - the flexibility of financing mechanisms, the state of health infrastructure,
   - the density of medical professionals, and their compensation methods.
2. Countries with strong healthcare financing systems established DRG mechanisms, higher doctor densities and competitive compensation systems (Poland, the Czech Republic, Estonia, Lithuania, and partly Slovakia) were better equipped to meet the challenges posed by COVID-19 and were able to respond more effectively.
3. Countries without a well-established healthcare financing system, lower doctor densities, and less effective compensation structures (Georgia, Latvia, and Bulgaria) faced significant challenges due to underfunding and high OOP payments, which strained their healthcare systems and hindered their ability to mobilize resources quickly.
4. All studied countries (Poland, Bulgaria, the Czech Republic, Slovakia, Estonia, Latvia, Lithuania and Georgia) have actively used international (EU) funding, to strengthen hospital systems and implement modern technologies, including the digitalization of health care.
5. The analysis experience in overcoming the consequences of COVID-19 in different countries (including measures to increase hospital resilience, ability to retain and motivate healthcare professionals, and develop telemedicine) can serve as a basis for analyzing successful strategies and identifying growth points for improving health systems around the world.
6. The "remediation" of the public health sector, situated within the context of socio-ecological and socio-economic systems, offers a comprehensive framework for addressing a broad spectrum of emerging challenges, providing solutions related to improving the social and environmental conditions and restoring population's health.
7. The experience of overcoming the consequences of the COVID-19 pandemic, analyzed in this study, indicates that effective remediation of the healthcare system must be combined with a well-thought-out strategy for its revitalization. Revitalization represents not merely recovery, but a scientifically grounded transformation aimed at building a sustainable, technologically equipped, and flexible healthcare system. This requires the implementation of medical-technological innovations, the development of digital infrastructure, the promotion of preventive medicine, as well as comprehensive

Contributors:

Sharashenidze A. – conceptualization, methodology, formal analysis, writing – original draft;

Cherniavskyi B. – writing – review & editing, supervision;

Buleishvili M. – methodology, formal analysis, writing – original draft;

Sanikidze T. – data curation, formal analysis, writing – review & editing;

Krasnikova N. – investigation, writing – review & editing, project administration.

Funding. The authors declare that the study was conducted without any financial support from governmental, commercial, or non-profit organizations. No funding was received for the preparation, execution, or publication of this research.

Conflict of interests. The authors declare no conflict of interest.

REFERENCES

1. COVID-19: Impact of the pandemic on healthcare delivery. The third of five BMA reports. [Internet]. 2024 Sep 18 [cited 2025 Jan 14]. Available from: https://www.bma.org.uk/advice-and-support/covid-19/what-the-bma-is-doing/covid-19-impact-of-the-pandemic-on-healthcare-delivery#heading_bc72014323af4e31990d37ce4b3cef63
2. Haldane V, De Foo C, Abdalla SM, et al. Health systems resilience in managing the COVID-19 pandemic: lessons from 28 countries. Nat Med. 2021;27:964-80. doi: https://doi.org/10.1038/s41591-021-01381-y
3. Pujolar G, Oliver-Anglès A, Vargas I, Vázquez ML. Changes in Access to Health Services during the COVID-19 Pandemic: A Scoping Review. Int J Environ Res Public Health. 2022;19(3):1749. doi: https://doi.org/10.3390/ijerph19031749
4. Ranney ML, Griffeth V, Jha AK. Critical supply shortages – The need for ventilators and personal protective equipment during the COVID-19 pandemic. N Engl J Med. 2020;382:1181-3. doi: https://doi.org/10.1056/NEJMp2006141
5. Benatar M, Fregonese F, Muiruri C. COVID-19-related healthcare impacts: An uncontrolled, segmented time-series analysis of tuberculosis diagnosis services in Mozambique, 2017-2020. BMJ Glob Health. 2022;7(4):e007878. doi: https://doi.org/10.1136/bmjgh-2021-007878

6. Lippi G, Plebani M. The Critical Role of Laboratory Medicine during Coronavirus Disease 2019 (COVID-19) and Other Viral Outbreaks. Clinical Chemistry and Laboratory Medicine. 2020;58:1063-9.
doi: https://doi.org/10.1515/cclm-2020-0240

7. Paltiel AD, Zheng A, Zheng A. Assessment of SARS-CoV-2 screening strategies. JAMA. 2020;324(2):140-1. doi: https://doi.org/10.1001/jamanetworkopen.2020.16818

8. Cohen J, van der Meulen Rodgers Y. Contributing factors to personal protective equipment shortages during the COVID-19 pandemic. Prev Med. 2020;141:106263. doi: https://doi.org/10.1016/j.ypmed.2020.106263

9. Kaye AD, Okeagu CN, Pham AD, Silva RA, Hurley JJ, Arron BL, et al. Economic impact of COVID-19 pandemic on healthcare facilities and systems: International perspectives. Best Pract Res Clin Anaesthesiol. 2021;35(3):293-306.
doi: https://doi.org/10.1016/j.bpa.2020.11.009

10. Khullar D, Bond AM, Schpero WL. COVID-19 and the financial health of US hospitals. JAMA. 2020;323(21):2127.
doi: https://doi.org/10.1001/jama.2020.6269

11. Sharashenidze A. Analysis of COVID-19 Hospital Services Financing Practices (Based on the Examples of Austria and Germany) (in Georgian). Economics. 2022;105(03):159-64.
doi: https://doi.org/10.36962/ecs105/3/2022-159

12. Bambra C, Riordan R, Ford J, Matthews F. The COVID-19 pandemic and health inequalities. J Epidemiol Community Health. 2020 Nov;74(11):964-8.
doi: https://doi.org/10.1136/jech-2020-214401

13. Ala A, Wilder J, Jonassaint NL, Coffin CS, Brady C, Reynolds A, et al. COVID-19 and the Uncovering of Health Care Disparities in the United States, United Kingdom and Canada: Call to Action. Hepatol Commun. 2021 Oct;5(10):1791-800.
doi: https://doi.org/10.1002/hep4.1790

14. Miszczyńska K, Miszczynski PM. Measuring the efficiency of the healthcare sector in Poland–a window-DEA evaluation. Int J Prod Perform Manag. 2021;71(7):2743-70.
doi: https://doi.org/10.1108/IJPPM-06-2020-0276

15. Łyszczarz B, Abdi Z. Factors Associated with Out-of-Pocket Health Expenditure in Polish Regions. Healthcare (Basel). 2021;9(12):1750.
doi: https://doi.org/10.3390/healthcare9121750

16. Global Health Expenditure Database [Internet]. 2023 Apr 03 [cited 2025 Jan 14]. Available from: https://ghdx.healthdata.org/record/who-global-health-expenditure-database

17. European Commission [Internet]. 2020 Jan 29 [cited 2025 Jan 14]. Available from: https://ec.europa.eu/commission/presscorner/detail/en/ip_20_124

18. Sowada C, Sagan A, Kowalska-Bobko I, Maretso A. Poland: Health system summary. WHO [Internet]. 2022 [cited 2025 Jan 14]. Available from: https://iris.who.int/bitstream/handle/10665/365287/9789289059275-eng.pdf?sequence=1

19. European Commission. State of Health in the EU: Poland country health profile 2020 [Internet]. 2023 [cited 2025 Jan 14]. Available from: https://ec.europa.eu/health/state/country_profiles_en

20. Krzeczewski B, Hassan C. Health models – Financing and effects: A comparative study of the models in Poland and Italy. Finanse i Prawo Finansowe [Internet]. 2024 Feb 27 [cited 2025 Jan 14]. Available from: https://api.semanticscholar.org/CorpusID:268138098

21. Czechia – Public Health – European Commission [Internet]. 2023 [cited 2025 Jan 14]. Available from: https://ec.europa.eu/health/state/country_profiles_en

22. Health at a Glance 2021: OECD Indicators. OECD Publishing, Paris [Internet]. 2021 Nov 9 [cited 2025 Jan 14]. Available from: https://www.oecd.org/en/publications/health-at-a-glance-2021_ae3016b9-en.html

23. Bryndová L, Šlegerová L, Votápková J, Hrobon P, Shuftan N, Spranger A. Czechia: Health System Review. Health Syst Transit. 2023 Mar;25(1):1-216.

24. World Health Organization. World health statistics 2023: Monitoring health for the SDGs, Sustainable Development Goals [Internet]. 2023 May 19 [cited 2025 Jan 14]. Available from: https://www.who.int/publications/i/item/9789240074323

25. Country Health Profiles 2023. OECD [Internet]. 2024 Feb 06 [cited 2025 Jan 14]. Available from: https://web-archive.oecd.org/temp/2024-02-06/455310-country-health-profiles-eu.htm

26. Ministry of Health of the Slovak Republic [Internet]. [cited 2025 Jan 14]. Available from: https://www.health.gov.sk/?minister-of-health-eng-verzia

27. Dimova A, Rohova M, Koeva S, Atanasova E, Koeva-Dimitrova L, Kostadinova T, et al. Bulgaria: Health System Summary. WHO Regional Office for Europe [Internet]. 2022 Jul [cited 2025 Jan 14]. Available from: https://iris.who.int/handle/10665/365286

28. OECD Economics Outlook. Volume 2023, Issue 1. A long unwinding road. OECD [Internet]. 2023 Jun 07 [cited 2025 Jan 14]. Available from: https://www.oecd.org/en/publications/oecd-economic-outlook/volume-2023/issue-1_ce188438-en.html

29. Eurofound. Living and working in Europe 2021 [Internet]. 2022 May 09 [cited 2025 Jan 14]. Available from: https://www.eurofound.europa.eu/en/publications/2022/living-and-working-europe-2021

30. World Health Organization. Out-of-pocket spending on health in Europe: Monitoring policies and progress [Internet]. 2024 [cited 2025 Jan 14]. Available from: https://gateway.euro.who.int/en/indicators/h2020_29-out-of-pocket-expenditures/#id=17097

31. World Health Organization. European Health Information Gateway. Bulgaria – statistical data [Internet]. 2024 [cited 2025 Jan 14]. Available from: https://gateway.euro.who.int/en/country-profiles/bulgaria/

32. Behmane D, Dudele A, Villerusa A, Misins J, Klavina K, Mozgis D, et al. Latvia: Health system review. Health Syst Transit. 2019;21(4):1-165. PMID: 32863240.

33. World Bank. Georgia: Health sector reform [Internet]. 2022 [cited 2025 Jan 14]. Available from: https://documents1.worldbank.org/curated/en/099802505242216398/pdf/IDU07bfac40d035c20431a0bc1b0755ced4057df.pdf

34. TBC Capital. Overview of Healthcare sector in Georgia [Internet]. 2023 Jul [cited 2025 Jan 14]. Available

from: https://tbccapital.ge/static/file/202307072806-healthcare-eng.pdf

35. Indicators of Health Care, 2022. Geostat [Internet]. 2022 [cited 2025 Jan 14]. Available from: https://www.geostat.ge/en/single-news/2900/indicators-of-health-care-2022

36. COVID-19 Health System Response. WHO EUROHEALTH [Internet]. 2020 [cited 2025 Jan 14]. Available from: https://iris.who.int/bitstream/handle/10665/-336263/Eurohealth-26-2-2020-eng.pdf?sequence=1

37. Sastry S, Basu A. How to Have (Critical) Method in a Pandemic: Outlining a Culture-Centered Approach to Health Discourse Analysis. Frontiers in Communication [Internet]. 2020 Oct [cited 2025 Jan 14];14;5. doi: https://doi.org/10.3389/fcomm.2020.585954

38. Balan O, Shepel M, Savelich L. Healthcare Institution Manager's Deontological Culture as a Component of the Professional Image. Economics: time realities. 2022 Dec 27;6(64):14-24. doi: https://doi.org/10.15276/etr.06.2022.2

39. Vazov R, Kanazireva R, Grynko TV, Krupskyi OP. Strategies for Healthcare Disaster Management in the Context of Technology Innovation: the Case of Bulgaria. Medychni perspektyvy. 2024 Jun 28;29(2):215-28. doi: https://doi.org/10.26641/2307-0404.2024.2.307703

40. Krishnan K, Lin Y, Prewitt KRM, Potter DA. Multidisciplinary Approach to Brain Fog and Related Persisting Symptoms Post COVID-19. Journal of Health Service Psychology. 2022 Feb;48(1):31-8. doi: https://doi.org/10.1007/s42843-022-00056-7

41. Intraprise Health. 5 steps to creating a healthcare risk remediation plan [Internet]. [cited 2025 Jan 14]. Available from: https://intraprisehealth.com

42. Lypynska O, Sviridova S, Balan O. The quality of providing medical services through the prism of management decisions. Economic journal Odessa polytechnic university. 2023 Aug 30;3(25):119-26. doi: https://doi.org/10.15276/ej.03.2023.13

43. Chakraborty S, Raut RD, Rofin TM, Chakraborty S. A comprehensive and systematic review of multi-criteria decision-making methods and applications in healthcare. Healthcare Analytics. 2023 Dec;4:100232. doi: https://doi.org/10.1016/j.health.2023.100232

44. Cherniavska T, Cherniavskyi B, Sanikidze T, Sharashenidze A, Tortladze M, Buleishvili M. Optimization of medical logistics with bee colony algorithms in emergency, military conflict and post-war remediation settings [Internet]. In: Shakhovska N, Jiao J, Izonin I, Chretien S, editors. Proceedings of the 7th International Conference on Informatics & Data-Driven Medicine (IDDM 2024); 2024 Nov 14-16; Birmingham, United Kingdom. Aachen: CEUR-WS.org; 2024 [cited 2025 Apr 16]. p. 220-235. Available from: https://ceur-ws.org/Vol-3892/paper16.pdf

45. Cherniavska T, Cherniavskyi B. Architecture-Oriented Agent-Based Model (AOAM) for Optimizing Transport Evacuation Management and Emergency Medical Assistance in the Context of the War in Ukraine: Challenges and Prospects [Internet]. In: Shakhovska N, Jiao J, Izonin I, Chretien S, editors. Proceedings of the 7th International Conference on Informatics & Data-Driven Medicine (IDDM 2024); 2024 Nov 14-16; Birmingham, United Kingdom. Aachen: CEUR-WS.org; 2024 [cited 2025 Apr 16]. p. 319-336. Available from: https://ceur-ws.org/Vol-3892/paper21.pdf

Стаття надійшла до редакції 31.03.2025;
затверджена до публікації 30.04.2025