Health Problems of Civilization
eISSN: 2354-0265, ISSN: 2353-6942

REVIEW PAPER

Immunoprophylaxis of infectious diseases as a key determinant of population public health in Ukraine

Olena Lototska[1(A,D,G)], **Nataliia Melnyk**[2(B,E)], **Mariana Danchyshyn**[1(C,F)]

[1]Department of General Hygiene and Ecology, Ivan Horbachevsky Ternopil National Medical University, Ternopil, Ukraine

Lototska O, Melnyk N, Danchyshyn M. Immunoprophylaxis of infectious diseases as a key determinant of population public health in Ukraine. Health Prob Civil. https://doi.org/10.29316/hpc/230983

Tables: 0
Figures: 3
References: 46
Submitted: 2026 May 22
Accepted: 2026 Aug 10

Address for correspondence: Nataliia Melnyk, Department of General Hygiene and Ecology, Ivan Horbachevsky Ternopil National Medical University, m. Voli 1, 46001 Ternopil, Ukraine, e-mail: melnyknan@tdmu.edu.ua
ORCID: Olena Lototska https://orcid.org/0000-0002-1393-7914, Nataliia Melnyk https://orcid.org/0000-0002-7357-7551, Mariana Danchyshyn https://orcid.org/0000-0002-7422-2883

Abstract

The article highlights the relevance of immunoprophylaxis as one of the most effective approaches to reducing morbidity and mortality, as well as preventing outbreaks of infectious diseases, in order to preserve public health under current conditions. Vaccination is considered a key instrument of disease prevention and public health protection. The study summarizes approaches to the organization of vaccination programs in leading countries worldwide. It was established that the effectiveness of immunization is ensured through a comprehensive set of measures, including adequate funding, vaccine accessibility, implementation of modern monitoring systems, the use of mobile vaccination units, and active information policies. A comparative analysis of vaccination schedules made it possible to identify both common patterns and differences in the approaches adopted by different countries. The main challenges facing the immunoprophylaxis system in Ukraine were identified, including insufficient vaccination coverage and a lower level of public trust in vaccination. The conclusions emphasize that the implementation of best international practices, expansion of immunization programs, and improvement of vaccine accessibility will contribute to strengthening public health in Ukraine.

Keywords: vaccination calendar, immunoprophylaxis, vaccination, infectious diseases, public health

Introduction

Despite significant advances in modern medicine, infectious diseases continue to remain one of the leading threats to the global healthcare system [1]. Their outbreaks are associated with substantial economic losses, including both direct costs related to treatment, hospitalization, and pharmaceutical provision, as well as indirect costs associated with reduced workforce productivity, loss of labor potential, and premature mortality [2,3]. In this regard, the comprehensive implementation of preventive measures aimed at limiting the spread of infectious diseases has become particularly important [4,5].

According to the majority of researchers, immunization is one of the most effective and economically justified medical interventions in the course of the epidemic process, as it ensures the development of specific immunity against infectious disease pathogens. This not only prevents the occurrence of disease in individuals but also limits its spread within the population, thereby contributing to a significant reduction in morbidity and mortality rates. The primary objective of vaccination is to protect the body against infectious agents, prevent severe disease progression, and reduce the risk of complications [6,7].

Owing to the implementation of vaccination programs, humanity has succeeded in eradicating smallpox, while the incidence of poliomyelitis has decreased by 99%. The prevalence of tetanus,

diphtheria, pertussis, rubella, meningitis, and liver cancer has also declined significantly. Global measles mortality has decreased by 75%, whereas neonatal mortality caused by tetanus has been reduced more than thirteenfold. In order to interrupt the circulation of highly contagious pathogens, particularly the measles virus, immunization coverage must reach at least 95%, thereby ensuring the development of herd immunity [8]. Over the past five decades, the use of vaccines against only 14 infectious diseases has saved at least 154 million lives. During the same period, immunization contributed to an approximately 40% reduction in child mortality worldwide [9].

The approach to disrupting the epidemiological chain involves targeting the susceptible component, namely the human body, through the development of specific resistance. In turn, this makes it possible to protect not only vaccinated individuals but also those who cannot be immunized due to medical contraindications, owing to the effect of herd immunity [10,11].

The immunoprophylaxis system in Ukraine has both strengths and weaknesses when compared with international experience. Its advantages include the existence of a national immunization schedule, its gradual harmonization with European standards, and the implementation of updates aimed at optimizing vaccination strategies [12]. At the same time, vaccination coverage remains insufficient, periodically resulting in outbreaks of infectious diseases, particularly measles [13]. An additional negative factor is the impact of the war in Ukraine, which has disrupted vaccine supply logistics, reduced access to healthcare services, and decreased population coverage with preventive immunization. Compared with developed countries, vaccination monitoring systems in Ukraine function less effectively, financial support remains limited, and public information and educational activities are insufficiently developed [14]. Furthermore, lower public confidence in vaccination and limited availability of certain vaccines create additional barriers to achieving the required level of herd immunity [15].

The generalization of international experience in the immunoprophylaxis of infectious diseases under conditions of insufficient vaccination coverage and existing organizational challenges in Ukraine may help identify effective approaches to vaccination management. In the future, these approaches could be used to improve the healthcare system in Ukraine.

Aim of the work

The aim of the study was to substantiate strategic directions for improving the vaccination system in Ukraine, particularly in the context of implementing the updated National Immunization Schedule, based on a comparative analysis of international experience in the functioning of immunization systems.

Methods

A comprehensive methodological approach was applied, incorporating comparative analysis, bibliosemantic and information-analytical methods, as well as systematic content analysis. The study materials comprised Ukrainian regulatory documents, including the Order of the Ministry of Health of Ukraine No. 396 of March 5th, 2025, and strategic documents issued by the World Health Organization (WHO) [16].

A literature search was conducted manually in the PubMed, Elsevier, and Google Scholar electronic databases using keywords related to immunization systems and vaccine-preventable diseases. The search covered publications from December 2017 to March 2026. Peer-reviewed articles published in English or Ukrainian were eligible for inclusion if they provided comparative data on vaccination models implemented in seven reference high-income countries (the United States, Canada, Australia, the United Kingdom, Germany, Sweden, and Japan) and in Ukraine's neighboring countries (Poland and the Czech Republic). Conference abstracts, duplicate publications, and studies of a non-medical or exclusively experimental nature were excluded from the analysis.

Inclusion criteria:

1. countries with a high Human Development Index (HDI) and well-established national immunization programs, demonstrated by consistently high routine vaccination coverage (>90-95%);
2. countries with comprehensive national immunization schedules covering an expanded range of 12-17 vaccine-preventable diseases;
3. countries of geographical and policy relevance to Ukraine, including Poland and the Czech Republic, as examples of successful integration of post-socialist healthcare systems into European Union public health standards.

Exclusion criteria:

1. countries classified as low- or lower-middle-income economies, as well as countries lacking transparent national immunization reporting systems or the Order of the Ministry of Health - validated vaccination coverage data.

Literature review results

In modern conditions, vaccination is the leading tool in the fight against infectious diseases worldwide. Each country implements its own immunoprophylaxis model, taking into account social, economic, and infrastructural characteristics. At the same time, the key objective remains ensuring equitable access to vaccines for all population groups, increasing public awareness of the importance

of immunization and reducing the incidence of vaccine-preventable diseases. Global experience convincingly demonstrates that well-organized vaccination programs can significantly improve public health outcomes [17,18].

Analysis of measles incidence trends from 2016 to 2025 demonstrated that measles has remained the most aggressive and unpredictable vaccine-preventable disease over the past decade due to its exceptionally high transmissibility. From only 102 reported cases in 2016, the number of infections increased dramatically, rising nearly 46-fold to 4,782 cases in 2017 and reaching epidemic peaks in 2018 and 2019, with 53,219 and a record 57,282 cases, respectively. During this period, Ukraine recorded one of the highest measles incidence rates worldwide, largely as a consequence of prolonged insufficient population immunity. Following the accumulation of post-outbreak immunity and the implementation of strict COVID-19 quarantine measures, measles incidence declined substantially, reaching 264 cases in 2020 and only 11 cases in 2022. However, since 2023, measles transmission has resurged, with 65 cases reported in 2023, 433 in 2024, and 1,060 cases during the first 11 months of 2025. This renewed increase is primarily associated with immunity gaps in the population and the forced congregation of people in bomb shelters and temporary accommodation centers for internally displaced persons (Figure 1) [19].

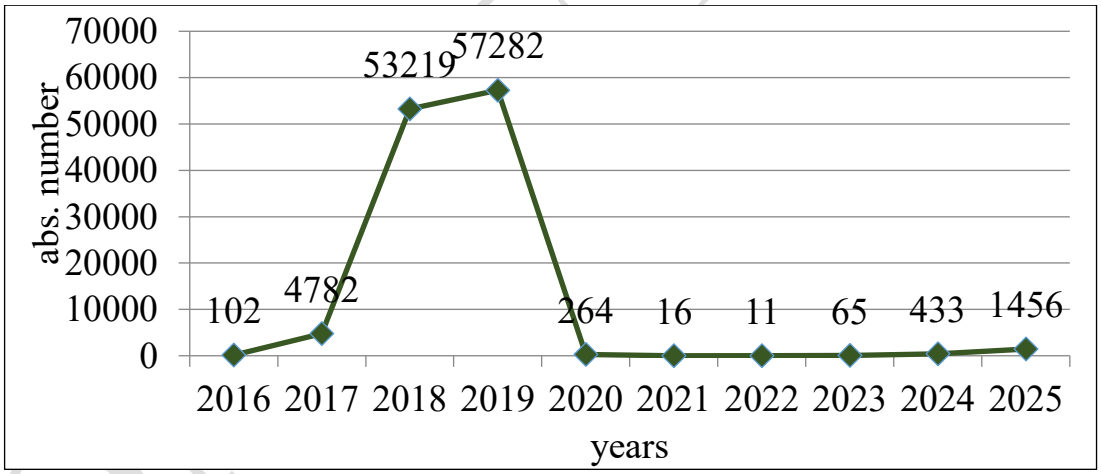

Figure 1. Trends in the annual number of reported measles cases in Ukraine, 2016-2025 (absolute numbers), based on data from the Public Health Center of the Ministry of Health of Ukraine [19]

In contrast to measles, the epidemiological situation for rubella demonstrates successful disease control after 2020. Between 2016 and 2018, the number of reported cases increased gradually from 150 to 235, followed by a decline to 138 cases in 2019. Since 2020, routine immunization has reduced rubella to sporadic occurrence, with the disease reaching its lowest recorded level in 2025, when only six cases were reported (Figure 2) [19].

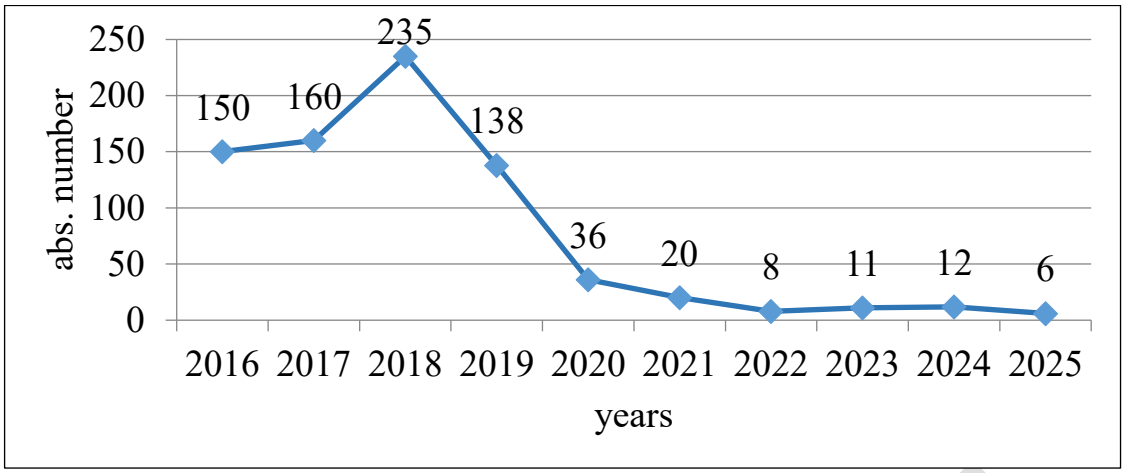

Figure 2. Trends in the annual number of reported rubella cases in Ukraine, 2016-2025 (absolute numbers), based on data from the Public Health Center of the Ministry of Health of Ukraine [19]

Analysis of the long-term trends in mumps incidence in Ukraine during 2016-2025 also demonstrates the cyclical nature of the epidemic process. Between 2016 and 2019, the annual number of reported cases remained relatively high, ranging from 336 to 439. The highest incidence during this period was recorded in 2016 (439 cases). In 2017, the number of cases declined to 336, followed by a moderate increase to 392 and 382 cases in 2018 and 2019, respectively. In 2020 and 2021, mumps incidence decreased substantially to 163 and 175 cases, respectively, most likely reflecting the impact of COVID-19-related public health restrictions and the consequent reduction in viral transmission. In 2022, a slight increase to 190 cases was observed, followed by the largest outbreak of the past decade in 2023, when 529 cases were reported. This resurgence may indicate the accumulation of susceptible individuals who were either unvaccinated or had experienced waning vaccine-induced immunity. Following the outbreak, incidence declined again, with 142 cases reported in 2024 and only 42 cases in 2025 (Figure 3) [19].

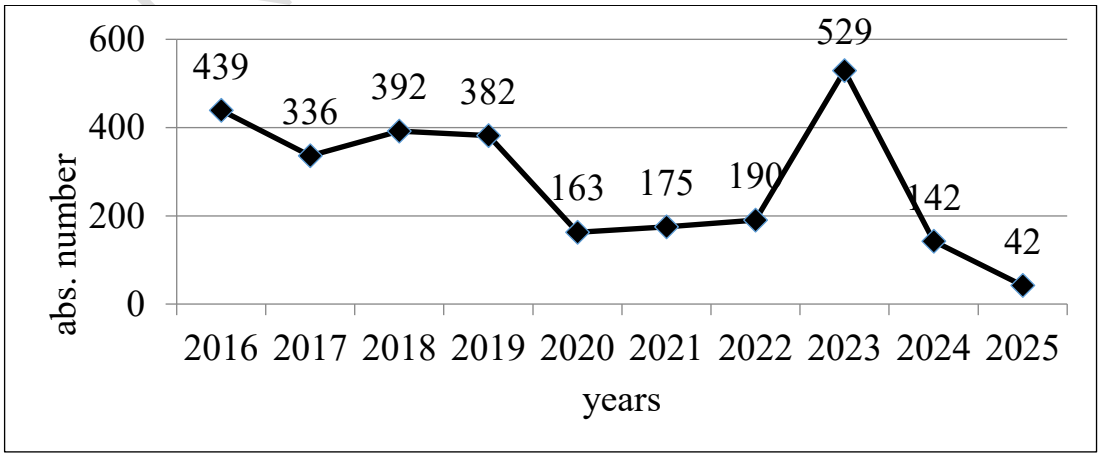

Figure 3. Trends in the annual number of reported mumps cases in Ukraine, 2016-2025 (absolute numbers), based on data from the Public Health Center of the Ministry of Health of Ukraine [19]

As of 2025, both rubella and mumps have reached historically low incidence levels, largely due to the implementation of intensive catch-up vaccination campaigns. Overall, the analysis of measles, rubella, and mumps incidence trends in Ukraine highlights the pivotal role of vaccination in the effective control of vaccine-preventable diseases [19].

The WHO provides general recommendations on immunization for children and adults against a range of infectious diseases, and each country independently develops its national immunization schedule. Accordingly, vaccination calendars differ in the number of diseases covered by state-funded immunization programs. In most European countries, immunization programs cover between 12 and 17 infectious diseases. For example, Austria provides vaccination against 17 diseases, the United States against 16, Switzerland against 14, while Germany and Sweden include 13 diseases in their national schedules [20].

The vaccination system in the United States is considered one of the most advanced in the world and covers the prevention of all major infectious diseases, including poliomyelitis, diphtheria, pertussis, hepatitis B, measles, and others. Immunization is mandatory for all children, as well as for certain groups of the adult population, such as healthcare workers and the elderly. An important component of the program is systematic monitoring through electronic databases, which enables effective tracking of immunization status. As a result, vaccination coverage among children exceeds 90%, helping to prevent outbreaks of infectious diseases. In addition, the United States actively implements public information campaigns aimed at increasing public confidence in vaccination. Significant support is also provided for scientific research in vaccinology, which facilitates the rapid introduction of new vaccines. All these factors ensure high program effectiveness and contribute to a reduction in morbidity and mortality from infectious diseases [21,22].

The Canadian immunization program is also among the most successful in the world, largely due to the clear coordination between federal and provincial authorities. Vaccination is provided free of charge to all citizens and is carried out in accordance with the national immunization schedule. One of its key features is ensuring vaccine accessibility in remote and rural areas through mobile vaccination units. Considerable attention is given to preventing infectious diseases among vulnerable population groups, including children, the elderly, and immunocompromised individuals. As a result, vaccination coverage among children exceeds 90%, contributing to a substantial reduction in vaccine-preventable diseases. Canadian healthcare institutions actively conduct public education campaigns and provide support for individuals who cannot be vaccinated for medical reasons. Through the combination of accessibility and mobility, this system represents an effective model that can be adopted by other countries [23].

The vaccination program in Australia is characterized by a high level of population coverage and the implementation of innovative approaches to promoting immunization. It includes mandatory

vaccinations for children and the widespread provision of free vaccines for the adult population, particularly for elderly individuals, people with chronic diseases, and other high-risk groups. Considerable attention is paid to ensuring access to healthcare services in remote and rural areas, where mobile vaccination units are actively operating. In order to increase coverage, the government applies financial incentives for parents, encouraging childhood immunization. As a result, vaccination coverage among children reaches approximately 95%, contributing to a significant reduction in the prevalence of infections such as poliomyelitis, pertussis, and influenza. The effectiveness of this program is ensured by the combination of vaccine accessibility and active public information campaigns [24].

In the United Kingdom, the immunization program is another example of an effectively organized vaccination system. It covers all major vaccine-preventable infectious diseases, includes mandatory childhood immunization, and actively promotes vaccination among adults, particularly for influenza prevention. Significant attention is given to information campaigns aimed at building public trust in vaccination. Special emphasis is placed on protecting vulnerable groups, such as the elderly and immunocompromised individuals. Vaccination coverage among children exceeds 90%, allowing for effective control of infectious disease transmission. To improve accessibility, especially in rural and remote areas, mobile vaccination units are used. The implementation of this program has contributed to a substantial reduction in the incidence of poliomyelitis, measles, and other infectious diseases [25,26].

In Germany, the vaccination program also demonstrates a high level of effectiveness. It includes mandatory immunization for children and regular vaccination campaigns among the adult population. Vaccines are provided free of charge to all citizens, and public awareness is continuously promoted. An important component of the system is the use of electronic immunization registries, which ensure effective monitoring of vaccination coverage. Special attention is paid to vulnerable population groups. Vaccination coverage among children exceeds 90%, contributing to a reduction in the incidence of vaccine-preventable diseases. The program also includes subsidized vaccination for certain categories of the adult population [27].

The Japanese immunization system is an example of high effectiveness achieved through a combination of mandatory childhood vaccination and voluntary immunization among adults. The country actively introduces new vaccines and ensures a high level of population coverage, including through the use of electronic immunization records. Vaccination is accessible to all citizens, and regular information campaigns help increase public awareness. Particular attention is paid to vaccinating elderly individuals as a high-risk group. As a result, Japan has one of the lowest incidences of vaccine-preventable diseases among developed countries [28,29].

In Sweden, the vaccination program is among the most successful in Europe, supported by free access to vaccines for all citizens. Immunization is mandatory for children and is administered according to the national schedule. The program also includes regular vaccination campaigns for adults, particularly against influenza and pneumococcal infections. The use of modern technologies for immunization registration and monitoring, along with active public health communication, contributes to achieving coverage levels above 90% and significantly reduces the risk of epidemics [30].

A comparative analysis of immunization schedules in Ukraine, the United Kingdom, Germany, the Czech Republic, Poland, and the United States demonstrated that in all these countries, vaccination against diphtheria, tetanus, pertussis, poliomyelitis, and *Hemophilus influenzae* type b is administered during the first six months of life, starting from two months of age. Immunization against measles, mumps, and rubella is usually performed at around one year of age. At the same time, in the United Kingdom, additional vaccines against meningococcal and pneumococcal infections, as well as rotavirus, are included [31,32]. Vaccination against pneumococcal infection in most of the mentioned countries is administered concurrently with other routine immunizations, while meningococcal vaccination is included in the mandatory immunization schedules in several states [33]. Measles vaccination in most countries is performed at 12-15 months of age using a combined vaccine, whereas revaccination schedules vary between countries [34].

Hepatitis B vaccination is mandatory in most countries and is administered during the first year of life, often immediately after birth, whereas hepatitis A vaccination is mandatory only in the United States [35].

Approaches to tuberculosis vaccination differ considerably: in Poland, it is administered within the first 24 hours of life, in Ukraine, on days 3-5 after birth, in the Czech Republic, only for risk groups, while in the United States and Germany, it is not included in routine immunization schedules, and in the United Kingdom, it is used only based on epidemiological indications [36]. Vaccination against rotavirus infection is mandatory in several countries, whereas in Ukraine, it is recommended. A similar situation is observed regarding vaccination against varicella [37,38].

Vaccination against human papillomavirus (HPV) is administered in many countries during adolescence and is included in national immunization programs. According to the WHO, this vaccination has been introduced in most countries worldwide. At the same time, influenza vaccination is routinely implemented in many countries, whereas in Ukraine, it is not mandatory [39].

Thus, the effectiveness of vaccination programs is determined not only by the existence of a national immunization schedule but also by a comprehensive approach to its implementation, including stable financing, vaccine availability, modern monitoring systems, and a high level of public trust.

In Ukraine, until 2026, immunoprophylaxis covered 10 infectious diseases. Starting from January 1st, 2026, in accordance with Order of the Ministry of Health of Ukraine No. 396 dated March 5th, 2025, an updated National Immunization Schedule came into effect, aimed at optimizing the vaccination timetable, reducing the number of injections, and harmonizing it with European standards. The main changes include the introduction of HPV vaccination for girls aged 12-13 years; the transition to the inactivated poliomyelitis vaccine; optimization of the hepatitis B vaccination schedule; modification of the timing of revaccination against measles, mumps, and rubella; and adjustment of tuberculosis vaccination timing. In the long term, further expansion of the immunization schedule is planned, in particular through the inclusion of pneumococcal vaccination. Additionally, vaccination against rotavirus infection, influenza, varicella, and other diseases remains recommended but not mandatory [40,41].

The WHO emphasizes that even short-term interruptions in routine immunization can lead to outbreaks of infectious diseases. In Ukraine, insufficient vaccination coverage has contributed to outbreaks, particularly measles in 2017-2019 [42]. Compared with developed countries, the Ukrainian vaccination system shares certain common features; however, it lags behind in terms of monitoring, financing, and information support. Limited use of mobile vaccination units and insufficient attention to adult immunization also remain pressing issues. In addition, the level of public trust in the healthcare system in Ukraine is lower, which negatively affects vaccination coverage. A significant proportion of vaccines are still classified as recommended rather than mandatory, creating a gap compared to the European Union practices.

Following the collapse of the Soviet Union in the 1990s, economic instability, disruptions in vaccine supply, healthcare system restructuring, and weakened governmental oversight had a profound negative impact on childhood vaccination coverage in Ukraine. During the same period, vaccine hesitancy and anti-vaccination attitudes became increasingly widespread, fueled by declining public trust in governmental institutions and healthcare providers, as well as by misinformation disseminated through mass media and, later, social media platforms. As a result, by 2016, vaccination coverage had declined to critically low levels, ranging from 19% to 30% depending on the vaccine administered [43].

The full-scale war in Ukraine has had a substantial impact on the immunoprophylaxis system, causing both organizational and epidemiological challenges. The destruction of healthcare infrastructure and attacks on medical facilities (more than 2,800 documented cases) have significantly complicated access to healthcare services, including vaccination [44]. Large-scale population displacement, disruptions in supply logistics, and overload of the healthcare system have led to reduced vaccination coverage and interruptions in routine immunization programs [45]. This, in turn, has contributed to an increased incidence of vaccine-preventable diseases, particularly measles and

pertussis, indicating rising epidemiological risks [46]. At the same time, despite these challenging conditions, international support and healthcare system adaptations (mobile teams, strengthening of the cold chain) have allowed Ukraine to partially maintain continuity of immunoprophylaxis services.

Conclusions

The experience of high-income countries, including the United States, the United Kingdom, Germany, Canada, Sweden, and Japan, demonstrates that sustained achievement of the target population immunity level (90-95 %) depends on the combined effect of three key factors: broad vaccine coverage against 13-17 vaccine-preventable diseases through publicly funded immunization programs, the implementation of integrated digital surveillance systems, and a high level of public trust in the healthcare system. Comparative analysis of national immunization schedules revealed substantial consistency in primary immunization strategies against core childhood infections, including diphtheria, pertussis, tetanus, poliomyelitis, measles, mumps, rubella, and hepatitis B during the first months of life. At the same time, marked differences were identified in tuberculosis prevention strategies, with Eastern European countries, including Ukraine and Poland, maintaining universal Bacillus Calmette-Guérin (BCG) vaccination, whereas most Western European countries and the United States have adopted selective or risk-based vaccination policies. Differences were also observed in the public funding of vaccination against rotavirus, pneumococcal disease, and HPV.

The modernization of Ukraine's immunization system, implemented from January 1st, 2026, under the Order of the Ministry of Health of Ukraine No. 396, represents a major step toward harmonization with European public health standards. The introduction of publicly funded HPV vaccination for girls aged 12-13 years, the complete transition to the inactivated poliovirus vaccine (IPV), and the optimization of immunization schedules have substantially reduced the gap between Ukraine's vaccination program and international best practices, expanding protection to 11 vaccine-preventable diseases.

Disclosures and acknowledgements

The authors wish to acknowledge the contributions of Ivan Horbachevsky Ternopil National Medical University for assisting with data collection and to all the participants for providing information used in this study.

The authors declare no conflicts of interest with respect to the research, authorship, and/or publication of this article.

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

The research was approved by the Bioethics Commission of I. Horbachevsky Ternopil National Medical University of the Ministry of Health of Ukraine (Approval No. 85, April 1st, 2026).

Artificial intelligence (AI) was not used in the creation of the manuscript.

References:

1. Reluga TC, Smith RA, Hughes DP. Dynamic and game theory of infectious disease stigmas. Journal of Theoretical Biology. 2019; 476: 95-107. https://doi.org/10.1016/j.jtbi.2019.05.020
2. Smith KM, Machalaba CC, Seifman R, Feferholtz Y, Karesh WB. Infectious disease and economics: the case for considering multi-sectoral impacts. One Health. 2019; 7: 100080. https://doi.org/10.1016/j.onehlt.2018.100080
3. Bloom DE, Cadarette D. Infectious disease threats in the twenty-first century: strengthening the global response. Frontiers in Immunology. 2019; 10: 549. https://doi.org/10.3389/fimmu.2019.00549
4. Ryu S, Chun JY, Lee S, Yoo D, Kim Y, Ali ST, et al. Epidemiology and transmission dynamics of infectious diseases and control measures. Viruses. 2022; 14(11): 2510. https://doi.org/10.3390/v14112510
5. Rodrigues CM, Plotkin SA. Impact of vaccines; health, economic and social perspectives. Frontiers in Microbiology. 2020; 11: 526. https://doi.org/10.3389/fmicb.2020.01526
6. Melese M, Wolde F, Sori T, Girma S. Role of understanding the chain of infection for effective infectious disease prevention and control. Austin J Public Health Epidemiol. 2025; 12(2): 1178.
7. Montero DA, Vidal RM, Velasco J, Carreño LJ, Torres JP, Benachi MAO, et al. Two centuries of vaccination: historical and conceptual approach and future perspectives. Frontiers in Public Health. 2024; 11: 1326154. https://doi.org/10.3389/fpubh.2023.1326154
8. Ministry of Health of Ukraine. [How herd immunity works: explanation by the Ministry of Health of Ukraine] [Internet]. Kyiv: Ministry of Health of Ukraine; 2023 [access 2023 Sep 23]. Available from: https://moz.gov.ua/uk/jak-pracjue-kolektivnij-imunitet (in Ukrainian).
9. Lakioti E, Pagonis N, Flegkas D, Itziou A, Moustakas K, Karayannis V. Social factors and policies promoting good health and well-being as a sustainable development goal: current achievements and future pathways. Sustainability. 2025; 17(11): 5063. https://doi.org/10.3390/su17115063
10. Truschenkova LV, Terenda NO, Soltys IS. [Comparative analysis of organizational forms and models of population immunization management in the world and in Ukraine.]. Bulletin of

Social Hygiene and Health Care Organization of Ukraine. 2023; 1: 70-74 (in Ukrainian). https://doi.org/10.11603/1681-2786.2023.1.13864

11. Plans-Rubió P. Vaccination coverage for routine vaccines and herd immunity levels against measles and pertussis in the world in 2019. Vaccines. 2021; 9(3): 256. https://doi.org/10.3390/vaccines9030256
12. Oxamyt IY. [Immunization schedules in pediatrics: domestic and international experience]. The 3rd International Scientific and Practical Conference "Technologies in Education in Schools and Universities" (January 23-26, 2024). Athens: International Science Group; 2024. p. 363 (in Ukrainian).
13. Shcherbak O, Evstafieva A, Konoplya L, Ivashchenko R. [Dependence of measles incidence in 2018-2022 on immunoprophylaxis in the Kharkiv, Poltava, and Sumy regions]. Antwerp: Collection of scientific papers «SCIENTIA»; 2023. p. 297-300 (in Ukrainian).
14. Smilyanska M, Volyansky A, Didorenko T, Karlova T, Lysenko O. [The situation of vaccine-preventable infections in Ukraine under martial law]. Scientific Collection «InterConf+». 2025; 58: 181-186 (in Ukrainian). https://doi.org/10.51582/interconf.19-20.06.2025.021
15. Verbytska YM. [Medical and social problems of population vaccination in communities under martial law]. Medicine Today and Tomorrow. 2024; 93(4): 87-93 (in Ukrainian). https://doi.org/10.35339/msz.2024.93.4.ver
16. Ministry of Health of Ukraine. [Order No. 396 of March 5, 2025, "On Amendments to the Calendar of Preventive Vaccinations in Ukraine"] [Internet]. Kyiv: Ministry of Health of Ukraine; 2025 [access 2026 Apr 25]. Available from: https://moz.gov.ua/ (in Ukrainian).
17. Siciliani L, Wild C, McKee M, Kringos D, Barry MM, Barros PP, et al. Strengthening vaccination programmes and health systems in the European Union: a framework for action. Health Policy. 2020; 124(5): 511-518. https://doi.org/10.1016/j.healthpol.2020.02.015
18. Echeverria-Londono S, Li X, Toor J, de Villiers MJ, Nayagam S, Hallett TB, et al. How can the public health impact of vaccination be estimated?. BMC Public Health. 2021; 21: 2049. https://doi.org/10.1186/s12889-021-12040-9
19. Public Health Center of the Ministry of Health of Ukraine. [Infectious morbidity in Ukraine in November and 11 months of 2024-2025] [Internet]. Kyiv: Public Health Center of the Ministry of Health of Ukraine; 2025 [access 2026 Apr 25]. Available from: https://phc.org.ua/kontrol-zakhvoryuvan/inshi-infekciyni-zakhvoryuvannya/infekciyna-zakhvoryuvanist-naselennya-ukraini/ (in Ukrainian).
20. ECDC. Vaccine schedules in all countries in the EU/EEA [Internet]. Solna: ECDC [access 2026 Apr 25]. Available from: https://vaccine-schedule.ecdc.europa.eu/
21. Roper L, Hall MAK, Cohn A. Overview of the United States' immunization program. J Infect

Dis. 2021; 224(Suppl. 4): S443-S451. https://doi.org/10.1093/infdis/jiab310

22. Holder N, Smith K, Coyne-Beasley T. The adolescent immunization platform: the past and future. J Adolesc Health. 2025; 77(Suppl. 2): S11-S13. https://doi.org/10.1016/j.jadohealth.2025.05.002
23. Chit A, Lee JK, Shim M, Nguyen VH, Grootendorst P, Wu J, et al. Economic evaluation of vaccines in Canada: a systematic review. Hum Vaccin Immunother. 2016; 12(5): 1257-1264. https://doi.org/10.1080/21645515.2015.1137405
24. Hanly M, Churches T, Fitzgerald O, MacIntyre CR, Jorm L. Vaccinating Australia: How long will it take?. Vaccine. 2022; 40(17): 2491-2497. https://doi.org/10.1016/j.vaccine.2021.07.006
25. Crocker-Buque T, Mounier-Jack S. Vaccination in England: a review of why business as usual is not enough to maintain coverage. BMC Public Health. 2018; 18: 1351. https://doi.org/10.1186/s12889-018-6228-5
26. Vuolanto P, Almeida AN, Anderson A, Auvinen P, Beja A, Bracke P, et al. Trust matters: the addressing vaccine hesitancy in Europe study. Scand J Public Health. 2024; 52(3): 379-390. https://doi.org/10.1177/14034948231223791
27. Bechini A, Boccalini S, Ninci A, Zanobini P, Sartor G, Bonaccorsi G, et al. Childhood vaccination coverage in Europe: impact of different public health policies. Expert Rev Vaccines. 2019; 18(7): 693-701. https://doi.org/10.1080/14760584.2019.1639502
28. Katsuta T, Moser CA, Feemster KA, Saitoh A, Offit PA. Comparison of immunization systems in Japan and the United States – What can be learned?. Vaccine. 2020; 38(46): 7401-7408. https://doi.org/10.1016/j.vaccine.2020.09.028
29. Kamiya H, Kamidani S, Saitoh A. An introduction to the Japanese immunization program: past, present, and future perspectives. The Pediatric Infectious Disease Journal. 2023; 42(5): 154-157. https://doi.org/10.1097/INF.0000000000003854
30. Blomqvist P. The Swedish child vaccination programme. In: de la Porte C, Björk Eydal G, Kauko J, Nohrstedt D, 't Hart P, Sofus Tranøy B, editors. (Successful public policy in the Nordic countries: cases, lessons, challenges. Oxford: Oxford University Press; 2022. p. 306-328. https://doi.org/10.1093/oso/9780192856296.003.0015
31. Pawar B, Loganathan S, Mukkatira Belliappa K, Ranganathan LB, Thekdi KP, Hiware SD. A comprehensive review of vaccine development: from traditional platforms to messenger RNA (mRNA) technologies. Cureus. 2026; 18(1): e100608. https://doi.org/10.7759/cureus.100608
32. Mahase E. Childhood vaccination: access problems in UK began way before covid-19. BMJ. 2021; 373: n1436. https://doi.org/10.1136/bmj.n1436
33. Sheikh S, Biundo E, Courcier S, Damm O, Launay O, Maes E, et al. A report on the status of

vaccination in Europe. Vaccine. 2018; 36(33): 4979-4992. https://doi.org/10.1016/j.vaccine.2018.06.044

34. Kuppalli K, Omer SB. Measles: the urgent need for global immunisation and preparedness. Lancet. 2025; 405(10489): 1565-1567. https://doi.org/10.1016/S0140-6736(25)00675-0
35. Harmon SHE, Faour DE, MacDonald NE, Graham JE, Steffen C, Henaff L, et al. Immunization governance: Mandatory immunization in 28 Global NITAG Network countries. Vaccine. 2020; 38(46): 7258-7267. https://doi.org/10.1016/j.vaccine.2020.09.053
36. Orenstein WA, Hinman A, Nkowane B, Olive JM, Reingold A. Measles and Rubella Global Strategic Plan 2012-2020 midterm review. Vaccine. 2018; 36(Suppl 1): A1-A34. https://doi.org/10.1016/j.vaccine.2017.09.026
37. Ghildayal N. Cost-effectiveness of Hepatitis A vaccination in a developed and developing country. Int J Health Care Qual Assur. 2019; 32(8): 1175-1199. https://doi.org/10.1108/IJHCQA-05-2019-0096
38. Cernuschi T, Malvolti S, Nickels E, Friede M. Bacillus Calmette-Guérin (BCG) vaccine: a global assessment of demand and supply balance. Vaccine. 2018; 36(4): 498-506. https://doi.org/10.1016/j.vaccine.2017.12.010
39. Bruni L, Saura-Lázaro A, Montoliu A, Brotons M, Alemany L, Diallo MS, et al. HPV vaccination introduction worldwide and WHO and UNICEF estimates of national HPV immunization coverage 2010-2019. Prev Med. 2021; 144: 106399. https://doi.org/10.1016/j.ypmed.2020.106399
40. Bushkovska N. Vaccination in the war in Ukraine. BMJ. 2023; 381: 963. https://doi.org/10.1136/bmj.p963
41. Semenov VV, Kriachkova LV, Boată AE, Geantă MM. Trends in cervical cancer epidemiology and vaccination coverage in Ukraine. Wiad Lek. 2025; 5: 999-1005. https://doi.org/10.36740/WLek/205358
42. Marchetti G, D'Angelo F, Ferrari C, Bellini A, Sabato M, Scarso S, et al. The opportunity provided by vaccination offer to refugees from Ukraine in European countries. Vaccines. 2024; 12(6): 589. https://doi.org/10.3390/vaccines12060589
43. Zavalniuk OL. [Some statistical studies of infectious morbidity and vaccine prevention of infectious diseases in Ukraine and the world]. Science and Life: Proceedings of articles the international scientific conference. Czech Republic, Karlovy Vary – Ukraine, Kyiv, November 16-17, 2017. Karlovy Vary: Skleněný Můstek, s.r.o.; 2017. p. 141-146 (in Ukrainian).
44. Bogdan BV. [The impact of Russian military aggression on the state policy of population protection against infectious diseases in Ukraine]. Kyiv Journal of Law. 2022; 3: 49-53 (in

Ukrainian). https://doi.org/10.32782/klj/2022.3.7

45. Nikityuk SO, Panychev VO, Yakymchuk YU, Stelmakh OE. [The role of the public sector in population vaccination in the Ternopil region under the conditions of the Russian-Ukrainian war]. Bulletin of Social Hygiene and Health Care Organization of Ukraine. 2024; 3: 10-15 (in Ukrainian). https://doi.org/10.11603/1681-2786.2024.3.14938
46. Smilyanska M, Volyansky A, Didorenko T, Karlova T. [Prospects for personalized immunoprophylaxis in Ukraine]. Scientific Collection «InterConf». 2024; 200: 169-173 (in Ukrainian).