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## Dynamics of early detection of HIV infection among children born to HIV-positive mothers in Ukraine in 2016–2024

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Vertical transmission of human immunodeficiency virus (HIV) from mother to child remains an urgent public health problem, even in the conditions of widespread implementation of mother-to-child transmission prevention programs (prevention of mother-to-child transmission – PMTCT). Early diagnosis of HIV infection in children under 2 months of age using the polymerase chain reaction (PCR) is one of the key indicators of the effectiveness of these programs, as it allows timely detection of infection and initiation of antiretroviral therapy.

**Aim** – to assess the dynamics of early detection of HIV infection among children under 2 months of age born to HIV-positive mothers, in Ukraine, in 2016–2024.**Materials and methods.** A retrospective analysis of statistical data of the Public Health Center of the Ministry of Health of Ukraine regarding the number of HIV-positive children born to HIV-positive mothers and examined by the PCR method at the age of 2 months was conducted. The study covered the period 2016–2024. The methods of descriptive statistics, comparative analysis and assessment of regional features of the indicator were used.**Results.** A clear trend towards a decrease in the number of HIV-positive children detected at an early age has been established: from 57 cases in 2016 to 6 cases in 2024, which corresponds to an overall decrease of 89.5%. The highest values of the indicator during the studied period were observed in the Dnipropetrovsk and Odesa regions, as well as in the city of Kyiv. In most regions in 2022–2024, isolated cases or their complete absence were recorded, which indicates a decrease in regional variability. At the same time, in the period after 2022, the impact of military actions on the completeness of data collection, access to health services, and coverage of testing is possible.**Conclusions.** The obtained results indicate a positive trend in reducing the early detection of HIV infection among children born to HIV-positive mothers, which may be related to the improvement of the effectiveness of PMTCT programs in Ukraine. However, the results of recent years require careful interpretation, taking into account the possible undercounting of cases and the influence of external factors. Further monitoring of the indicator is necessary for an objective assessment of the epidemic situation and planning of public health measures.

The authors declare no conflict of interest.

**Keywords:** human immunodeficiency virus (HIV), children under 2 months, polymerase chain reaction (PCR), diagnostics, vertical transmission, Ukraine.

### Динаміка раннього виявлення ВІЛ-інфекції серед дітей, народжених від ВІЛ-позитивних матерів, в Україні у 2016–2024 роках

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Вертикальна передача вірусу імунодефіциту людини (ВІЛ) від матері до дитини залишається актуальною проблемою громадського здоров'я навіть в умовах широкого впровадження програм профілактики передачі від матері до дитини (ППМД). Рання діагностика ВІЛ-інфекції у дітей віком до 2 місяців за допомогою полімеразної ланцюгової реакції (ПЛР) є одним із ключових індикаторів ефективності цих програм, оскільки дає змогу своєчасно виявити інфікування та розпочати антиретровірусну терапію.

**Мета** – оцінити динаміку раннього виявлення ВІЛ-інфекції серед дітей віком до 2 місяців, народжених від ВІЛ-позитивних матерів, в Україні у 2016–2024 роках.**Матеріали та методи.** Проведено ретроспективний аналіз статистичних даних Центру громадського здоров'я МОЗ України щодо кількості ВІЛ-позитивних дітей, народжених від ВІЛ-позитивних матерів та обстежених методом ПЛР віком до 2 місяців. Дослідження охоплювало період 2016–2024 років. Використано методи описової статистики, порівняльного аналізу та оцінки регіональних особливостей показника.**Результати.** Встановлено чітку тенденцію до зниження кількості ВІЛ-позитивних дітей, виявлених у ранньому віці: з 57 випадків у 2016 році до 6 випадків у 2024 році, що відповідає загальному зниженню на 89,5%. Найвищі значення показника протягом досліджуваного періоду спостерігалися у Дніпропетровській та Одеській областях, а також у місті Києві. У більшості регіонів у 2022–2024 роках реєструвалися поодинокі випадки або їхня повна відсутність, що свідчить про зменшення регіональної варіабельності. Водночас у період після 2022 року воєнні дії вплинули на повноту збору даних, доступ до медичних послуг та охоплення тестуванням.**Висновки.** Отримані результати свідчать про позитивну динаміку щодо зниження раннього виявлення ВІЛ-інфекції серед дітей, народжених від ВІЛ-позитивних матерів, що може бути пов'язано з підвищенням ефективності програм ППМД в Україні. Водночас результати останніх років потребують обережної інтерпретації з урахуванням можливого недообліку випадків та впливу зовнішніх факторів. Подальший моніторинг показника є необхідним для об'єктивної оцінки епідемічної ситуації та планування заходів громадського здоров'я.

Автори заявляють про відсутність конфлікту інтересів.

**Ключові слова:** вірус імунодефіциту людини (ВІЛ), діти до 2 місяців, полімеразна ланцюгова реакція (ПЛР), діагностика, вертикальна передача, Україна.

## Introduction

Human immunodeficiency virus (HIV) infection remains one of the leading medical and social problems in the world and in Ukraine, despite significant achievements in the field of prevention, diagnosis, and treatment [1,11]. A special place in the structure of the epidemic process is occupied by vertical transmission of the virus from mother to child, which can reach high rates without proper preventive measures. In this regard, one of the key directions of the public health system is the implementation and improvement of mother-to-child HIV transmission prevention programs, which involve a complex of medical and organizational measures [2].

Early diagnosis of HIV in children born to HIV-positive mothers is an important component of assessing the effectiveness of prevention of mother-to-child transmission (PMTCT). Since maternal antibodies can be stored in the child's body for a long time, the use of serological methods in the first months of life is limited. That is why the «gold standard» of early diagnosis is the use of molecular genetic methods, in particular polymerase chain reaction (PCR), which allows detecting the virus already in the first weeks of a child's life [3].

The indicator of the number of HIV-positive children detected by the PCR method at the age of 2 months is an important indicator of the quality of the provision of medical care to pregnant women, the coverage of antiretroviral therapy, and the effectiveness of preventive measures. The analysis of this indicator in time dynamics makes it possible to assess changes in the epidemiological situation, identify regional features, and identify problematic aspects of the organization of medical care [4].

In Ukraine, in recent years, there has been a tendency to decrease the level of vertical transmission of HIV, which is associated with the expansion of access to antiretroviral therapy, the improvement of algorithms for the management of pregnant women with HIV, and the improvement of laboratory diagnostics. At the same time, modern challenges, in particular socio-economic changes and the impact of military operations, can affect the availability of medical services, the completeness of records, and the quality of statistical data [5].

The study of the dynamics of early detection of HIV among children born to HIV-positive mothers is relevant and necessary for an objective assessment of the effectiveness of existing programs, as well as for further planning of measures in the field of public health. The analysis of the relevant statistical data makes it possible to form scientifically based conclusions and determine priority directions for improving medical care.

**Aim** – to assess the dynamics of early detection of HIV infection among children under 2 months of age born to HIV-positive mothers, in Ukraine, in 2016–2024.

## Materials and methods

The study has a retrospective descriptive-analytical nature and is based on the use of secondary statistical data. The source of information was the official reporting data of the Public Health Center of the Ministry of Health of Ukraine regarding the number of HIV-positive children born to HIV-positive mothers and examined by the PCR method at the age of 2 months. The analysis covered the period from 2016 to 2024 and included indicators both at the national level and by administrative-territorial units. The object of the study was cases of early detection of HIV infection among children under the age of 2 months born to HIV-positive mothers. The subject of the study was the dynamics of the number of such cases and their regional features. The study used methods of descriptive statistics, in particular, analysis of absolute values, as well as comparative and time analysis to assess changes in the dynamics of the indicator. To identify trends, an approach was used to assess relative changes in the indicator over the period under study.

In addition, a regional analysis was carried out to determine regions with the highest and lowest values of the indicator. When interpreting the results, possible limitations were taken into account, in particular, the incompleteness of data registration in certain regions, as well as the influence of external factors, including changes in the availability of medical services in the period after 2022. Statistical data processing was carried out using standard approaches to the analysis of medical and statistical information without the use of complex mathematical models.

## Results of the study and discussion

In the course of the conducted analysis, a pronounced and stable tendency to decrease the number of HIV-positive children born to HIV-positive mothers and detected by the PCR method at the age of 2 months in Ukraine during the years from 2016 to 2024 was established (table). The total number of cases decreased from 57 in 2016 to 45 in 2017 (-21.1%), 38 in 2018 (-15.6%), 31 in 2019 (-18.4%), 24 in 2020 (-22.6%), and remained at 24 in 2021. A further decrease was recorded to 21 cases in 2022 (-12.5%), 18 in 2023 (-14.3%), and 6 in 2024 (-66.7% compared to the previous year). The total reduction for the studied period was 89.5%. The most intense decrease in

*Table*  
**The number of HIV-positive children born to HIV-positive mothers and detected by the PCR method at the age of 2 months in Ukraine and regions in 2016–2024**

<b>Ukraine</b>	57	45	38	31	24	24	21	18	6
<b>Chernihiv region</b>	0	1	1	2	0	0	0	0	0
<b>Chernivtsi region</b>	1	0	0	0	0	0	0	0	0
<b>Cherkasy region</b>	3	1	1	0	0	0	2	1	0
<b>Khmelnyskyi region</b>	0	0	1	0	0	0	0	0	0
<b>Kherson region</b>	5	0	1	2	2	2	1	0	0
<b>Kharkiv region</b>	1	1	2	1	0	2	0	2	2
<b>Ternopil region</b>	0	1	0	0	1	0	0	0	0
<b>Sumy region</b>	1	0	0	1	0	0	1	0	0
<b>Rivne region</b>	0	0	0	0	0	0	0	0	0
<b>Poltava region</b>	0	3	2	0	0	0	0	0	0
<b>Odesa region</b>	11	6	7	3	0	5	4	2	1
<b>Mykolayiv region</b>	4	4	2	3	0	1	1	0	0
<b>Kyiv</b>	6	1	0	2	4	2	2	2	0
<b>Lviv region</b>	2	2	0	1	1	1	0	2	0
<b>Luhansk region</b>	1	1	2	0	2	1	-	-	-
<b>Kirovohrad region</b>	1	2	1	1	3	1	0	2	1
<b>Kyiv region</b>	3	2	3	1	1	1	0	0	0
<b>Ivano–Frankivsk region</b>	0	0	0	0	2	0	0	1	0
<b>Zaporizhzhia region</b>	3	3	0	0	0	0	2	0	0
<b>Zakarpattia region</b>	0	0	0	0	0	0	0	0	0
<b>Zhytomyr region</b>	0	0	0	0	0	0	2	1	0
<b>Donetsk region</b>	3	3	4	3	1	1	1	0	0
<b>Dnipropetrovsk region</b>	9	11	1	10	5	6	5	4	2
<b>Volyn region</b>	2	0	0	0	0	1	0	0	0
<b>Vinnysia region</b>	1	3	0	1	2	0	0	1	0
<b>Years</b>	2016	2017	2018	2019	2020	2021	2022	2023	2024

the indicator was observed in 2016–2020, when the number of cases decreased by more than 2 times (from 57 to 24). In 2020–2021, a certain stabilization of the indicator was noted, which may indicate the achievement of a certain «plateau» of the effectiveness of preventive measures. At the same time, a sharp decrease in 2024 needs careful interpretation, as it may be related not only to a real improvement in the situation but also to the influence of external factors.

The regional analysis (Table) showed that in 2016, the largest contribution to the national indicator was made by Odesa region – 11 cases (19.3% of the total), Dnipropetrovsk region – 9 (15.8%) cases, Kyiv City – 6 (10.5%) cases, Mykolaiv region – 4 (7.0%) cases, and Donetsk region – 3 (5.3%) cases. In the following years, the tendency to concentrate cases in the specified regions remained, although the absolute values gradually decreased.

In 2017, the Dnipropetrovsk region reached the maximum value – 11 cases (24.4% of the all-Ukrainian indicator), while in the Odesa region, the number of cases decreased to 6%. In 2018, the overall decrease in the indicator was accompanied by a significant reduction in most regions, but the Donetsk region maintained a relatively high level (4% cases). In 2019, an increase was again noted in the Dnipropetrovsk region (10% cases), which accounted for almost a third (32.3%) of all cases in the country.

Starting from 2020, there is not only a decrease in the absolute number of cases, but also an equalization of the regional distribution of the indicator. In most regions, the number of HIV-positive children detected under the age of 2 months was 0–2 cases per year. In 2021, only a few regions (Dnipropetrovsk, Odesa, and Kharkiv regions) had indicators of more than 2 cases. In 2022–2023, a significant number of regions reported no cases, which may indicate a decrease in vertical transmission or insufficient testing coverage.

The situation in the eastern regions deserves special attention, where, after 2021, the data is incomplete (in particular, the Luhansk region), which limits the possibility of a full analysis. In addition, in 2022–2024, zero values of the indicator were recorded in many regions, which requires a critical assessment, taking into account possible undercounting.

In general, the obtained results demonstrate a significant decrease in the number of HIV-positive children detected at an early age, which may be related to the improvement of the effectiveness of PMTCT programs, the expansion of access to antiretroviral therapy among pregnant women, and the improvement of the organi-

zation of medical support. At the same time, for an objective assessment of effectiveness, an analysis of relative indicators is necessary, in particular, the frequency of vertical transmission among all examined children, as well as the level of coverage by PCR diagnostics.

The obtained results are consistent with the global trends in reducing the level of vertical transmission of HIV, provided effective implementation programs of PMTCT. According to a number of international studies, including, and the World Health Organization (WHO) reports, the timely appointment of antiretroviral therapy to pregnant women can reduce the risk of HIV transmission to less than 2%. Similar results are demonstrated by countries with a high level of coverage of PMTCT, where indicators of early infection of children are isolated [6].

As noted by a number of authors, including researchers in the field of public health and epidemiology of HIV infection, early diagnosis using PCR is critical for the timely detection of infected children and initiation of treatment. Some studies emphasize that a delay in diagnosis, even for a few months, can significantly worsen the prognosis for a child, while early detection significantly increases the effectiveness of antiretroviral therapy [7].

The data obtained in our study regarding the gradual decrease in the number of HIV-positive children in Ukraine in 2016–2024 indicate positive changes in the field of medical care for HIV-positive pregnant women. Similar trends are described in the scientific works of Ukrainian researchers, who note the expansion of access to testing, improvement of treatment adherence, and improvement of clinical protocols for pregnancy management in women with HIV [8]. At the same time, as some authors emphasize, the decrease in the absolute number of cases does not always directly reflect a real decrease in the level of vertical transmission, since this indicator depends on the coverage of the survey [9]. Our study used absolute values, which is a limitation because the lack of data on the total number of children examined does not allow us to calculate the frequency of transmission. This is consistent with the position of researchers who emphasize the need to use relative indicators for a more accurate assessment of the effectiveness of PMTCT [10].

The influence of external factors, in particular military operations, on the health care system of Ukraine requires special attention. As noted in modern publications, the war leads to disruption of access to medical services, population migration, and complication of the epidemiological surveillance system. This may explain

the sharp decline in rates between 2022 and 2024, which may in part be the result of underreporting of cases.

The obtained results are generally consistent with the literature data and indicate positive changes in the field of prevention of vertical transmission of HIV in Ukraine. At the same time, they emphasize the need for further research using complex indicators and taking into account the impact of socio-economic factors on the health care system [11].

### Conclusions

As a result of the conducted research, a pronounced trend towards a decrease in the number of HIV-positive children under the age of 2 months born to HIV-positive mothers in Ukraine in 2016–2024 was established. The total reduction of the indicator was 89.5%, which indicates a significant improvement in the epidemiological situation regarding the vertical transmission of HIV. The most intensive decrease was observed in 2016–2020, with subsequent stabilization and a decrease in the number of cases to single values in most regions.

It was found that at the initial stages of the studied period, the largest contribution to the national indicator was made by individual regions with a high prevalence of HIV infection, in particular, Dnipropetrovsk and Odesa regions, as well as the city of Kyiv. Later, there was an equalization of regional differences and a decrease in the number of cases in most regions to minimal values or their absence.

The obtained results may indicate an increase in the effectiveness of programs for the prevention of HIV transmission from mother to child, the expansion of access to antiretroviral therapy, and the improvement of the organization of medical support for pregnant women with HIV. At the same time, the sharp decrease in indicators in 2022–2024 requires careful interpretation in connection with the possible influence of military actions, which could lead to a decrease in survey coverage and incompleteness of statistical data. Further monitoring using relative indicators is necessary for an objective assessment of the effectiveness of PMTCT.

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