

Oksana Kyryliuk,
Alexandr Lavruk,
Oksana Domina,
Yana Tsymbalenko,
Igor Dzemishkevych,
Daryna Melnyk,
Igor Korobko,
Zinoviy Nadyuk,
Oleksandr Datsii,
Rostyslav Kostyk

MODELING OF SUSTAINABLE DEVELOPMENT OF THE HEALTHCARE SYSTEM ON THE BASIS OF SYNERGY OF EFFECTIVE PUBLIC ADMINISTRATION AND DIGITAL ACCOUNTING AND ANALYTICS

The object of research is the public administration system in the healthcare sector and its transformational changes under the influence of digitalization. Currently, new challenges for the healthcare system are emerging in the global world. These include global pandemics, active hostilities, migration shifts and processes, economic instability, and digital transformation. That is why ensuring the sustainability of the healthcare system is a critically important aspect of creating appropriate conditions for the social well-being of the population. The paper examines the system of management decisions in the medical field, which is considered as a multi-component dynamic structure that must adaptively respond to the challenges of the external environment and conditions of uncertainty. The paper substantiates a conceptual model of health care system sustainability based on the synergy of public administration and accounting and analytical support. The model is based on the concept of adaptive system dynamics and feedback, which allows mathematically determining the level of management actions on the level of sustainability of the healthcare system. The results of the analysis among five countries (Ukraine, Poland, USA, Germany and Estonia) are presented according to the indicators: healthcare spending in GDP, human resources and level of digitalization. Methodologies used: correlation-regression analysis, index method, comparative analysis. The results obtained showed a high level of causality and correlation between digital tools and economic performance, considering data verification by accounting and analytical support (Pearson coefficient $r_{xy} > 0.85$ for leading countries), which confirm the relevance of their implementation. The obtained data of the integrated index of health system sustainability (IS for Ukraine increased by 0.28) confirm that the introduction of public management tools in health care allows for a transition to its proactive management.

Keywords: e-health, accessibility, sustainability, digital development, public institutions, driver of modernization, correlation-regression model.

Received: 01.02.2026

Received in revised form: 21.03.2026

Accepted: 05.04.2026

Published: 30.04.2026

© The Author(s) 2026

This is an open access article

under the Creative Commons CC BY license

<https://creativecommons.org/licenses/by/4.0/>

How to cite

Kyryliuk, O., Lavruk, A., Domina, O., Tsymbalenko, Y., Dzemishkevych, I., Melnyk, D., Korobko, I., Nadyuk, Z., Datsii, O., Kostyk, R. (2026). Modeling of sustainable development of the healthcare system on the basis of synergy of effective public administration and digital accounting and analytics. *Technology Audit and Production Reserves*, 2 (4 (88)), 65–76. <https://doi.org/10.15587/2706-5448.2026.356922>

1. Introduction

In the global context, the health care system is basic and fundamental for the development of society and maintaining an adequate standard of living. For the sake of well-being and improving the lives of humanity, the necessary elements are social stability [1], economic productivity [2] and the development of new technologies [3], which together ensure the advancement of the system and form its key principles of transformation. Accounting and analytical support plays an important role in this process, which is the basis for making informed decisions and further strategic modeling of the system's development.

On the global stage, the health care system is currently facing numerous challenges [4], which include pandemics, military conflicts, climate change, demographic transformations and adaptive digitalization of humanity [5]. At the same time, public administration acts as

an institutional mechanism for regulating and organizing social processes [6, 7], creates the basis for sustainability and efficiency, and also ensures its reliable development. But the effectiveness of such management is not possible without adequate accounting and information support, which makes it possible to track resource flows in a timely manner and assess the sustainability of medical institutions in real time. In the medical system, public administration also plays a significant role and coordinates the main directions of development [8]. That is why the integration processes of public administration tools in the healthcare sector become determining factors. This is necessary for the formation of effective state regulation in crisis situations and to ensure long-term development [9]. In recent years, there has been a steady trend towards globalization and interdependence of states around the world in order to create new conditions for the functioning of the healthcare system [10, 11].

Thus, during the twentieth century, a number of health care organizations were organized. The World Health Organization (WHO) was founded in 1948, the International Committee of the Red Cross in 1863, the International Agency for Research on Cancer in 1965, the Global Fund to Fight AIDS in 2002, etc. All of them are designed to combat diseases that are large-scale and threaten humanity. A vivid example in the last decade was the COVID-19 pandemic, which confirmed that no country in the world can cope with such large-scale challenges alone [12]. Accordingly, in this context, the effectiveness of public administration in the field of health care is not only an internal problem of the state, but also a matter of international security and global cooperation [13, 14]. As previously indicated, it was the 2019 pandemic that became the catalyst for the impetus for transformational processes in the health care system [15, 16]. The experience gained from the reactions of even the most developed countries showed the unpreparedness of institutional approaches to such an extraordinary situation. In this case, financial capabilities and the management system did not receive effective levers for the formation of reliable security measures and the creation of conditions for overcoming the virus [17]. That is, healthcare systems in different countries have proven to be quite vulnerable to “re-booting”, and their government administration has not been able to cope with criticism due to insufficient transparency of actions and speed of reactions for decision-making [18]. As a result of the analysis of the global picture of public governance in the healthcare system, it is very different. In the EU, the USA, Asia and Africa, historically different political systems and, accordingly, currently different financial conditions have been formed [19], which directly affects different management models for ensuring the sustainability of the systems. It is worth noting the positive practice – such countries include Germany and South Korea [20]. These countries were able to quickly mobilize resources and implement an effective testing system against the virus [21, 22]. In contrast, Italy and Spain, due to the lack of high-quality public governance, received an excessive burden on hospitals and personnel, which confirms the lack of a sustainable management model in the healthcare system [23].

It is also worth paying attention to the rapid and quite widespread migration processes in recent years [24, 25]. Especially in terms of population movements in the EU due to active hostilities in Ukraine [26]. For countries receiving refugees, there is an urgent need for rapid adaptive expansion of medical infrastructure [27], which can be achieved through the effective implementation of management decisions. At the same time, countries with an outflow of population and, accordingly, a deterioration in the economic situation are faced with the problems of the emergence and/or increase in the deficit in financing the health care system, which also requires the use of effective levers of public administration [28, 29].

From the point of view of the theoretical basis, public administration in the field of health care should be considered as a set of components. These include: institutional – defining the role of state bodies and relevant regulatory and legal documents regulating their activities. Economic – calculation of costs incurred and results obtained as a result of economical use of available resources [30, 31]. Social – ensuring equality in providing quality medical services [32]. Digital – application of innovative technologies to optimize management, data collection and storage [33]. The combination of all components in a complex with the addition of a basic foundation of accounting and analytical data forms the basis for creating a sustainable health care model that is able to adapt to external risks. As a result of the analysis of international practice of effective public administration, positive results are worth noting [34, 35]. These include the countries of Northern Europe – Sweden, Denmark, Norway. In these countries, the effectiveness of the health care system is ensured due to high decentralization and created transparency of management [36]. There is also a practice of public-private partnership, which allows, on the one hand, to regulate the social development sector, and on the other hand, provides authority for

managed improvement [37, 38]. This practice is widespread in Canada and the USA, which are characterized by a high level of investment attractiveness in medicine [38]. At the same time, in the countries of the Pacific region – Japan, South Korea, Singapore – there is a pronounced practice of using digital technologies and Big Data to predict the needs of the population, including in medical services [39].

As for less developed countries – such as African countries, there is currently a persistent trend towards insufficient funding and a weak management component for the development of the medical system [40, 41]. In this case, the above-mentioned international organizations use their leverage to improve the situation through donor assistance programs [42].

As a result of studying the scientific and practical basis for public management of the health care system, it was possible to identify a number of gaps and unresolved issues, namely:

- financial instability – there is an uneven system of resource distribution at the regional level, which leads to a deterioration in the quality of medical services;
- personnel shortage – the migration trend of the population in general, and in the part of highly qualified and experienced medical personnel, leads to an increase in the period of verification of their competencies;
- digital inequality – the heterogeneous development of the latest technologies in the field of healthcare;
- social inequality – the presence of discriminatory phenomena regarding the population's access to quality medical services and medicines;
- crisis situations – the emergence of new pandemics, the outbreak of wars, natural disasters, which together significantly worsen the healthcare management system.

That is, the identified shortcomings in established scientific approaches indicate the fragmentation of developments and the focus, for the most part, on the financial aspects of medical sustainability. It is also possible to note newer developments regarding the digitalization of the healthcare sector. However, the combination and obtaining the synergy effect are currently not fully presented in scientific works. In light of this, the issues of quantitative assessment of public administration on the transformation of the system as a whole remain unresolved. Accordingly, there is a lack of such generalizing tools that would take into account the accounting and analytical components necessary to solve the urgent problems of today.

Accordingly, to overcome the above-mentioned problems, it was determined that this scientific research is aimed at integrating economic and managerial tools for formulating a sustainable healthcare system. Unlike existing methods and tools, the work focuses on comparative analysis and presentation of a conceptual model that will be flexible to differently oriented socio-economic conditions. *The object of research* is the public administration system in the healthcare sector and its transformational changes under the influence of digitalization. *The aim of the research* is to build a model of sustainable development of the healthcare system based on the synergy of effective public administration and digital accounting and analytical support. This will allow improving management decisions, ensuring transparency in the distribution of financial flows in medicine, and building an effective strategy for sustainable development of the healthcare system.

To achieve this aim, the following objectives have been identified:

1. To analyze current trends in the development of public administration in the healthcare system.
2. To establish a correlation between public administration tools and the economic effect of their implementation.
3. To determine the role of digital technologies in the processes of transformational development of health system management.
4. To propose a conceptual model of integration of public administration and accounting and analytical support into the health care system.

2. Materials and Methods

In order to address the specified field of problems regarding the object of research, it is necessary to determine a comprehensive methodological basis that will combine the interdisciplinary nature of research – economic analysis [43], calculation of statistical data of the medical system [44, 45] and the theory of public administration [46]. After all, within the framework of research, the object is the public administration system in the field of health care. The selected selection of methods is justified by the principle of the expediency of each component and its impact on the research result, namely, the presentation of a model of a sustainable health care system through the use of public administration. It is also taken into account that a mandatory element is the use of accounting and analytical tools that allow verifying the reliability of data on financial flows and resource use. The main goal of the proposed tool is to mathematically strengthen management levers when building a sustainable system that takes into account modern trends in transformational development.

A sequential research algorithm was formed from the solution of the tasks set, which includes the following stages:

1. *Using systemic and comparative analyses that allow identifying trends in international and national practice.* A number of indicators are used for this. The share of healthcare spending in the total GDP of the country under study. The number of medical personnel (including doctors) per 10,000 of the country's population. The level of accessibility of medical services for socially diverse populations and digital tools in the healthcare system [47]. In addition, the analysis should include indicators of the quality of accounting information and the level of transparency of financial reporting of medical institutions. From an economic point of view, these components are of different profiles, so their calculation should be unified according to the following mathematical representation

$$T_i = \frac{X_i(t)}{X_i(t-1)} - 1, \quad (1)$$

where T_i – the growth rate of indicator i in period t ; $X_i(t)$ – the value of the indicator in period t ; $X_i(t-1)$ – the value of the indicator in the previous period.

It is seen that by determining in the presented way it is possible to establish key trends in the development of the main listed indicators in the medical system.

2. *Application of correlation-regression analysis.* In this case, it is advisable to calculate and determine the Pearson correlation coefficient

$$r_{xy} = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2 \cdot \sum_{i=1}^n (y_i - \bar{y})^2}}, \quad (2)$$

where x_i – the value of the management tool; y_i – economic result; \bar{x} , \bar{y} – average values of the corresponding variables; n – number of observations.

It is also worth using a regression model to assess the impact, in which there is an element of accounting and analytical support

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_a A + \varepsilon, \quad (3)$$

where Y – the economic effect under study; X_k – management tools; A – an indicator of the quality of accounting and analytical support; ε – random error.

It is seen that in this case it is possible to obtain more reliable data and determine the relationship between the implemented management methods in healthcare and their real effectiveness.

3. *Identification of the role of digital tools in the processes of changes occurring in healthcare under the influence of public administration* [48, 49]. To obtain reliable data, it is quite logical to use the index method. With its help, it is possible to determine the level of digital transformation of the healthcare system, and the calculation is carried out as follows

$$I_{DT} = \frac{\sum_{j=1}^m \omega_j \cdot Z_j}{\sum_{j=1}^m \omega_j}, \quad (4)$$

where Z_j – indicators of the use of digitalization (electronic medical records, telemedicine (remote medical care), the use of big data, cybersecurity); ω_j – weight coefficients of the significance of indicators; m – number of indicators.

4. *Modeling based on system dynamics.* That is, the model should take into account the synergistic relationship between financial and personnel indicators, elements of digitalization and the effectiveness of public health management. The mathematical representation of such a model will be the expression

$$S = f(F, C, D, A, R), \quad (5)$$

where S – sustainability of the health care system; F – financing; C – staffing; D – digitalization; A – level of accounting and analytical support (data accuracy, transparency, accountability, speed of analysis, etc.); R – effectiveness in ensuring the appropriate level of health care (life expectancy, mortality rate, accessibility of services).

In order to quantitatively present the results of the model assessment, it is worth using the calculation of the integral index

$$I_s = \alpha F + \beta C + \gamma D + \theta A + \delta R, \quad (6)$$

where $\alpha, \beta, \gamma, \theta, \delta$ – weight coefficients that determine the significance of each component.

In the end, after calculating the I_s indicator, an important stage is the interpretation of the results obtained. According to the scientific and methodological approach proposed in the research, the indicator is integral, therefore its limits can be estimated on the scale [0;1]. According to the levels in this range, the results can have the following interpretation:

- 0.00–0.25 – low level, characterized by the presence of both a complete lack of resources and high risks for the system;
- 0.26–0.50 – medium level, formed on the basis of partial provision of the necessary resources, but there are problems with the functioning of the system;
- 0.51–0.75 – sufficient level, indicates promising directions for achieving the desired results in terms of developing the sustainability of the healthcare system through public administration, but it is not yet established;
- 0.76–1.00 – high level indicates an optimal, balanced and sustainable result of the system, which meets all expected requests for management efficiency.

For further calculations, open data from the Global Health Expenditure Database [50] and The Digital Economy and Society Index (DESI) [51] for the period 2021–2025 were used. The selection of indicators includes 35 relevant indicators aggregated by three components. All data were processed using the method of mathematical modeling using the MS Excel package.

As a result, deviations, mathematical expectation and statistical significance were taken into account. The calculation of p -values (threshold $p < 0.05$) was used, indicating the correlation of the relationships. Confidence intervals were determined with a value of 95% for the regression coefficient.

3. Results and Discussion

3.1. Current trends in public administration in the healthcare system

The initial analysis of the research began with a comprehensive assessment of changes in healthcare over the past five years in Ukraine and other countries of the world. The selected time period is justified by changes in global management practices in healthcare institutions, which is primarily associated with the pandemic that began in 2019 [52, 53]. The selection of countries for analysis was based on identifying key models of financing and management in healthcare. These are a number of the most common at present. The Bismarck model (Germany), which is built on mandatory social insurance. The Beveridge model (Estonia), which is provided through centralized state support in financial terms. The private module (USA) with the predominant influence of creating investment capital. The transitional model (Poland and Ukraine), which are in the process of transformational changes under the influence of integration into the European Union. Accordingly, the above forms the basis for a multi-directional determination of the support and impact of public administration on the sustainability of the healthcare system among various institutional environments.

The results of determining the dynamics (Table 1) allowed to determine the key vectors of public administration development. To strengthen this indicator, the tax burden indicator and the determination of the share of shadow spending were added. Open audit data allow to assess the effectiveness of public administration mechanisms.

As a result, the analysis of the dynamics of the obtained results of economic and social elements by determining their growth rate (T_i) (Fig. 1) allowed to establish a pattern between the development of the healthcare system and the levers of public administration that influence it.

As a result of the calculations, it was determined that there are growth rates for all the studied data by countries of the world, which indicates a transition from traditional public management of the health care system to flexible and service-oriented [54]. In the process of research, indicators were calculated for a period of five years using the presented methodology, which helped to unify various managerial and economic components to establish trends. As a result of generalizing the data (Fig. 1) and their correlation with the constituent elements (Table 1), it was established that there is a positive trend in the selected countries.

Table 1

Analysis of the dynamics of the development of key healthcare indicators for 2021–2025

Country/Healthcare system model	Indicator (i)	Year				
		2021	2022	2023	2024	2025
Ukraine/Transitional	Healthcare expenditure, % of GDP	4.8	6.1	7.2	7.6	7.9
	Number of healthcare workers per 10,000 population	44.1	44.3	44.8	45.1	45.3
	Index of use of digital tools	0.52	0.61	0.72	0.78	0.81
	Tax burden on healthcare system, %	5.20	6.50	7.80	8.20	8.50
	Shadow expenditure share (audit), %	18.5	16.2	14.1	12.5	10.8
Poland/Transitional	Healthcare expenditure, % of GDP	6.20	6.40	6.65	6.80	6.95
	Number of healthcare workers per 10,000 population	24.50	25.1	25.60	35.0	26.2
	Index of use of digital tools	0.61	0.68	0.74	0.80	0.84
	Tax burden on healthcare system, %	9.10	9.20	9.40	9.50	9.60
	Shadow expenditure share (audit), %	8.40	7.90	7.50	7.20	6.80
Germany/Bismarck	Healthcare expenditure, % of GDP	12.80	12.95	13.05	13.15	13.20
	Number of healthcare workers per 10,000 population	45.1	45.5	46.1	46.5	46.8
	Index of use of digital tools	0.74	0.78	0.82	0.86	0.89
	Tax burden on healthcare system, %	14.5	14.6	14.7	14.8	14.9
	Shadow expenditure share (audit), %	2.10	1.90	1.80	1.60	1.50
USA/Private, market	Healthcare expenditure, % of GDP	17.20	17.40	17.65	17.80	17.90
	Number of healthcare workers per 10,000 population	26.1	26.4	26.8	27.1	27.4
	Index of use of digital tools	0.82	0.85	0.89	0.93	0.96
	Tax burden on healthcare system, %	8.10	8.15	8.25	8.30	8.40
	Shadow expenditure share (audit), %	4.50	4.20	3.90	3.75	3.50
Estonia/Beverage, digital	Healthcare expenditure, % of GDP	7.10	7.30	7.45	7.55	7.60
	Number of healthcare workers per 10,000 population	35.2	35.5	35.8	36.0	36.1
	Index of use of digital tools	0.92	0.94	0.95	0.97	0.98
	Tax burden on healthcare system, %	12.10	12.2	12.4	12.5	12.6
	Shadow expenditure share (audit), % expenses (audit), %	1.20	1.10	1.00	0.90	0.80

Note: calculated by the authors based on data [50, 51]

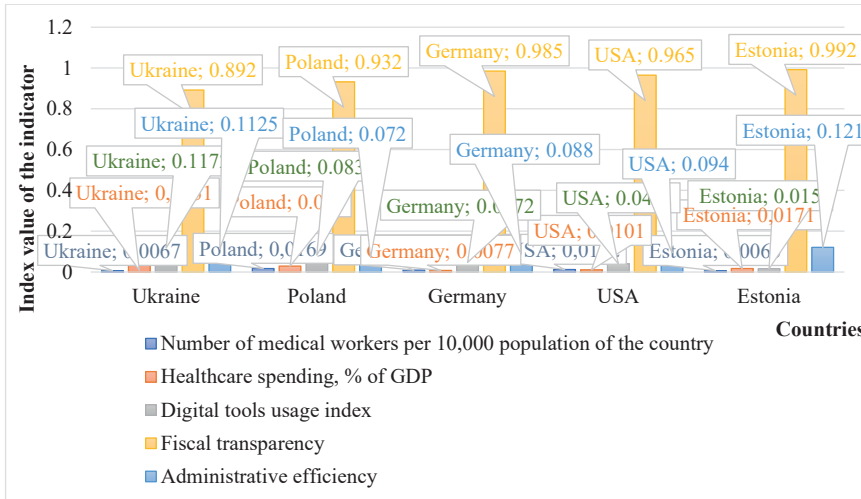


Fig. 1. Comparative analysis of the dynamics of the development of the healthcare system for 2021–2025 (calculated by the authors based on data from [50, 51])

The indicators vary for each individual representative, but it is worth noting the leaders. According to the calculations, they are the USA and Germany in the component of allocating the largest amount of funds from the total GDP of the countries. While Ukraine is currently the leader in the pace of attracting human resources for the population and reducing shadow financing from 18.5% to 10.8%. This indicates an increase in the influence of accounting and analytical support and compliance with the transparency of public administration. Such a trend can have either a positive meaning – personalization in the provision of services in medicine, or a negative meaning – a lag in the correlation of providing the number of medical workers for the population due to demographic problems. Regarding digital transformation, Estonia is currently a leader in the application of e-health, which indicates intensive reforms and an increase in the share of innovative management solutions [55]. In addition, this country has the lowest shadow costs, which is an exemplary indicator for the best result and ensuring the sustainability of the healthcare system.

In general, the results obtained confirm the gradual growth of all indicators, but their values are not uniform [56]. Accordingly, management decisions are not applied in a balanced way. To overcome this, it is necessary to normalize the directions of public management in healthcare by building a sustainability model.

3.2. Determining the economic effectiveness of the implementation of public management digitalization tools

Furthermore, to determine the sustainability of the healthcare system, a calculation of the correlation between public management tools, the quality of the accounting and analytical apparatus and their economic efficiency was carried out (Fig. 2). A feature of the

application of a scientific and methodological approach is the integration of digital tools as a technical basis for ensuring a modern accounting and audit system, which allows reducing financial costs and simultaneously increasing the transparency of resource allocation.

According to the presented scientific and methodological approach, the Pearson correlation coefficient was calculated. This analysis allows to deepen the research by eliminating subjectivity in the economic expression of the assessment of management methods and to obtain mathematical confirmation of the effectiveness of the implemented measures (Fig. 3). As proposed in the methodological block of the scientific research, the component of fiscal transparency (A) can reveal the dependence and correlation between accounting data and the speed of stabilization of the healthcare system in times of crisis.

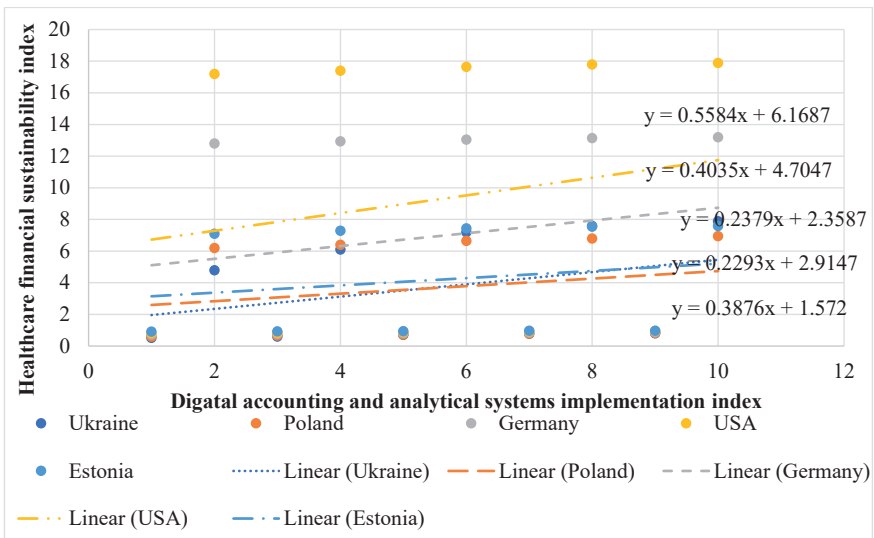


Fig. 2. Correlation between the level of implementation of accounting and analytical systems and the financial sustainability of the healthcare system for 2021–2025 and construction of the regression equation (Y) (calculated by the authors according to data [50, 51])

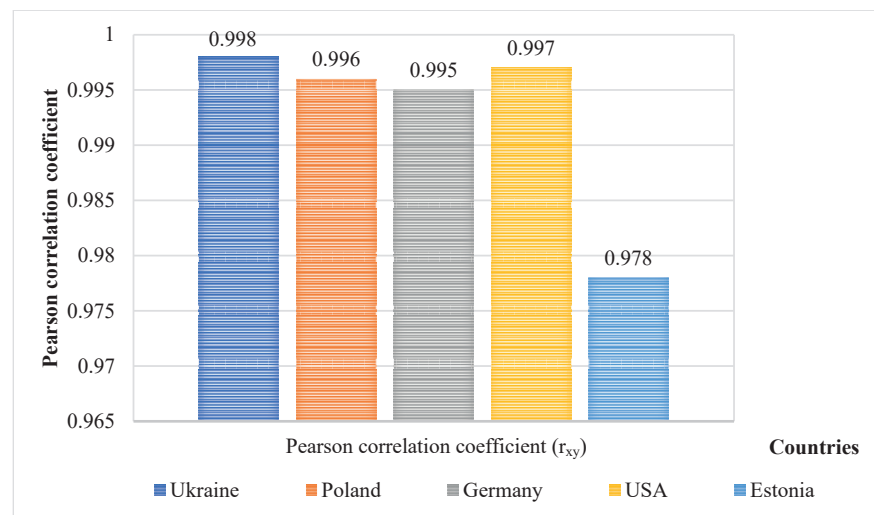


Fig. 3. Pearson correlation coefficient (r_{xy}) in the health care system in terms of the effectiveness of accounting and analytical support (calculated by the authors according to data [50, 51])

The results obtained clearly demonstrate the importance of public management in health care in ensuring the sustainability of its system. The values of the correlation relationship indicate the density of the results, which shows an almost linear pattern (Fig. 2). The highest correlation values were obtained for the USA and Poland, which indicates mutual consistency between the investments made in automated accounting systems and obtaining an economic effect by reducing the share of non-targeted spending. The presented regression equations make it possible to assess the impact of public management tools on the final result. Thus, for Ukraine, the coefficient $\beta = 10.95$, which provides modeling when an increase in the system digitalization index can provide an increase in healthcare spending by 1.09% of GDP. The obtained data confirm the presence of a direct connection between the level of accounting and analytical support and the effectiveness of the functioning of the healthcare system. Namely, the dynamics of the calculated indicators (Fig. 2, 3) indicate that the digitalization of accounting acts as a technical basis for transformative changes in financial resources to socially important results (for example, quality of life).

3.3. Digital innovations as a driver of modernization of public management in the healthcare sector

Currently, digital technologies are an integral part of all spheres of human activity. In the everyday aspect, this is the cooperation of the patient and the healthcare institution through applications and supplements. For medical institutions, this is the use of cloud storage to optimize their activities. Accordingly, in modern conditions, digital innovations act as the basis for accounting and analytical support. In its composition, this includes elements of financial, medical and administrative data that build a comprehensive complex. Accordingly, the continuous development of digital innovations is a powerful driver of improving public management methods in healthcare. And the role of their application is to create a transparent (but at the same time confidential) environment in which management actions are formed on the basis of real data, which also increases the objectivity of public management. From the point of view of accounting, such actions mean a transition from outdated recording of operations to operational data analysis and forecasting for the future.

According to the presented scientific and methodological approach, a calculation was carried out using the index method, which allows combining different indicators and bringing their values to one unified result. In the specified approach, Z_j is an indicator of the use of digital technologies. Due to the fact that the analysis is carried out for different countries, those that are present for all of them were selected. The following indicators were selected: the level of implementation of the digital platform (application) e-health (Z_1), the availability and possibility of providing remote medical care (Z_2), the degree of automation of management processes (Z_3) and the level of integration of electronic accounting and state audit systems (Z_4). According to the presented approach, each coefficient has a weight indicator – $w_1 = 0.4$, $w_2 = 0.2$, $w_3 = 0.2$, $w_4 = 0.2$, respectively. The presented values for the weight coefficients were selected taking into account the contribution of the indicators to building a sustainable healthcare system by improving public management tools. It is worth noting that the weight distribution reflects the cause-and-effect relationship between the components and the general system of public administration of the healthcare system, namely:

- w_1 has the greatest importance and, accordingly, the indicator of the use of digital e-health applications (Z_1) will prevail when cal-

culating the final result. This position is taken taking into account the fact that currently an important element is the construction of an electronic healthcare system. That is, there must be integration of patient registries, their electronic records with doctors, and prescriptions for treatment. And taking into account public administration, the development of digital applications forms the transparency of financial flows (according to the principle of “money follows the patient”);

- w_2 is customary to use the value of 0.2, because telemedicine is a method of forming operational stability by providing continuous services even in the presence of unforeseen circumstances (pandemic, war, climate disasters, relocation by geographical parameter, etc.). Accordingly, a smaller value was deliberately chosen to reflect the role of technology as an expansion of the boundaries of traditional medicine and reduce the transaction costs of budget funds for logistical directions to patients;

- w_3 has the smallest value – 0.2, because the formation of a document flow base for internal operational processes of medical institutions is an important element, but in the context of the previously selected components, it is not possible. Because the optimization of the administration of institutions is possible only on the basis of ensuring the first two indicators;

- w_4 is also accepted with a value of 0.2. It reflects the potential of the public administration system to automatically detect financial deviations and guarantee the targeted use of budget funds according to the principle of “transparent accounting”.

Taking into account the previously presented justification, the integral digital transformation index (IDT) was calculated for the studied countries (Fig. 4).

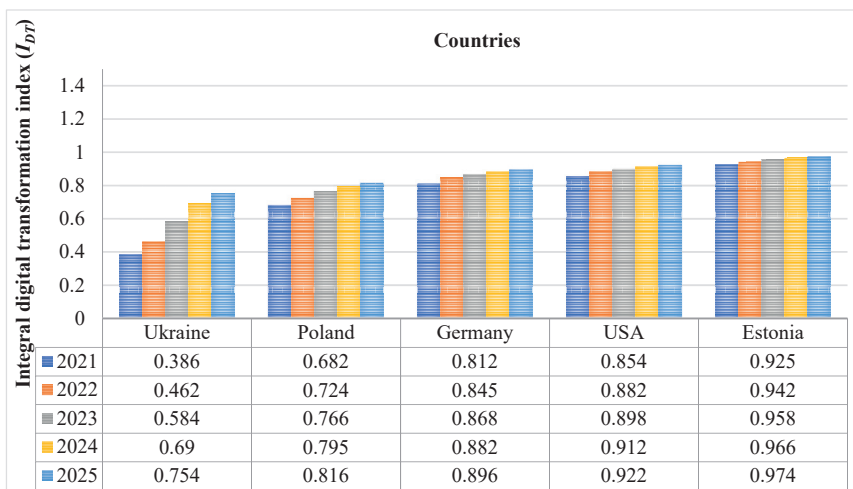


Fig. 4. Dynamics of the integral digital transformation index (IDT) for 2021–2025 in the healthcare system (calculated by the authors based on data from [50, 51])

As a result of the calculations, it was found that digital innovations are a catalyst for transformational processes in public healthcare management, although there are significant differences in the pace of development. The most rapid are the shifts for Ukraine. In recent years, Ukraine has been an example of the effective implementation of various elements of digital technologies. Thus, it is worth noting that Ukraine is a leader among countries in the world where a digital personal identification document is equated with a paper one. Accordingly, digital development in the healthcare system is also the most noticeable in comparison with other countries. Over the years under study, Ukraine has increased the integral index of digital transformation by 95.2%. Accordingly, this indicates that the overall digital transformation of the country within the framework of public administration acts as a factor of catch-up development.

This means that currently the Ukrainian economy, although it occupies a position with a “development” position, demonstrates an active position in digital technologies. The basis for such conclusions is obtaining high indicators in the component of electronic accounting of financial resources.

At the same time, for the USA and Estonia, the initial positions of the analysis have better results, but the growth rates are not so intensified. In this case, countries with a high level of resilience confirm the hypothesis put forward by the authors regarding the correlation of the level of resilience of the healthcare system and a high level of accounting and analytical support, which is a prerequisite for high-quality public administration. Over the studied period, growth for these countries is observed at an increase of 15.5% and 11.2%, respectively. These countries, according to the results of 2025, have almost absolute value in terms of digital maturity ($I_{DT} \rightarrow 0$).

For other countries – Poland and Germany – there is a positive growth trend of the indicator without significant deviations and fluctuations with an absolute value of growth of about 0.25 per year. That is, for these countries there is a defined strategic plan for the development of the healthcare system through the use of public management tools and digital transformation. In general, the results obtained show that innovative tools help to move from hierarchical public management to network management, in which the efficiency of the healthcare system is determined by the speed of data processing in it. It is worth noting that, given the growth rates of Ukraine, it should improve its results in the coming years and achieve full digital maturity in public management in healthcare, on a par with the USA and Estonia.

3.4. Conceptual model of integration of public administration and accounting and analytical support into the healthcare system to increase its sustainability

Currently, medicine is in constant transformation and driving processes due to external challenges raging in the world. Each country, relying on its own built healthcare system, ensures its support and development through the levers and tools of public administration, but it needs improvement and intensification. Currently, traditional approaches to the management and administration of medicine indicate limited effectiveness in conditions of uncertainty, especially in terms of operating with retrospective accounting data. Accordingly, the proposed model has a proactive position regarding the use of accounting and analytical data by identifying resource shortages even before they occur. Accordingly, the existing format of public administration should be based on the principles of adaptability, flexibility, decentralization and digital transparency of accounting, which will allow the general healthcare system to withstand crisis situations with dignity, develop dynamically and build a self-organization system.

As a result, it is quite logical to present a new model of public administration in healthcare, which is formed as a transition from reactive to proactive management. The basic concept of such a model is based on building a flexible architecture, in which the key integrator is the accounting and analytical center. This allows for constant monitoring and auditing of the targeted use of funds, which accordingly increases the level of public trust in public institutions. That is, public administration plays the role of an integrator – a structure that unites disparate business processes, technical systems and software into a single whole. It is in medicine that this manifests itself as a combination of the interests of the public sector, medical institutions and patients into a single ecosystem capable of reliable stability of functioning. Accordingly, the functioning and flexibility of such a system will be ensured through the synergy of institutional capacity and the high speed of making administrative decisions based on reliable verification of medical data.

From a theoretical point of view, the integration of public administration into the healthcare system is carried out with the aim of building an organizational and economic mechanism. It is worth noting that each tool in it (starting from financing and ending with the implementation of digital tools) ensures the improvement of the main indicators of the system's development. It is worth noting that in a broad sense, the proposed approach to the sustainability of the healthcare system is not its static state, but corresponds to the characteristics of dynamic changes.

That is, it is always a continuous process of adaptation, which is ensured by the use of public administration tools. Thus, the modification of public administration becomes a prerequisite for ensuring the national security of the healthcare system, which collectively affects the rational use of resources and the preservation of the quality of human capital.

Based on the presented justification for building a model of the sustainability of the healthcare system through the use of updated public management tools and applying methodological justification (5), (6), the final calculation of the integral sustainability index (IS) was carried out. It is worth mentioning that the calculation is based on the generalization of four indicators: financial (F), personnel (C), digital (D), accounting and analytical (A) and performance (R). In order to emphasize the chosen nature of the indicator – integrality – a weight coefficient is applied to each element – $\alpha, \beta, \gamma, \theta, \delta$, which are based on the results of expert assessment and take into account the strategic development of the system. The following distribution within 1 was chosen for the weight coefficients, namely:

- coefficient α corresponds to the composition of financing and is taken with values of 0.25. This distribution is due to the fact that financing is a priority area, without which any activity in general is not possible, and for the healthcare system, especially in view of the expensive equipment;
- coefficient γ – digitalization is accepted with a value of 0.15. Such tools have a certain weight due to the fact that their use helps to qualitatively ensure the stability of the system and objectively determine the efficiency of the use of all other resources. In the conditions of modern development and transformations of various sectors, digitalization acts as a factor in strengthening and transparency of public administration;
- coefficient β – has a value of 0.2 and characterizes the human resource potential. The chosen distribution is justified by the fact that human capital is the basis to a greater extent for long-term prospects and strategies, and if a sustainable healthcare system with a promising forecast is assessed and formed, then the personnel can be partially reduced in its impact on the overall result;
- coefficient θ – accounting and analytical support has the highest value of 0.3. This distribution is due to the fact that in the event of a shortage of resources, it is the accuracy of accounting and auditing that determine the level of system stability;
- coefficient δ – has a value of 0.1 for the effective component. Because effectiveness is the final indicator of the research and should concentrate the success of public administration, that is, it embodies the result obtained and its weight cannot affect the construction of the system's stability in the process of its formation.

The presented distribution of the weight of the coefficients allows to perform the function of balancing all its components. A priority package of the instrumental apparatus is created in the form of personnel and accounting and analytical markers that have a direct impact on public administration institutions. At the same time, the importance of the human factor of staffing and the determination of the social effect to a lesser extent in the form of calculating the final effectiveness is preserved.

As a result of the presented methodology and its justification, a calculation was carried out for the countries under study (Fig. 5).

The data obtained as a result of calculating the integral index of the sustainability of the health care system using public governance tools in countries around the world allowed to verify its current state and identify the patterns of the influence of public governance on medicine. The results obtained show a stable positive trend over all years of the study, which indicates the positive dynamics of the influence of public governance in medicine.

The growth of indicators in the rapid equivalent is observed in Ukraine and is 0.28 units, due to which the medical system has improved its level of sustainability to sufficient (according to the methodology presented in the 2nd section of the research). This trend is justified by new challenges for our country, which are primarily negative, but have prompted the health care system to significant transformations due to the integration of public governance. These include the rapid introduction of digital technologies, restructuring of financial flows, etc. Accordingly, the growth of the indicator proves that effective public administration, even in conditions of limited resources, can ensure the flexibility and adaptability of the system, which leads to the formation of its sustainability.

At the same time, other countries, such as Poland, have moderate results and stable growth. For this country, the main lever of slow development is the lack of human resources and the shortage of personnel, which unbalances the system as a whole and currently has a neutral effect on building the sustainability of the healthcare system. The group of leaders is the USA, Estonia and Germany.

For these countries, the integrated index of system sustainability for all years is within the highest values (according to the presented methodology 0.76–1.00). The results obtained directly correlate with previous calculations and confirm the sustainability of the system. For such representatives, there is a balance of all components, in which public administration tools play the role of a manager in creating ties in the built ecosystem.

To summarize, it is possible to say that Ukraine and Poland have good experience in implementing digital technologies, which allowed both countries to reach a sufficient level. However, to achieve even greater results and strengthen the position of public administration in healthcare, it is necessary to present a conceptual approach to building a sustainable healthcare system (Fig. 6).

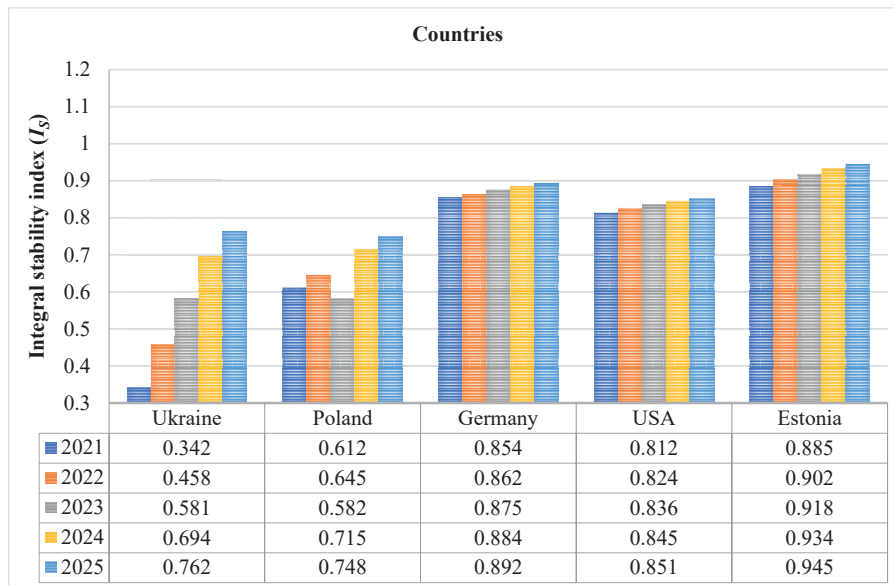


Fig. 5. Calculation of the dynamics of the integral sustainability index of the health care system (I_s) for 2021–2025

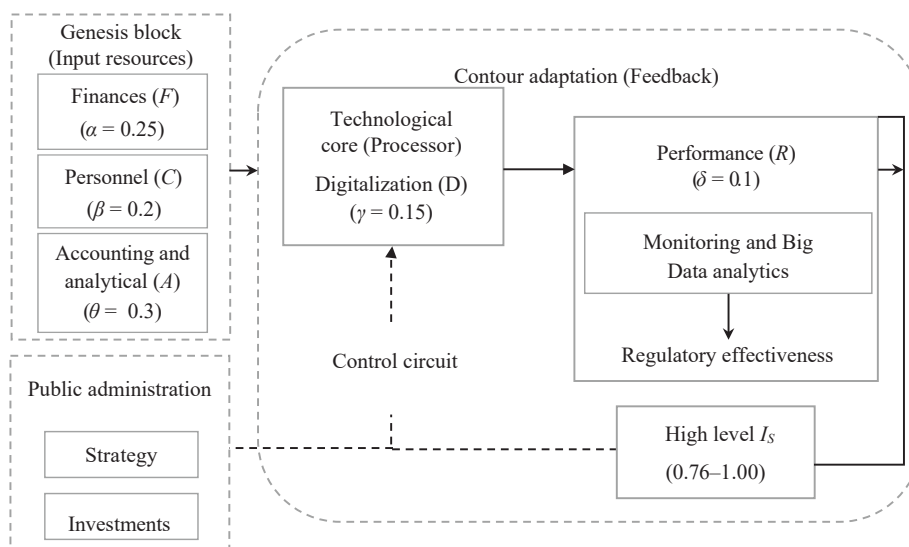


Fig. 6. Conceptual model of public administration to ensure the sustainability of the healthcare system

The presented visualization of the model is an interpretation of the public administration mechanism, in which sustainability (I_s) acts as a static indicator, and the indicators of the five vectors are dynamic. The specified model is based on the principle of cyclicity, in which there are input elements – financial (F) and human resources (C). Subsequently, they are controlled by digital tools (D) and the accounting and analytical block (A). And then they have in the end high efficiency and effectiveness (R) with minimization of institutional costs and corruption risks.

An important element of the model is monitoring and Big Data – analytics, where performance is monitored on an ongoing basis and is a dynamic indicator. Such logic is built with the aim of implementing a flexible network model that is capable of self-renewal as a result of decision-making on uncertainty. Accordingly, public management tools are transformed into a service platform using artificial intelligence, which ensures sustainable development and resilience of the healthcare system.

3.5. Discussion

Accordingly, the proposed methodological apparatus for the formation and assessment of a model of a sustainable healthcare system through the use of public management provides a comprehensive approach to determining its current state, development trends and further directions of transformational changes. It is worth noting that the presented toolkit is a comprehensive and interdisciplinary combination of managerial and mathematical methods that allow obtaining a quantitative result to increase practical implementation in the healthcare system.

As a research result, it is worth making a generalization and highlighting confirmation of the hypothesis put forward regarding the stimulating role of public management tools in the formation of a sustainable healthcare system. As advantages, it is worth highlighting the obtained mathematical calculations of the integral index (IS), which has shown significant progress in countries that are rapidly and effectively using digital technology tools as levers of influence in public management. Also, the advantages of the proposed model include:

- increasing the objectivity of management actions through the use of a mathematical model that represents calculated data in the form of indicators. Even if to take into account the expert method of presenting weighting coefficients, the presented methodology makes it possible to reduce the subjective view of management actions. Thus, the sustainability of the healthcare system can be determined by criteria from low to high levels;
- universality, which can be adapted and applied to different models of public administration in world practice. This is confirmed by the calculation of the presented results for countries with different economic status and geographical location;
- the forecasting potential is a separate advantage, because the proposed regression model makes it possible to model different scenarios for the development of the healthcare system, provided that investment funds in digital transformation are tracked.

In order to correctly implement the research in practice and obtain relevant results, it is worth noting some limitations of the presented research:

- the proposed conceptual model, in its conceptual approach, is oriented towards a system with established legal institutions. Within the framework of using a scientific and practical approach, it is worth considering the political factors of regulating the healthcare system, cultural barriers and the level of digitalization. Accordingly, it is possible to adjust the weight coefficients when calculating the integral index;
- the time intervals of conducting the research should be relevant within the time frame of implementing digital tools and obtaining economic effects. In terms of using public administration tools, it is worth considering possible bureaucratic delays;
- according to the presented approach, when calculating the integral index, the personnel component has a significant weight (0.3 in accor-

dance with Fig. 6). Accordingly, an important component is the level of digital literacy of personnel;

- within the framework of the proposed model, an opinion is given on the availability of basic digital infrastructure. Therefore, if there are limitations to innovative tools, the use of the conceptual model may be limited, which requires additional preliminary measures to adapt to local technical needs;

- it is important to adhere to ethics and security measures through additionally implemented cybersecurity protocols. The protection of personal data (especially for medicine) is an important condition for the social perception and legitimacy of the model.

At the same time, it is worth highlighting possible shortcomings and gaps in the proposed model. Despite the high level of methodological basis in the form of constructing cause-and-effect relationships and correlation interaction, the model has the following shortcomings:

- lack of consideration of fully established institutional factors for different countries. In this case, the level of political stability and cultural characteristics may negatively affect the implementation of digital technologies and be perceived by the population in an extremely detached manner;

- it is possible that the proposed chain of public administration actions may be difficult to implement in practice, because a certain period of time must pass between the moment of implementation of digital tools and obtaining an economic result. Results in the form of economic effect and efficiency cannot always be immediately calculated and determined mathematically. Accordingly, dynamic changes in the environment may have different consequences, and then the connection between public administration and economic effect may be much more difficult to establish;

- the heterogeneous speed of adaptation of the personnel component of medical institutions may cause an incorrect calculation of the final result. In this case, the use of digital public administration tools in practice may be negatively perceived by employees of healthcare institutions, and accordingly, the personnel component (C) according to the presented model (Fig. 6), which is an input resource and has a weight of 0.3, may significantly worsen the final result of calculating the integral index of the sustainability of the healthcare system;
- the integral nature of the methodology was presented above as an advantage due to its universality, but it can also be attributed to disadvantages. In this aspect, it is worth noting that not all institutional environments can provide equal conditions and accessibility to new and innovative technologies. Then this component acts as a disadvantage as a limitation of the universality of the specified architecture of sustainability;

- the high weight of the use of digital technologies can be considered both an advantage and a disadvantage. Regarding the first aspect, it is justified by modern trends and the development of the digital environment, regarding the second, the use of Big Data may cause concerns among skeptics regarding compliance with social norms and the protection of personal data.

Accordingly, the indicated advantages and disadvantages can enhance further discussions, which confirms the high scientific interest in the research. That is why the steps for further improvement are seen as the development of the proposed conceptual model of integration of public administration into the healthcare system to ensure its sustainability by taking into account several components. Among the main ones, the following are worth noting. Additional consideration of the integration of a set of measures for cybersecurity of medical data, which is an important aspect of the social component. Decentralization of management decisions at different levels of public administration is possible, which will help expand the model by hierarchical levels. Strengthening the mathematical foundation through the use of machine modeling, which will ensure an even higher level of public administration and reduce the subjectivity of the results.

4. Conclusions

1. As a research result of modern directions for improving public administration, existing transformational processes of transition from traditional and established to modern and adaptive, characterized by flexibility, have been established. Key trends have been identified, which can currently be formulated as barrier-free management processes, in which the state is no longer exclusively a regulator of actions, but is a coordinator in various systems, including medicine. In this case, institutional regulations combine medical institutions, patients and technological means in their management. As a result of the analysis of world experience, it was established that in recent years the role of institutional autonomy of hospitals has been increasing, which provides the opportunity to quickly respond to the challenges of external factors and uncertainty. Confirmation has been obtained that the modern format of public management is based on the principles of transparency of flows (resource, financial, personnel, etc.) and decentralization of management decision-making. It has been established that a significant tool of the above changes is a comprehensive accounting and analytical apparatus, which creates conditions for the transition from passive reporting to active monitoring of resource flows. From a practical point of view, the importance of this approach lies in the possibility of implementing cloud accounting services. This will reduce decision-making time by 15–20% due to process automation.

As a result of the analysis, it was determined that the Ukrainian healthcare management system has significant challenges. They are indirectly but closely related to a full-scale invasion due to an increase in the burden on this industry. Accordingly, it was established that the transformation processes of the healthcare system today are determined by the capabilities of government structures to build ecosystems in which managerial influence is transformed into sustainability through strategic planning mechanisms and improved resource use. Confirmation was obtained of the effective implementation of the audit system and transparent accounting (for example, the practice of the Ukrainian environment – Prozorro and e-health), which to a large extent allowed to reduce the share of shadow spending and thereby increased the level of fiscal transparency.

2. The paper presented the application of the correlation-regression method and mathematically confirmed the existence of a correlation between the intensity of use of public management tools (digitalization) and the economic support of the health care system with the support of accounting and analytical support tools. The results of calculating the Pearson correlation coefficient (r_{xy}) for the studied countries have a value of more than 0.97, which indicates a direct relationship between the effectiveness of the system and the quality of the public management tools used in it. The applied data verification through the calculation of p-value ($p < 0.05$) confirmed the statistical significance. And the regression models built on this basis allow to determine the highest impact indicators, which indicates a multiplicative and synergistic effect. As a result, each increase in the public management index allows to increase the amount of healthcare spending in the GDP of the studied country. Accordingly, this result proves that public management (process automation, application of applications, e-procurement, digital audit, etc.) in the healthcare system is a driving force for transparent use of resources. As a result, the established interdependence allows predicting economic development and stability of the medical sector by adjusting management actions at the institutional level.

3. It was determined that digitalization is a basic tool that ensures the convergence of public administration and the activities of medical institutions. As a result of calculating the integrated digital transformation index (I_{DT}) for 2021–2025, the largest increase was determined for Ukraine (an increase of +0.4, which is 92.5%), which, due to the unstable economic situation and the impact of major risks in the geopolitical environment, has effectively applied public administration tools through

digital levers in recent years. The absolute increase in indicators was +0.4, which in percentage terms is an increase of 92.5%. Currently, such levers in the domestic medical market include the implementation of the e-health application, telemedicine, electronic prescriptions for medicines, etc. All of them reduce transaction costs and strengthen the position of public administration, while improving service for patients. The justification is presented that the set of technologies currently used in medicine is a reliable source of formation of the principle of public management, according to which “money follows the patient”. The analysis also helped to obtain confirmation that the countries that had a high initial level during the analysis (USA, Estonia) have a phase of development of the healthcare system at the level of “technological maturity”. Accordingly, the results obtained collectively confirm that public management is currently going beyond passive observation and moving to the stage of proactive management of medical processes.

4. As a result of the synthesis of quantitative and qualitative indicators, a conceptual model of adaptation of public management to the healthcare system in order to ensure its sustainability is presented. It is based on tracking changes in indicators in dynamics and covers a combination of five components: finances, personnel, digitalization, performance and accounting and analytical validation. An important element of the model is the feedback loop (intelligent audit), according to which the effectiveness of future management actions is adjusted through the Big Data analytics mechanism. The calculation of the results for the studied countries confirmed the initial hypothesis and showed sufficiently high final results. For the leading countries, an indicator exceeding 0.85 was obtained, while for Ukraine it reaches 0.64, which indicates only the development of the healthcare system. Accordingly, it is possible to conclude that the sustainability of the healthcare system is achieved not only by the direct accumulation of resources, but also by the quality of the implementation of digital tools. As a result, the healthcare system looks like a flexible ecosystem in which public administration is an intelligent operator of decision-making. And the proposed concept is the basis for further improvement and development of a broader development strategy for ensuring national security.

Conflict of interest

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this paper.

Financing

The research was performed without financial support.

Data availability

Data will be made available on reasonable request.

Use of artificial intelligence

The authors confirm that they did not use artificial intelligence technologies in creating the submitted paper.

Authors' contributions

Oksana Kyrlyuk: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review and editing, Visualization, Funding acquisition; **Alexandr Lavruk:** Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review and editing, Visualization, Funding acquisition; **Oksana Domina:** Conceptualiza-

tion, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review and editing, Visualization, Funding acquisition; **Yana Tsybalenko**: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review and editing, Visualization, Supervision, Funding acquisition; **Igor Dzemishkevych**: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review and editing, Visualization, Funding acquisition; **Daryna Melnyk**: Conceptualization, Methodology, Software, Validation, Formal Analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review and editing, Visualization, Funding acquisition; **Igor Korobko**: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review and editing, Visualization, Funding acquisition; **Zinovy Nadyuk**: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review and editing, Visualization, Funding acquisition; **Oleksandr Datsii**: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review and editing, Visualization, Project administration, Funding acquisition; **Rostyslav Kostyk**: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review and editing, Visualization, Funding acquisition.

References

- Digdowniseiso, K. (2024). Fiscal decentralization and social stability in selected developing countries: the role of institutional quality. *Cogent Social Sciences*, 10 (1). <https://doi.org/10.1080/23311886.2024.2432070>
- Strietholt, M. (2026). Money, liberty and nonpublic sources of social stability. *Review of Social Economy*, 1–41. <https://doi.org/10.1080/00346764.2025.2612022>
- Chauhan, S., Gupta, P., Goyal, S. (2022). The role of innovation type and country context in diffusion of innovative technologies in organisations – a meta-analytic review. *Behaviour & Information Technology*, 42 (11), 1845–1873. <https://doi.org/10.1080/0144929x.2022.2100826>
- Kovtun, V., Andriushchenko, K., Horbova, N., Lavruk, O., Yelyzaveta Muzychka, Y. (2020). Features of the Management Process of Ambidextrous Companies. *TEM Journal*, 9 (1), 221–226. <https://doi.org/10.18421/tem91-31>
- Turyasima, M., Niwampeire, P., Ssendyona, M., Akot, B., Acheng, M., Katongole, S. et al. (2025). Enhancing Diagnostic and Patient Safety in Healthcare Systems: Key Insights from the World Patient Safety Day 2024 Commemoration in Uganda. *Drug, Healthcare and Patient Safety*, 17, 135–143. <https://doi.org/10.2147/dhps.s520743>
- James, T. S. (2025). Democracy, public administration, and democratic backsliding. *Policy Studies*, 1–26. <https://doi.org/10.1080/01442872.2025.2521170>
- Yatsenko, O. M., Nitsenko, V. S., Mardani, A., Tananaiko, T. S. (2018). The impact of global risks on the world trade and economic environment. *Financial and Credit Activity Problems of Theory and Practice*, 4 (27), 435–444. <https://doi.org/10.18371/fcaptivev4i27.154279>
- Liu, W., James, T. S., Man, C. (2022). Governance and public administration in China. *Policy Studies*, 43 (3), 387–402. <https://doi.org/10.1080/01442872.2022.2054091>
- Andriushchenko, K., Liezina, A., Vasylichak, S., Manylich, M., Shterma, T., Petrynyak, U. (2022). Management of the Development of the Innovative Potential of the Region. *TEM Journal*, 11 (1), 339–347. <https://doi.org/10.18421/tem111-43>
- Equils, O., Bakaj, A., Wilson-Mifsud, B., Chatterjee, A. (2023). Restoring Trust: The Need for Precision Medicine in Infectious Diseases, Public Health and Vaccines. *Human Vaccines & Immunotherapeutics*, 19 (2). <https://doi.org/10.1080/21645515.2023.2234787>
- Lei, K. C., Loi, C. I., Cen, Z., Li, J., Liang, Z., Hu, H. et al. (2023). Adopting an electronic medication administration system in long-term care facilities: a key stakeholder interview study in Macao. *Informatics for Health and Social Care*, 48 (3), 252–266. <https://doi.org/10.1080/17538157.2023.2165084>
- Andriushchenko, K., Kovtun, V., Cherniaieva, O., Datsii, N., Aleinikova, O., Mykolaiets, A. (2020). Transformation of the Educational Ecosystem in the Singularity Environment. *International Journal of Learning, Teaching and Educational Research*, 19 (9), 77–98. <https://doi.org/10.26803/ijlter.19.9.5>
- Katz, E., Chikwenhere, Y., Essien, E., Ollirus Owilli, A., Westerhaus, M. (2023). Rethinking global health from south and north: A social medicine approach to global health education. *Global Public Health*, 18 (1). <https://doi.org/10.1080/17441692.2023.2191685>
- Senghor, A. S., Mbaye, M. S., Diop, R., Tosam, M. J., Kabou, P., Niang, A., Okoye, G. (2023). Towards a transactional medicine approach to combating global emerging pathogens: the case of COVID-19. *Global Public Health*, 18 (1). <https://doi.org/10.1080/17441692.2023.2272710>
- Andriushchenko, K., Tepluk, M., Boniar, S., Ushenko, N., Liezina, A. (2019). Influence of cost drivers on value-oriented management of investment activity of companies. *Investment Management and Financial Innovations*, 16 (3), 353–364. [https://doi.org/10.21511/imfi.16\(3\).2019.31](https://doi.org/10.21511/imfi.16(3).2019.31)
- Kraitzman, A. P., Genauer, J. (2023). The impact of security issues on government evaluation: evidence from the Arab World. *Democratization*, 30 (4), 693–714. <https://doi.org/10.1080/13510347.2023.2177639>
- Jambi, L., Almutairi, F., Alotaibi, A., Alshaya, A., Alharbi, O., Alqahtani, A. et al. (2025). The Impact of the COVID-19 Pandemic on a Nuclear Medicine Department in Riyadh, Saudi Arabia. *Journal of Multidisciplinary Healthcare*, 18, 6431–6444. <https://doi.org/10.2147/jmdh.s523104>
- Yatsenko, O., Nitsenko, V., Tananaiko, T., Szetela, B., Kobylanska, A. (2019). Trade and economic integration dominants in North America countries' interaction. *Journal of International Studies*, 12 (3), 277–293. <https://doi.org/10.14254/2071-8330.2019-12-3/22>
- Rockholt, M. M., Addae, G., Chee, A., Chin, W., Cuff, G., Wang, J. et al. (2023). Implementing Telemedicine During the COVID-19 Pandemic: Disparities in Utilization in an Urban Pain Medicine Practice. *Journal of Pain Research*, 16, 2763–2775. <https://doi.org/10.2147/jpr.s415415>
- Mekonen, Z. T., Fenta, T., Nadeem, S., Cho, D. (2024). Global Health Commodities Supply Chain in the Era of COVID-19 Pandemic: Challenges, Impacts, and Prospects: A Systematic Review. *Journal of Multidisciplinary Healthcare*, 17, 1523–1539. <https://doi.org/10.2147/jmdh.s448654>
- Andriushchenko, K., Datsii, O., Aleinikova, O., Mohamed Abdulla, A., Mohammed Ali, A. (2019). Improvement of the water resources management system at the territorial level. *Problems and Perspectives in Management*, 17 (3), 421–437. [https://doi.org/10.21511/ppm.17\(3\).2019.34](https://doi.org/10.21511/ppm.17(3).2019.34)
- Ortiz-Prado, E., Izquierdo-Condoy, J. S., Vasconez-Gonzalez, J., López-Cortés, A., Salazar-Santoliva, C., Vargas Michay, A. R. et al. (2025). From pandemic onset to present: five years of insights into ARDS caused by COVID-19. *Expert Review of Respiratory Medicine*, 19 (8), 843–862. <https://doi.org/10.1080/17476348.2025.2507207>
- Polishchuk, Y., Kornyluk, A., Lavreniuk, V., Horbov, V., Ivashchenko, A., Tepluk, M. (2024). Running a business during wartime: Voice of Ukrainian displaced business. *Problems and Perspectives in Management*, 22 (3), 287–302. [https://doi.org/10.21511/ppm.22\(3\).2024.23](https://doi.org/10.21511/ppm.22(3).2024.23)
- Andriushchenko, K., Lavruk, V., Uliganets, S., Kovtun, V., Matvienko, H. (2019). Reputation Risk Management Companies Based on Competence Approach. *TEM Journal*, 8 (2), 516–524. <https://doi.org/10.18421/tem82-27>
- Jung, H.-J., Kim, D.-I., Choi, S.-J., Park, J.-K., Lee, J.-M. (2025). Effectiveness and Safety of Korean Medicine in Treating Female Infertility: A Prospective Multicenter Observational Study. *International Journal of Women's Health*, 17, 1771–1787. <https://doi.org/10.2147/ijwh.s520044>
- Pokataiev, P., Liezina, A., Petukhova, H., Andriushchenko, A. (2022). The role of biotechnology in the development of the bioeconomy. *Acta Innovations*, 46, 19–34. <https://doi.org/10.32933/actainnovations.46.2>
- Schmalhofer, C., Otte im Kampe, E., Eheberg, D., Sandhu, H., Maier, M., Perschke, A. et al. (2025). Economic evaluation of oral Nirmatrelvir/ritonavir versus best supportive care in patients at high risk for progression to severe COVID-19 in Germany: a cost-effectiveness analysis. *Journal of Medical Economics*, 28 (1), 1226–1240. <https://doi.org/10.1080/13696998.2025.2536974>
- Agostino, M., Mammone, M., Ruberto, S. (2024). Pandemic and Infodemic: The Role of Social Media in Disinformation Relating to COVID-19 in Italy. *Forum for Social Economics*, 54 (4), 499–529. <https://doi.org/10.1080/07360932.2024.2405588>
- Tepluk, M., Polishchuk, Y., Fomenko, B., Bortnik, A., Domina, O., Matsola, S. (2024). An entropic perspective on business relocation in the context of sustainable development. *Financial and Credit Activity Problems of Theory and Practice*, 1 (54), 421–439. <https://doi.org/10.55643/fcaptive.1.54.2024.4248>
- Andriushchenko, A., Liezina, A., Kolybo, D., Gurina, G., Havrysh, K., Mazur, N. et al. (2026). Determining the investment attractiveness of the biotechnology and bioinnovation market based on market trends in the pharmaceutical business. *Technology Audit and Production Reserves*, 1 (4 (87)), 21–33. <https://doi.org/10.15587/2706-5448.2026.352711>
- Triadafilopoulos, T., Taylor, Z. (2023). The domestic politics of selective permeability: disaggregating the Canadian migration state. *Journal of Ethnic and Migration Studies*, 50 (3), 702–725. <https://doi.org/10.1080/1369183x.2023.2269785>
- Buriachenko, A., Zakhozay, K., Liezina, A., Lysak, V. (2022). Sustainability and security of public budget of the Visegrad Group countries. *Acta Innovations*, 42, 71–88. <https://doi.org/10.32933/actainnovations.42.6>
- Hirata, R., Tago, M., Shikino, K., Watari, T., Takahashi, H., Sasaki, Y., Shi-

- mizu, T. (2024). Standardizing Generalist Definitions to Improve Evidence in General Medicine: Addressing Diverse Interpretations and Lack of Consistency. *International Journal of General Medicine*, 17, 2939–2943. <https://doi.org/10.2147/ijgm.s468755>
34. Andriushchenko, K., Liezina, A., Lavruk, V., Sliusareva, L., Rudevskva, V. (2022). Intelligent enterprise capital control based on Markov chain. *Acta Innovations*, 45, 18–30. <https://doi.org/10.32933/actainnovations.45.2>
35. Kermani, F., Reandi, S. T. A. (2023). Exploring the Funding Challenges Faced by Small NGOs: Perspectives from an Organization with Practical Experience of Working in Rural Malawi. *Research and Reports in Tropical Medicine*, 14, 99–110. <https://doi.org/10.2147/rrtm.s424075>
36. Hallal, H., Hoteit, M., Hallit, S., Hallal, M. (2025). Perceptions, attitudes and experiences of hospital pharmacists working in the private sector regarding drug shortage in Lebanon: a national cross-sectional study. *Journal of Pharmaceutical Policy and Practice*, 18 (1). <https://doi.org/10.1080/20523211.2025.2464786>
37. Huerta, A., Huerta, J. (2024). Navigating the nexus of personalized medicine and healthcare management: Advancing paediatric pain management modalities in sickle cell disease through thematic analysis for ages 1–12. *International Journal of Healthcare Management*, 19 (1), 145–155. <https://doi.org/10.1080/20479700.2024.2413797>
38. Andriushchenko, K., Datsii, O., Lavruk, O., Dmytrenko, R., Kutashev, I., Vinichenko, I. et al. (2021). Development of a matrix of food industry capacity for making management decisions in the formation of sustainable development of agroecosystems. *Eastern-European Journal of Enterprise Technologies*, 2 (13 (110)), 16–27. <https://doi.org/10.15587/1729-4061.2021.227805>
39. Tago, M., Hirata, R., Shikino, K., Watari, T., Takahashi, H., Nishi, T. et al. (2025). A Classification Method for General Medicine Physicians to Advance Field Research in Japan. *International Journal of General Medicine*, 18, 5033–5038. <https://doi.org/10.2147/ijgm.s540846>
40. Tseng, C.-Y., Li, J., Lin, L.-H., Wang, K., White III, C. C., Wang, B. (2023). Deep reinforcement learning approach for dynamic capacity planning in decentralised regenerative medicine supply chains. *International Journal of Production Research*, 63 (2), 555–570. <https://doi.org/10.1080/00207543.2023.2262043>
41. Shalko, M., Domina, O., Korobko, I., Melnyk, D., Andriushchenko, A. (2024). The transformative impact of large language models in healthcare. *Technology Audit and Production Reserves*, 6 (4 (80)), 32–42. <https://doi.org/10.15587/2706-5448.2024.319006>
42. Kommalar, A., Ramalingam, D., Manjunath, N., Venkatesh, P., Bidaremane Junjappa, S. et al. (2026). Successful perinatal management of a large placental chorio-angioma: a case report demonstrating the effectiveness of a public-private partnership model. *Paediatrics and International Child Health*, 1–7. <https://doi.org/10.1080/20469047.2025.2609525>
43. Sahithya, V., Sivanantham, P., Anandraj, J., Parameswaran, S., Sekhar Kar, S. (2024). Economic cost of hemodialysis and peritoneal dialysis under public-private partnership in a public tertiary care centre of Puducherry, India. *Expert Review of Pharmacoeconomics & Outcomes Research*, 25 (3), 415–421. <https://doi.org/10.1080/14737167.2024.2439515>
44. Domina, O., Andriushchenko, K., Liezina, A., Tsybalenko, Y., Titova, O., Kyryliuk, O., Vylgin, Y. (2025). The Impact of Artificial Intelligence on the Formation of a Teacher's Digital Twin in the Metaverse. *Journal of Vasyl Stefanyk Precarpathian National University*, 12 (3), 169–185. <https://doi.org/10.15330/jpnu.12.3.169-185>
45. Nauenberg, E., Yurga, E. (2023). Public-private partnership alternative for a national pharmacare program in Canada. *Journal of Pharmaceutical Policy and Practice*, 16 (1). <https://doi.org/10.1186/s40545-023-00526-3>
46. Zainal, H., Xiaohui, X., Thumboo, J., Kok Yong, F. (2023). Digital competencies for Singapore's national medical school curriculum: a qualitative study. *Medical Education Online*, 28 (1). <https://doi.org/10.1080/10872981.2023.2211820>
47. Pokataiev, P., Teteruk, K., Andriushchenko, A. (2023). A biotechnological role-business incubator as an instrument of innovation entrepreneurship. *Recent Trends in Business and Entrepreneurial Ventures*. Available at: <https://novapublishers.com/shop/recent-trends-in-business-and-entrepreneurial-ventures/>
48. Anaya, J.-M., Herrán, M., Pino, L. E. (2025). Challenges and opportunities for precision medicine in developing nations. *Expert Review of Precision Medicine and Drug Development*, 10 (1), 1–15. <https://doi.org/10.1080/23808993.2025.2505796>
49. Kohler, J. C., Castro-Arteaga, M., Panjwani, S., Mukanga, D., Lumpkin, M. M., Fundafunda, B. et al. (2025). Understanding the regulatory-procurement interface for medicines in Africa via publicly available information on standards, implementation, and enforcement in five countries. *Journal of Pharmaceutical Policy and Practice*, 18 (1). <https://doi.org/10.1080/20523211.2024.2436898>
50. *Global Health Expenditure Database*. Available at: <https://apps.who.int/nha/database/>
51. *The Digital Economy and Society Index (DESI)*. Available at: <https://digital-strategy.ec.europa.eu/en/policies/desi>
52. Liezina, A., Lavruk, A., Matviienko, H., Ivanets, I., Tseluiko, O., Kuchai, O. (2023). Impact of econometric modeling and perspectives of economic security of the cross-industry complex. *Acta Innovations*, 47, 73–83. <https://doi.org/10.32933/actainnovations.47.7>
53. Williamson, J., Hasan, S. S., Gc, V. S. (2025). Economic and developmental impacts of FDA designations: a systematic review and meta-analysis. *Expert Review of Pharmacoeconomics & Outcomes Research*, 25 (7), 1051–1061. <https://doi.org/10.1080/14737167.2025.2507426>
54. Wu, J., Ma, Y., Wang, J., Xiao, M. (2024). The Application of ChatGPT in Medicine: A Scoping Review and Bibliometric Analysis. *Journal of Multidisciplinary Healthcare*, 17, 1681–1692. <https://doi.org/10.2147/jmdh.s463128>
55. Andriushchenko, K., Khaletska, A., Ushenko, N., Zholnerchyk, H., Ivanets, I., Petrychuk, S., Uliganets, S. (2021). Education process digitalization and its impact on human capital of an enterprise. *Journal of Management Information and Decision Sciences*, 24 (5), 1–9. Available at: <https://www.abacademies.org/articles/Education-process-digitalization-and-its-impact-on-human-capital-of-an-enterprise-1532-5806-24-5-271.pdf>
56. Alemu, A. B., Ibrahim, N. A., Argaw, K. W. (2023). Magnitude of Medicine Wastage and Perceived Contributing Factors Among Public Health Facilities in Dire-Dawa City Administration, in Mid COVID-19 Pandemic in Ethiopia: Retrospective, Cross-Sectional Study. *Integrated Pharmacy Research and Practice*, 12, 61–75. <https://doi.org/10.2147/irpr.s395102>
-
- ✉ **Oksana Kyryliuk**, PhD of Philosophy in Entrepreneurship, Trade and Stock Exchange, Associate Professor, Department of Business Economics and Entrepreneurship, Kyiv National Economic University named after Vadym Hetman, Kyiv, Ukraine, e-mail: kyryliuk.oksana@kneu.edu.ua, ORCID: <https://orcid.org/0009-0002-6766-746X>
-
- Alexandr Lavruk**, Doctor of Science in Public Administration, Associate Professor, Department of Public Administration, Management and Inclusive Economy, Educational and Rehabilitation Institution of Higher Education "Kamianets-Podilskyi State Institute", Kamianets-Podilskyi, Ukraine, ORCID: <https://orcid.org/0000-0002-7932-0036>
-
- Oksana Domina**, PhD, Grant-funded Researcher, Research Units of the Faculty of Social Sciences, University of Helsinki, Helsinki, Finland, ORCID: <https://orcid.org/0000-0003-4242-6344>
-
- Yana Tsybalenko**, PhD, Associate Professor, Authorized Person for the Prevention and Detection of Corruption, National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Kyiv, Ukraine, ORCID: <https://orcid.org/0000-0003-0442-7549>
-
- Igor Dzemishkevych**, PhD, Associate Professor, Department of Fundamental Training, Management and Administration, Private Joint-Stock Company "Higher Education Institution "Interregional Academy of Personnel Management", Kyiv, Ukraine, ORCID: <https://orcid.org/0000-0003-4727-2241>
-
- Daryna Melnyk**, PhD, Department of Public Administration and Land Management, Classical Private University, Zaporizhzhia, Ukraine, ORCID: <https://orcid.org/0009-0002-4880-2777>
-
- Igor Korobko**, PhD, Associate Professor, Department of Public Administration and Land Management, Classical Private University, Zaporizhzhia, Ukraine, ORCID: <https://orcid.org/0000-0002-1292-9971>
-
- Zinoviy Nadyuk**, Doctor in Public Administration, Department of Politology and Public Administration, Lesya Ukrainka Volyn National University, Lutsk, Ukraine, ORCID: <https://orcid.org/0000-0001-6408-888X>
-
- Oleksandr Datsii**, Doctor of Economic Sciences, Professor, Department of Business Economics, Private Joint-Stock Company "Higher Education Institution "Interregional Academy of Personnel Management", Kyiv, Ukraine, ORCID: <https://orcid.org/0000-0002-7436-3264>
-
- Rostyslav Kostyk**, PhD, Department of Public Administration and Administration, Kyiv University of Aviation and Information Technologies, Kyiv, Ukraine, ORCID: <https://orcid.org/0009-0001-0413-1863>
-
- ✉ Corresponding author