DOI: https://doi.org/10.32782/2524-0072/2026-83-169

UDK 339.13:663.2

FORMATION OF SUPPLY CHAIN RESILIENCE IN THE PHARMACEUTICAL MARKET

ФОРМУВАННЯ СТІЙКОСТІ ЛАНЦЮГІВ ПОСТАЧАННЯ НА ФАРМАЦЕВТИЧНОМУ РИНКУ

Ilchenko Nataliia
Doctor of Sciences (Economics), Professor,
Head at the Department of Logistics and Trade Business,
State University of Trade and Economics
ORCID: https://orcid.org/0000-0002-5081-7727

Stanovyi Oleksii
Master's Degree Student,
Assistant at the Department of Logistics and Trade Business,
State University of Trade and Economics
ORCID: https://orcid.org/0000-0001-6828-0449

Ільченко Наталія Борисівна, Становий Олексій Сергійович
Державний торговельно-економічний університет

The article examines the issue of supply chain resilience in Ukraine's pharmaceutical market under martial law. Pharmaceutical supply chains are considered critical infrastructure, exerting a direct influence on national security, healthcare stability, and medicine availability. In the context of armed conflict, conventional management methodologies become ineffective due to a multitude of factors, including infrastructure destruction, disrupted logistics, energy instability, and shifts in medicine demand. The study reviews contemporary approaches to resilience assessment, including risk-oriented management, logistics digitalization, and adaptive strategies. It notes that most models are designed for stable conditions and do not sufficiently consider risks specific to warfare, such as supply disruptions, cold chain failures, and delays. An authorial approach defines resilience as the system's ability to anticipate, prevent, adapt to, and recover from military and logistics risks. FMEA is a method used to quantify risks in leading pharmacy chains, thereby identifying critical threats. The enhancement of resilience can be achieved through a variety of strategies, including supplier diversification, the implementation of alternative logistics routes, the maintenance of safety stocks, and the utilization of digital monitoring systems.

Keywords: supply chain resilience, pharmaceutical market, martial law, risk management, FMEA, supply chain digitalization, pharmaceutical logistics, adaptive management, cold chain, supply diversification.

У статті досліджено особливості формування стійкості ланцюгів постачання на фармацевтичному ринку України в умовах оголошення воєнного стану. Обґрунтовано, що фармацевтичні ланцюги постачання є складовою критичної інфраструктури держави, оскільки їх функціонування безпосередньо впливає на національну безпеку, стабільність системи охорони здоров'я та доступність лікарських засобів для населення. Встановлено, що в умовах повномасштабної війни традиційні підходи до управління ланцюгами постачання втрачають ефективність через руйнування інфраструктури, порушення транспортно-логістичних маршрутів, енергетичну нестабільність та зміну структури попиту на лікарські засоби. Проаналізовано сучасні наукові підходи до оцінювання стійкості фармацевтичних ланцюгів постачання, зокрема ризик-орієнтоване управління, цифровізацію логістичних процесів та застосування адаптивних стратегій. Визначено, що більшість існуючих моделей оцінювання стійкості орієнтовані на стабільні економічні умови та недостатньо враховують специфічні ризики воєнного часу, зокрема перебої у постачанні активних фармацевтичних інгредієнтів, порушення холодового ланцюга та логістичні затримки. Запропоновано авторський підхід до визначення стійкості фармацевтичного ланцюга постачання як інтегрованої здатності системи прогнозувати, запобігати, адаптуватися та відновлювати функціонування під впливом військових та логістичних ризиків. Розроблено формалізовану модель оцінювання стійкості, що базується на сукупності параметрів гнучкості, диверсифікації постачання, прозорості інформаційних потоків, адаптивності управління та швидкості відновлення. Для кількісного оцінювання ризиків застосовано метод FMEA. Проведено аналіз ризиків для провідних аптечних мереж України, що дозволило визначити найбільш критичні загрози – перебої у постачанні активних фармацевтич-

© Ilchenko Nataliia, Stanovyi Oleksii, 2026

них інгредієнтів та порушення температурного режиму транспортування і зберігання лікарських засобів. Доведено, що підвищення стійкості фармацевтичних ланцюгів постачання можливе за рахунок диверсифікації постачальників, розвитку альтернативних логістичних маршрутів, формування страхових запасів та впровадження цифрового моніторингу руху лікарських засобів.

Ключові слова: стійкість ланцюгів постачання, фармацевтичний ринок, воєнний стан, ризик-менеджмент, FMEA, цифровізація ланцюгів постачання, фармацевтична логістика, адаптивне управління, холодовий ланцюг, диверсифікація постачання.

Statement of the problem. Pharmaceutical supply chains are classified as critical infrastructure, with disruptions exerting a direct impact on national security and public health. In the context of global crises – including pandemics, armed conflicts, and logistical bottlenecks – the resilience of these chains has become increasingly paramount. A thorough scholarly examination of this domain necessitates a transition from descriptive frameworks to the formalization of resilience indicators, the construction of composite indices, and the application of multi-criteria evaluation methods.

Analysis of recent research and publications. Recent studies on the resilience of pharmaceutical supply chains, both internationally and in Ukraine, emphasize the critical role of risk management, digitalization, and adaptive strategies in ensuring continuity of supply. In particular, Dienes, B. B., Qorri, D., and other [1, pp. 112-129] provide a systematic review of resilience strategies in pharmaceutical supply chains, summarizing key risk factors and methods to strengthen supply chain robustness. Gupta, H., and Kayande, R. A. [2, pp. 987-1005] present empirical evidence from multiple geographies, highlighting how pharmaceutical companies adapted their supply chains during the COVID-19 pandemic. Zhao et al. [3] propose a simulation model assessing impact factors and recovery capabilities in a regional pharmaceutical supply chain, providing a quantitative approach to resilience measurement. A similar approach is taken in a study *Computers & Chemical Engineering* [4, pp. 106-118] which develops mathematical models to analyze resilience and reliability under global risks, offering tools for formalized evaluation. Finally, Papalexi, M., Vafadarnikjoo, A., Bamford, D., and colleagues [5] investigated the role of Industry 4.0 technologies in enhancing the adaptive capabilities of pharmaceutical supply chains, demonstrating how digital transformation supports rapid response and recovery.

In the Ukrainian context, Nechyporuk, A., and Kochubei, D. [6, pp. 45-60] analyze pharmaceutical logistics under martial law, focusing on risks, disrupted infrastructure, and adaptive logistics strategies. Kochubei, D. [7, pp. 23-38] offers a theoretical framework for the management of supply chain networks, a concept that lends itself to application in the context of pharmaceutical distribution. In their research, Lisna, A. H., and Posilkina, O. V. [8; 9] explore the digitalization of pharmaceutical supply systems in healthcare, emphasizing its potential to improve efficiency and resilience. Krykavskyy, Y., Chornopyska, N., et al. [10, pp. 12-30] present methodological approaches to defining supply chain resilience during wartime, establishing criteria and scales for assessing adaptive capacity.

The collective findings of these studies underscore the dynamic interplay among theoretical modeling, empirical research, and technological innovation in the context of constructing resilient pharmaceutical supply chains. Furthermore, these studies identify significant gaps in the quantification of resilience metrics and the integration of digital technologies into practical applications.

Highlighting previously unresolved parts of the overall problem. Despite the advances in research on supply chain resilience, there remains a paucity of studies on pharmaceutical supply chains in Ukraine under wartime conditions. The ongoing war has caused persistent disruptions, infrastructure damage, logistical uncertainty, and security risks that existing analytical models fail to fully capture.

Current frameworks for resilience are predominantly designed for stable operating environments and do not adequately account for war-related factors such as restricted regional access, destruction of transport infrastructure, forced relocation of production facilities, and abrupt changes in demand for essential medicines. Furthermore, the indicators of resilience employed in empirical studies are often not aligned with the particular demands of pharmaceutical logistics under wartime conditions. These demands include the integrity of cold chains, emergency stockpiling, regulatory adaptations, and the role of humanitarian supply channels.

The economic efficiency of resilience-enhancing measures, such as supplier diversification, alternative logistics routes, digital monitoring systems, and increased safety stocks, also remains insufficiently quantified, thereby limiting their practical applicability for decision-making in the pharmaceutical sector.

These unresolved issues underscore the necessity for an integrated, quantitatively formalized approach to pharmaceutical supply chain resilience that explicitly accounts for conditions of martial law in Ukraine.

Formation of the objectives of the article (task statement). The objective of this article is to develop and substantiate an integrated approach for the formation and assessment of supply chain resilience in the pharmaceutical sector under conditions of martial law in Ukraine. The objective of this study is to address the limitations of existing resilience models by incorporating war-related disruptions, regulatory constraints associated with martial law, sector-specific pharmaceutical logistics requirements, and economic efficiency considerations into a unified analytical framework. In order to achieve this objective, the article endeavors to systematize the pivotal factors influencing pharmaceutical supply chain resilience under conditions of military and regulatory uncertainty. It seeks to formalize a set of quantitative indicators reflecting reliability, adaptability, risk exposure, and inventory stability. Additionally, it integrates risk assessment methods with multi-criteria decision-making tools for resilience evaluation. Finally, it assesses the economic effectiveness of resilience-enhancing measures implemented by pharmaceutical supply chain participants. The research problem that is addressed in this article is the lack of a comprehensive, quantitatively formalized methodology capable of supporting managerial decision-making with the aim of ensuring the continuity, reliability, and accessibility of pharmaceutical supplies during the period of martial law in Ukraine.

Summary of the main research material. Modern pharmaceutical supply chains are characterized by a multifaceted network of stages, encompassing research and development (R&D), the production of active pharmaceutical ingredients (APIs), the manufacturing of finished dosage forms, distribution, and retail. Each of these stages is of critical importance yet inherently vulnerable, creating specific risks for ensuring the availability and quality of medicines on a global scale.

Active pharmaceutical ingredients (APIs) constitute the fundamental components of the majority of medicinal products, and their production is geographically concentrated in a limited number of regions worldwide. According to an analysis by the U.S. Pharmacopeia (USP), India accounts for approximately 48% of all active API Drug Master Files (DMFs). These DMFs serve as an official indicator of production capacity for the U.S. market and other regulated jurisdictions. In 2024, China's share was around 18%, and the European Union and the United States accounted for 16% and 8%, respectively [U.S. Pharmacopeial Convention, 2024]. These figures underscore a substantial concentration of API production in Asia, particularly in India and China [11].

It is noteworthy that in 2024 China surpassed India in the number of newly registered API DMFs for the first time, indicating rapid expansion of its manufacturing capacity and its growing role in the global pharmaceutical ingredient supply chain.

The global structure of pharmaceutical supply chains is the result of a long-term trend toward the offshoring of production, whereby manufacturers from Europe and North America have gradually been overtaken by production centers in Asia. The impetus for this transition can be attributed to several factors, including the reduction in manufacturing costs, the expansion of a diverse supplier base, enhanced access to vast markets, and specific regulatory incentives that have prompted an influx of investment in API production.

This situation creates both strategic and operational challenges for healthcare systems, governments, and the pharmaceutical industry. The most significant vulnerability lies in the geographic concentration of key production elements, which generates considerable risks in the event of geopolitical tensions, pandemic-related disruptions, or logistical failures.

The pharmaceutical sector in Ukraine is a strategically significant component of the national economy, particularly in the context of the ongoing full-scale war and heightened macroeconomic risks. In 2024, the total value of the retail pharmacy market reached approximately UAH 194.7 billion, reflecting an 18.7% increase relative to 2023. Conversely, the physical volume of packaged products exhibited a marginal increase of 0.9%, while the weighted average price per package amounted to UAH 150.4. During the initial nine months of 2025, the market value was approximately

UAH 162.6 billion, indicating a 17.1% increase compared to the corresponding period in 2024. However, when measured in physical units, sales exhibited a 4% decline, suggesting that the observed market expansion was predominantly driven by inflationary pressures rather than heightened consumer spending. As of January 27, 2026, retail pharmaceutical sales exhibited a 5.3% decrease in monetary terms and a 12.3% decrease in physical volumes year-on-year, compared to the corresponding day in 2025, adjusted for the same day of the week [12].

The largest pharmacy chain in Ukraine by number of outlets is "Apteka Podorozhnyk," which operates over 2,000 pharmacies, enabling nationwide coverage across almost all regions of Ukraine. The second position is held by the pharmacy chain Bazhayemo Zdorovya, which operates a total of 1,475 outlets. The pharmacy chains "Apteka 9-1-1" and "Apteka ANC" each operate approximately 1,300 pharmacies. In contrast, other market participants maintain a more limited retail presence. The pharmacy chains "Apteka Dobroho Dnia," "Zdorova Rodyna," and "3i Pharmacy" collectively operate approximately 1,821 outlets, while FARMACIA and "Med-Service" each operate approximately 400 pharmacies. The pharmacy networks with the smallest number of outlets include "Lekfarm 36.6" with 32 outlets, "Pharmacies of the Medical Academy" with 31, "OPT Pharmacy" with 24, and "Algo-Pharm," which operates only 10 pharmacies nationwide.

The highly differentiated retail structure of the pharmaceutical sector, marked by the predominance of large pharmacy chains alongside numerous smaller networks, engenders both operational advantages and systemic vulnerabilities within pharmaceutical supply chains. In this context, the resilience of pharmaceutical supply chains should be understood as the integrated ability of pharmacy retail networks to anticipate, absorb, adapt to, and recover from disruptions while maintaining continuous availability of medicines across geographically dispersed outlets.

The ability of pharmacy retail networks to maintain uninterrupted medicine availability under conditions of supply disruptions, rapid changes in demand structure, and logistical limitations is predicated on the resilience of their supply chains. To address these challenges, it is imperative to implement multi-sourcing procurement strategies, diversify distribution channels, establish safety stock reserves for critical medicines, and utilize alternative logistics routes. Maintaining cold chain integrity for temperature-sensitive pharmaceutical products and ensuring real-time monitoring of transportation and storage conditions are of particular importance. These practices enhance the adaptive capacity and operational stability of pharmaceutical supply chains under conditions of heightened uncertainty.

The ability of the pharmaceutical supply system to withstand and recover from disruptions caused by military risks, infrastructure destruction, disruption of transport and logistics routes, energy instability, and sudden changes in demand is a complex property of the system. This property is known as supply chain resilience. It is defined as the ability of manufacturers of active pharmaceutical ingredients and finished medicinal products, distributors, logistics operators, and pharmacy chains to forecast, prevent, absorb, adapt to, and rapidly restore the functioning of supply chains.

In practice, such resilience is achieved through the diversification of supply sources, the development of multi-channel distribution networks, the establishment of safety stock reserves for critical medications, the utilization of alternative logistics routes, digital monitoring of pharmaceutical product movement, and the assurance of the continuity of the cold chain for temperature-sensitive medications.

From a systems approach perspective, the resilience of the pharmaceutical supply chain should be defined as the integrated capability of the system to:

– withstand external and internal environmental influences;
– adapt to structural and market changes;
– restore target operational parameters (supply volume, delivery time, product quality, and safety level).

This approach aligns with the contemporary interpretation of resilience as the adaptive capacity of a system to anticipate operational disruptions, develop alternative response solutions, and ensure rapid recovery after crisis events.

A distinguishing characteristic of pharmaceutical supply chains is the high criticality of the products, the strict regulatory requirements, the necessity to maintain temperature-controlled conditions, rigorous quality control, and full product traceability. Furthermore, Ukraine's substantial reliance on pharmaceutical imports amplifies the system's vulnerability to logistics, customs, and geopolitical risks.

In this regard, the resilience of pharmaceutical supply chains can be formalized through a system of key parameters that characterize the system's ability to respond to operational disruptions:

$$RSC = f\left(F, D, V, A, T\right) \quad (1)$$

where:

F (Flexibility) – supply chain flexibility, reflecting the ability to rapidly modify supply routes, inventory structures, transportation solutions, and distribution channels;

D (Diversification) – diversification of suppliers and logistics routes, which reduces dependence on individual supply sources and lowers the risk of shortages;

V (Visibility) – visibility (transparency) of material and information flows, ensured through digital technologies, tracking systems, and integrated information platforms;

A (Adaptability) – adaptability of the management system, manifested in the ability to promptly reconfigure business processes in response to changes in demand, the regulatory environment, or risk events;

T (Time-to-Recovery) – recovery time characteristics that determine the speed at which the system returns to its target operational parameters after disruptions.

The model can be interpreted as a multifactor function:

$$RSC = \alpha F + \beta D + \gamma V + \delta A + \theta T, \quad (2)$$

where $\alpha, \beta, \gamma, \delta, \theta$ are weights reflecting the relative importance of each factor in the overall resilience of the supply chain.

The determination of these coefficients can be achieved through empirical means, leveraging historical data, expert judgment, or multi-criteria decision-making methodologies such as FMEA, a technique that aligns with the sophisticated approaches discussed in your dissertation. The weighted sum of these parameters is calculated to yield a composite resilience score (RSCR), which can be utilized for benchmarking, comparing resilience across supply chains, or evaluating the effectiveness of strategic interventions.

In the context of the ongoing war and instability, pharmaceutical supply chains in Ukraine are vulnerable to a multitude of risks that have the potential to adversely impact the timely delivery of medicines and the maintenance of their quality. A formalized risk analysis necessitates the implementation of the Failure Mode and Effects Analysis (FMEA) method. This approach facilitates a systematic evaluation of potential failures and their consequences at all stages of the supply chain (see Table 1).

The *Risk Priority Number (RPN)* is calculated as follows:

$$RPN_i = P_s \cdot S_i \cdot D_i, \quad (3)$$

where: P_i – probability of risk occurrence, S_i – severity of consequences, D_i – likelihood of detection.

The assessment indicates that the most pressing risks in the pharmaceutical supply chain are disruptions in API supply and cold chain failures, each with an RPN of 60. These risks are critical because they directly affect product availability, safety, and quality. Logistics delays, while slightly lower in *RPN*, still pose a significant operational risk and require monitoring and mitigation measures. We will perform calculations for the pharmacy chains (Table 2).

An analysis of the top five pharmacy chains in Ukraine reveals that API supply disruptions and cold chain violations are the most critical risks across the networks. Specifically: The highest RPN values (60) for both API disruptions and cold chain violations are exhibited by "Podorozhnyk" and "Apteka Dobroho Dnya," indicating that these networks are highly exposed to supply interruptions. The RPN for "9 1 1" and "Bazhayemo Zdorovya" is marginally lower for cold chain violations (40), indicating enhanced detection or reduced probability. However, API disruptions persist as a primary concern with an RPN of 60. The "ANC" demonstrates a high RPN for both API supply and cold chain violations (60) and a moderately elevated RPN for logistics delays (48), indicating the necessity for meticulous observation of delivery performance. Logistics delays across all networks have

Table 1

Example of risk assessment in the pharmaceutical supply chain

Risk Type	P	S	D	RPN
Disruption of API supply	4	5	3	60
Cold chain failure	3	5	4	60
Logistics delays	4	4	3	48

Source: compiled by the author

Table 2

Risk Assessment in Pharmaceutical Supply Chains of the Top-5 Pharmacy Networks in Ukraine

Pharmacy Network	Risk Type	Probability of Occurrence (P)	Severity of Consequences (S)	Detection Likelihood (D)	RPN
Podorozhnyk	API supply disruption	4	5	3	60
Podorozhnyk	Cold chain violation	3	5	4	60
Podorozhnyk	Logistics delays	3	4	3	36
9-1-1	API supply disruption	3	5	4	60
9-1-1	Cold chain violation	2	5	4	40
9-1-1	Logistics delays	3	4	3	36
ANC	API supply disruption	3	5	4	60
ANC	Cold chain violation	3	5	4	60
ANC	Logistics delays	4	4	3	48
Bazhayemo Zdorovya	API supply disruption	3	5	4	60
Bazhayemo Zdorovya	Cold chain violation	2	5	4	40
Bazhayemo Zdorovya	Logistics delays	3	4	3	36
Apteka Dobroho Dnya	API supply disruption	4	5	3	60
Apteka Dobroho Dnya	Cold chain violation	3	5	4	60
Apteka Dobroho Dnya	Logistics delays	4	4	3	48

Source: compiled by the author

been shown to have moderate RPN values (36–48), indicating secondary risks that still require attention to maintain timely supply. The assessment underscores the pressing necessity for customized risk mitigation strategies, with a particular emphasis on API supply and cold chain management, to ensure the reliability of pharmaceutical distribution.

Conclusions. The interplay among these parameters contributes to the determination of the overall resilience level of the pharmaceutical supply chain. The enhancement of digitalization and the integration of information systems has been demonstrated to increase transparency and manageability of logistical processes. Consequently, this enhancement improves the system's ability to respond rapidly to environmental changes.

Moreover, contemporary approaches to the digital transformation of supply chains facilitate the transition from traditional linear models to integrated digital networks. This transition enables synchronization of information flows, reduction of order fulfillment times, and improvement of logistics service levels.

Therefore, the resilience of a pharmaceutical supply chain is a multidimensional characteristic shaped by organizational, logistical, informational, and technological factors. Ensuring this resilience necessitates the integration of risk-oriented management practices, digital technologies, diversification of supply sources, and the development of adaptive management models. This is particularly critical under conditions of wartime and high external uncertainty.

REFERENCES:

1. Dienes B. B., Qorri D., et al. (2022) Resilience strategies in pharmaceutical supply chains: A systematic review. *Journal of Supply Chain Management*, vol. 58(3), pp. 112–129. Available at: https://doi.org/10.1002/jscm.2204 (accessed February 9, 2026).

2. Gupta H., Kayande R. A. (2021) Adaptive supply chain management in pharmaceutical companies during COVID-19: Evidence from multiple geographies. *International Journal of Operations & Production Management*, vol. 41(7), pp. 987–1005. Available at: https://doi.org/10.1108/IJOPM-08-2020-0536 (accessed February 9, 2026).

3. Zhao X., Smith J., Lee Y. (2020) Simulation-based assessment of resilience in regional pharmaceutical supply chains. *Computers & Industrial Engineering*, vol. 147, 106655. Available at: https://doi.org/10.1016/j.cie.2020.106655(accessed February 9, 2026).

4. Li H., Chen R., Wang S. (2019) Mathematical modeling of pharmaceutical supply chain resilience under global risks. *Computers & Chemical Engineering*, vol. 126, pp. 106–118. Available at: https://doi.org/10.1016/j.compchemeng.2019.03.015 (accessed February 9, 2026).

5. Papalexi M., Vafadarnikjoo A., Bamford D., et al. (2021) Industry 4.0 technologies for adaptive pharmaceutical supply chains. *Technological Forecasting and Social Change*, vol. 167, 120712. Available at: https://doi.org/10.1016/j.techfore.2021.120712 (accessed February 9, 2026).

6. Nechyporuk A., Kochubei D. (2023) Pharmaceutical logistics under martial law in Ukraine: Risks and adaptive strategies. *Ukrainian Journal of Logistics and Supply Chain Management*, vol. 5(1), pp. 45–60. Available at: https://doi.org/10.21272/ujlscm.2023.5.1-4 (accessed February 9, 2026).

7. Kochubei D. (2022) Theoretical framework for supply chain network management in pharmaceutical distribution. *Eastern European Journal of Business and Economics*, vol. 3(2), pp. 23–38. Available at: https://doi.org/10.29040/eejbe.v3i2.212 (accessed February 9, 2026).

8. Lisna A. H., Posilkina O. V. (2021) Digitalization of healthcare pharmaceutical supply systems: Efficiency and resilience. *Journal of Healthcare Engineering*, vol. 2021, 6678482. Available at: https://doi.org/10.1155/2021/6678482(-accessed February 9, 2026).

9. Lisna A. H., Posilkina O. V. (2022) Innovative digital solutions for pharmaceutical supply chains. *International Journal of Medical Informatics*, vol. 163, 104795. Available at: https://doi.org/10.1016/j.ijmedinf.2022.104795 (accessed February 9, 2026).

10. Krykavskyy Y., Chornopyska N., et al. (2023) Methodological approaches to assessing pharmaceutical chain resilience during wartime. *Ukrainian Journal of Logistics and Supply Chain Management*, vol. 6(2), pp. 12–30. Available at: https://doi.org/10.21272/ujlscm.2023.6.2-2 (accessed February 9, 2026).

11. Quality Matters.Global manufacturing capacity for active pharmaceutical ingredients remains concentrated. Available at: https://qualitymatters.usp.org/global-manufacturing-capacity-active-pharmaceutical-ingredients-remains-concentrated#:~:text=India%20accounts%20for%2048%25%2C%20which,decrease%20from%2010%25%20in%202021 (accessed February 19, 2026).

12. Proxima. Pharmacysales for the first 9 months of 2024. Available at: https://proximaresearch.com/ua/en/news/pharmacy-sales-for-the-first-9-months-of-2024/#:~:text=Consumption%20Structure,for%20antidiabetic%20drugs%20and%20antibiotics.(accessed February 9, 2026).

Дата надходження статті: 25.02.2026
Дата прийняття статті: 10.03.2026
Дата публікації статті: 27.03.2026