# Assessment of Healthcare Interventions for Preventing HIV Transmission in Children: A Study of Hemocontact and Perinatal Infections in Osh region

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## Abstract:

*Background:* HIV surveillance and monitoring are essential to identifying transmission trends and implementing effective prevention interventions. The study presents an epidemiological examination of hemocontact and perinatal HIV infection in children in the Osh area, with the objective of implementing effective preventative interventions to lower transmission rates.
*Methods:* A complete epidemiological examination was carried out utilizing laboratory, epidemiological, and statistical research techniques. Data were gathered and analyzed to evaluate the distribution and prevalence of HIV infection among children in several districts of the Osh area.
*Results:* 513 children tested positive for HIV, accounting for 15.8±0.6% of the overall HIV-infected population. The Nookat district had the largest percentage (37.2±2.4%), followed by Karasui (23.5±1%) and Chon-Alai (25.0±15.3%) ($p<0.05$). Karasui had the highest rate of pediatric HIV infection per 100,000 children (141.7±10.1), followed by Nookat (87.0±10.8), Alai (18.5±7.6), Aravan (19.7±6.3), Uzgen (10.2±2.7), Karakuld (20.0±7.6), Chon-Alai (15.9±11.2), and Osh city (67.2±7.2) ($p<0.05$). The highest frequency occurred between 2007 and 2012, coinciding with a nosocomial epidemic of hemocontact infection in hospital institutions and increased perinatal transmission. The most common mode of transmission was nosocomial hemocontact exposure (71.5±1.9%), followed by perinatal transmission (25.7±1.9%). Unidentified routes accounted for a tiny percentage.
*Conclusion:* Breach of sanitary, hygienic, and antiepidemic standards in medical facilities was the major cause of the hemocontact HIV outbreak among children. To reduce future pediatric HIV transmission in the region of Kyrgyzstan, infection control and prevention techniques must be strengthened.
**Keywords:** HIV Infection, Pediatric Epidemiology, Hemocontact Transmission, Perinatal Transmission, Kyrgyzstan

## 1. Introduction:

Though over decades HIV prevention and treatment have made great progress, the disease still poses a major worldwide health risk disproportionately impacting vulnerable populations including women and children under 14 years of age. With an estimated 1.5 million (range: 1.2–2.1 million) children aged 0–14 years, around 39 million individuals (range: 33.1–51.3 million) were living with HIV worldwide by the beginning of 2023, therefore accounting for 3.8% of all reported cases [1]. Remarkably, in Kyrgyzstan in 2022 over 130,000 children under the age of 15 caught HIV alone.Changing epidemiological picture of HIV is characterized by inadequate

infection control strategies and shifting transmission patterns. Especially in Russia and Central Asia, insufficient prevention measures have contributed to hemocontact transmission in healthcare settings. Concurrently, the rising frequency of sexual transmission and the increasing number of HIV-positive women of reproductive age have raised the risk of neonatal transmission, therefore hastening the HIV pandemic among the young population [2].

Regarding the frequency of HIV infection, the southern parts of the Kyrgyz Republic remain among the most severely impacted ones. Mostly via parenteral (hemocontact) exposure among children getting medical treatment in healthcare institutions within the Osh area, the changing dynamics of the HIV pandemic have helped to enable the establishment of nosocomial transmission clusters. Many agree that present approaches meant to stop the HIV pandemic are inadequate and poorly carried out, not fully addressing important demographic segments at increased risk for HIV transmission [3]. Minimal success in stopping the HIV epidemic's expansion in the area has come from this limited coverage and absence of a focused strategy. Nonetheless, one important area where significant public health benefits may be obtained by means of better preventative tactics and stronger infection control practices is the attempt to lower the prevalence of fresh HIV infections among the pediatric population [4].

Data from the Republican AIDS Center showed, as of January 1, 2024, 12,434 officially confirmed cases of HIV infection in Kyrgyzstan, or a prevalence rate of 177.1 per 100,000 people. Among these cases, 2.5% (305 cases) were attributed to perinatal transmission from mother to child; 3.4% ( 423 cases) included hemocontact transmission in medical facilities among children aged 0–14 years [5]. Addressing with this public health issue calls for the development of reasonable, region-specific preventative plans based on a comprehensive knowledge of the local epidemiological patterns and socio-economic factors affecting disease propagation [6]. Though the HIV pandemic in the area is severe enough scientific study on the epidemiological dynamics of pediatric HIV transmission remains inadequate in Kyrgyzstan. The lack of data emphasizes the need of focused research to evaluate the main channels of transmission and to find changeable risk factors among the young population [7]. Thus, the present study is to do a comprehensive epidemiological investigation of hemocontact and perinatal HIV transmission among children in the Osh area, thereby offering a scientific foundation for the implementation of enhanced preventative actions. More efficient therapies supported by greater awareness of the paths of transmission can help to lower new pediatric HIV diagnoses and consequently improve general public health results in the Kyrgyzstan.

## 2. Materials And Methods:

For Osh city and the Osh area, this retrospective study collected data from the official statistics reporting forms No. 4 "On the results of a blood test for HIV infection" and No. 4a "On registration of HIV infection". Data has also

been collected from records of HIV infection regions from the states of Kyrgyzstan, also epidemiological analyses as well as from records of HIV-infected children's dispensary monitoring.

The research focused mostly on the epidemiological trends, morbidity, rate, and risk factors associated with HIV infection. Along with laboratory diagnostics comprising enzyme immunoassay (EIA) and immunoblot tests, a thorough epidemiological study has been conducted using both retrospective and current data analytic approaches. A retrospective study was considered appropriate for examining infection trends throughout the 20-year period since the first cases of pediatric HIV infection in the Osh area were first recorded in 2003. Key variables evaluated were incidence rates of HIV infection among children under 15 years, long-term morbidity patterns, and child engagement in the epidemic process stratified by gender, age, residency, and infection risk factors. Epi-Info and Microsoft Excel programs were used in statistical analysis. Extensive and intense indicators were among the descriptive statistics calculated with mean values shown as M±m. The error-free prediction criteria (P-value) and the Student's t-test have considered to be evaluate the dependability of the outcomes.

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki [8]. This study was exempt from ethical approval due to its retrospective design. All patient data were anonymized to ensure confidentiality and privacy.

## 3. The Results And Discussions.

Regarding pediatric HIV cases, Osh region conditions have changed dramatically over time. Children's HIV infection was first recorded in 2003; since then, the number of new cases clearly has been rising. 553 HIV-infected children in all had been registered in the area at the conclusion of the research period. This produced a 90.1 ± 2.3 per 100,000 kid prevalence rate between 0 and 14 years old. With a significant prevalence rate of 202.3 ± 1.2 per 100,000 population, the total number of HIV-infected persons recorded in the Osh area by 2024 had reached 3,250 cases. This rate indicates a somewhat greater burden of HIV in the area than the national average of 177.1 ± 1.5 per 100,000 ($p < 0.05$), statistically substantially higher.

The rising number of pediatric HIV infections is alarming as it emphasizes how vulnerable children are in the area to HIV transmission. The pattern also shows the more general difficulties the Osh area has in terms of HIV diagnosis, prevention, and treatment. Although the total number of pediatric cases is still rather low in comparison to the general population, the higher prevalence rate in children indicates the need of more focused treatments, especially in healthcare environments where nosocomial (hospital-acquired) transmission remains a main issue.

When these cases were distributed throughout many Osh region districts, there were clear differences; certain places showed much higher rates of HIV infection in youngsters. This geographical variation suggests the potential of localized elements, including public health policies and healthcare infrastructure, which could be responsible for the noted variations in frequency **(Figure.1).**

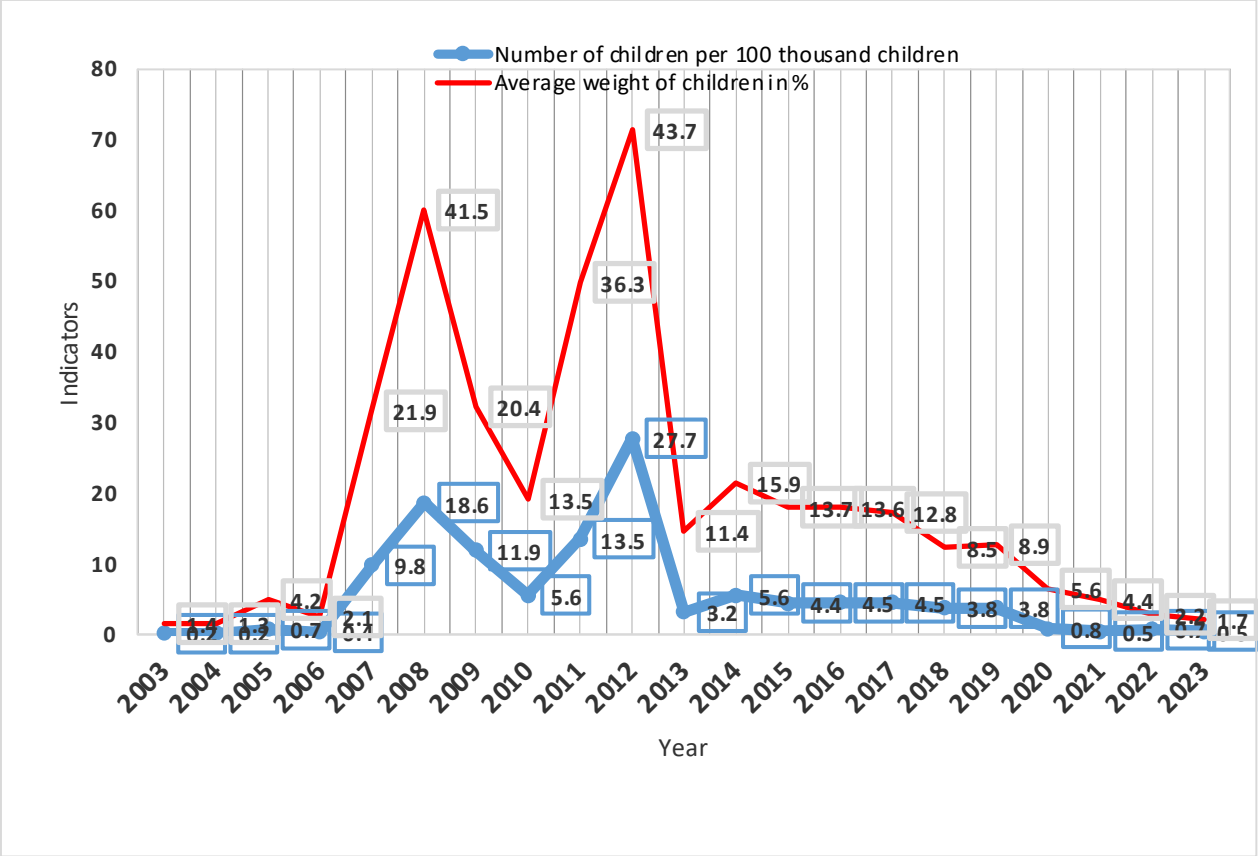


*Figure 1 – Long-term dynamics of the incidence of HIV infection among children per 100.0 children and the proportion of children in the total structure of HIV-infected people (in%) in the Osh region for the period 2003-2023.*

In 2003, the incidence rate per 100,000 children varied between 0.2 ±0.2 and 0.5 ±0.3, as shown in Figure 1. The highest frequency of HIV infection in children was found between 2007 and 2012, coinciding with an epidemic of hemocontact infection in medical facilities and increased perinatal HIV transmission from mother to child. The incidence rate per 100,000 children rose from 9.8 ± 1.5 in 2007 to 27.7 ± 2.5 in 2012 ($p < 0.05$). HIV infection has continued to be identified after that time, and it is linked to the 2008 epidemic. Since 2013, the incidence has stabilized at 3.8±0.42 in 2019, compared to 5.6±0.56 in 2014 and 4.5±0.56 in 2016. ($p<0.05$). The overall percentage of HIV-infected kids was 15.8±1.6. During the follow-up period, the percentage of children in the HIV-infected population fluctuated from 1.4±0.2% in 2003 to 1.79±06% in 2023, which is not statistically significant ($p>0.05$). The greatest rates of HIV infection among children were recorded in 2008 (41.5±1.6), 2011, (36.3±1.44),

and 2012 (43.7±1.9). Peak identification of HIV-infected children occurred in 2011-2012. It is connected with targeted ("continuous") HIV screening of certain populations (children under the age of 14 and pregnant women) as well as testing for epidemiological indicators. Currently, HIV infections among children are being reported in all districts of Osh (Figure 2).

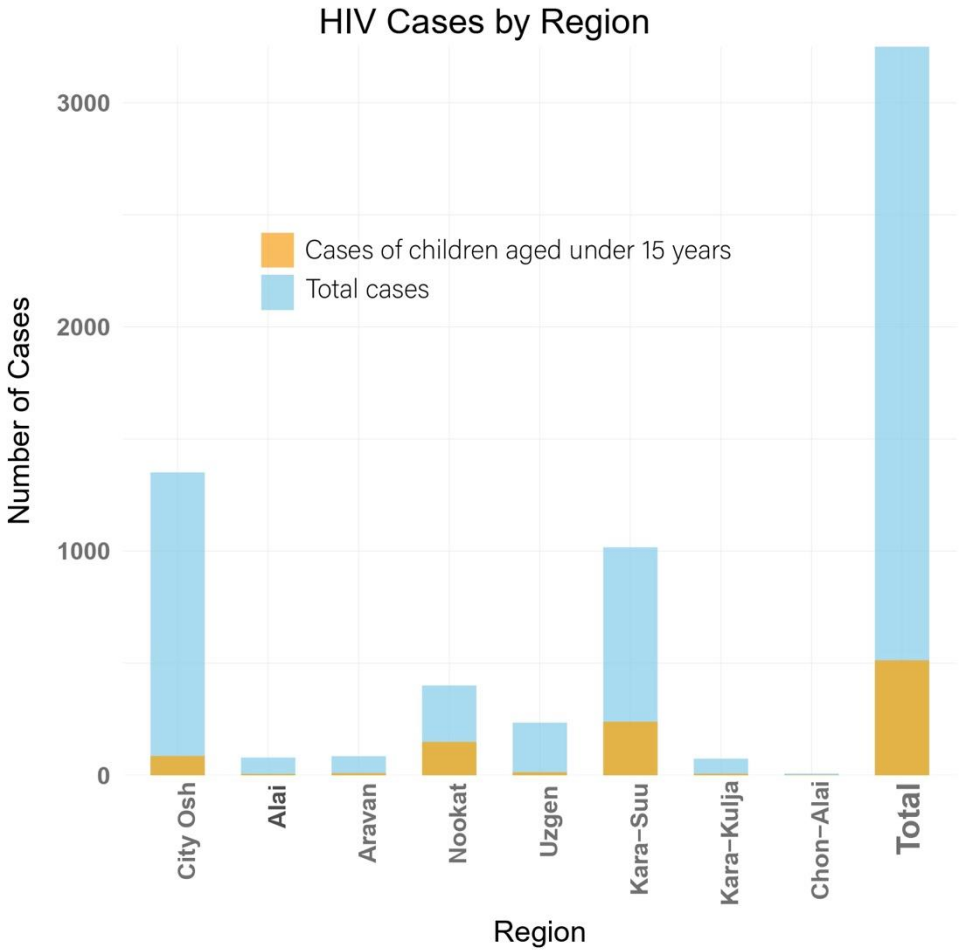


*Figure 2 - Information on the number of cases of HIV infection among the population and the proportion of children in the total structure of HIV-infected people in the regions of the Osh-nearby region as of 01.01.2024.*

In the Osh region's districts, 513 children tested positive for HIV, accounting for 15.8±0.6% of the overall HIV-infected population (Table 1). The indicator is substantially greater in Nookat (37.2±2.4%), Karasui (23.5±1%), and Chon-Alai (25.0±15.30%) districts ($p < 0.05$). The districts with the lowest proportions of HIV-infected children were Osh (6.4±0.6%), Alai (7.6±2.9%), Uzgen (5, ±1.59%), and Karakuld (9, ±3.45%), with an average

regional indicator of 15.8±0.6%. It should be mentioned that this indication was: in the world - about 3.8%, mostly owing to African nations; in Russia - 1.5% due to vertical infection of children from HIV(+) mothers; and in Kazakhstan -3% due to hemocontact and perinatal infection. The analysis demonstrates high reliability ($p<0.05$). Children in Karasui had a high prevalence of HIV infection (141.7±10.1), followed by Nookat (87.0±10.8), Alai (18.5±7.6), Aravan (19.7±6.3), and Uzgen (10.2±2.7) per 100,000 children. The majority of HIV-infected children were recorded in Karasui (46.6±2.2%), Nookat (29.1±1.8%), and Osh (16.8±1.7%) ($p<0.01$). Morbidity rate and proportion of children in HIV cases by region is illustrated in Figure 3.

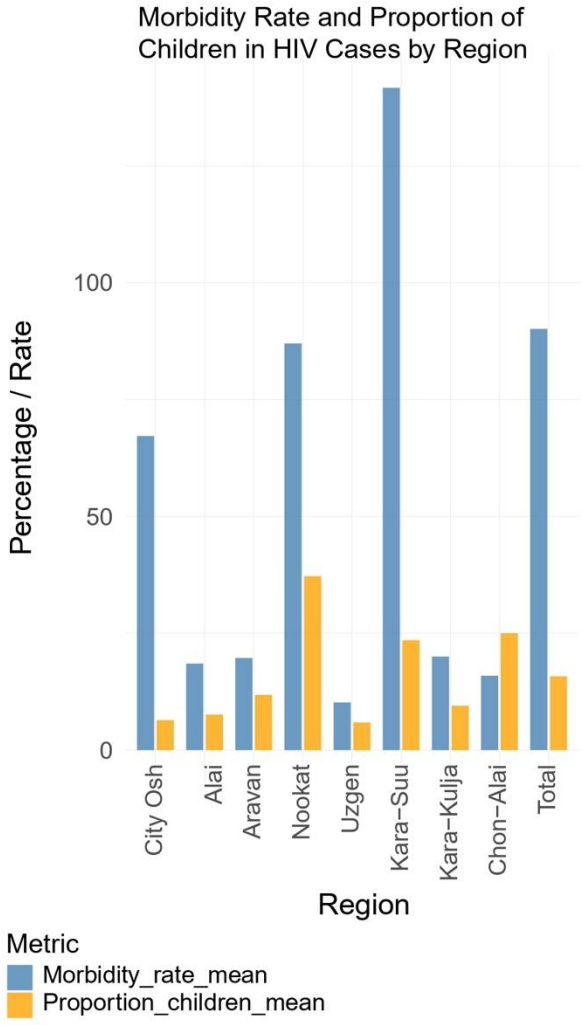


Figure 3: Morbidity rate per 100,000 children under 15 years of age, illustrating the incidence of health conditions within this population group of Osh and nearby region.

Our retrospective study revealed that HIV infection with prenatal infection was found in six children between 2001 and 2006 (three in Osh, three in Karasuysky, and one in Uzgen area). In 2007, two cases of HIV infection via hemocontact infection in children were reported for the first time, and both were hospitalized. Our epidemiological examination into these facts revealed the existence of nosocomial infection of HIV-positive youngsters in inpatient treatment facilities. In 2007-2012, as part of a focused epidemiological study of an in-hospital epidemic and aggressive HIV testing, 373 children were identified with HIV via the hemocontact route, the majority of whom lived in the Nookat, Karasui, and Osh regions. HIV infection was sporadic among tested children in the Alai, Aravan, Karakuldzhinsky, Uzgen, and Chon-Alai districts, with only 1-2 cases per year detected due to the vertical path of infection or children who visited nosocomial foci in regional medical institutions in the Osh region.

The incidence of infants infected with HIV before birth has increased since 2013. However, using antiretroviral medicines (ARVs) throughout pregnancy, labor, and the postpartum period has lowered the chance of HIV transmission to a child from 8% in 2013 to 2.5% in 2022. However, the issue persists: inadequate medical care for HIV-infected women, poor adherence to ARV medications, insufficient consultation coverage, and so on.

Our epidemiological studyof foci and analysis of available medical documentation in children and their mothers revealed that in the majority (71.5±1.89%) of HIV-infected children, nosocomial (hemacantact) infections in nosocomial foci were a risk factor for HIV infection, with the vertical path of infection from HIV-infected mothers in second place (25.7 ±1.96%). In 2.8±0.75% of patients (Table 1), the route of infection was not determined.

*Table 1 - The structure of the distribution of children with HIV infection by infection factors in the districts of the Osh region on 01.01.2024*

| No. | Districts | Total | Infection factors in percentage | | |
|---|---|---|---|---|---|
| | | | Hemocontact (nosocomial infection) pathway | The perinatal pathway | Unidentified pathway |
| 1 | Osh city | 86 | 50,6±2,2 | 46,9±2,2 | 2,5±0,69 |
| 2 | Alai region | 6 | 66,6±2,1 | 33,4±2,1 | - |
| 3 | Aravanski | 10 | 77,7±1,9 | 22,3±1,9 | - |
| 4 | Nookat region | 149 | 80,7±1,8 | 17,2±1,69 | 2,1±0,64 |
| 5 | Uzgen region | 14 | 64,3±2,15 | 34,7±2,1 | - |
| 6 | Karasu region | 239 | 73,5±3,9 | 23,1±1,9 | 3,4±0,8 |
| 7 | Kara-Kulja region | 7 | 83,3±1,7 | - | 16,7±1,7 |

| | | | | | |
|---|---|---|---|---|---|
| 8 | Chon-Alai region | 2 | 50,0±2,2 | 50,0±2,2 | - |
| | Total | 513 | 71,5±1,89 | 25,7±1,96 | 2,8±0,75 |

Table 2 shows that HIV-infected children in Karasui (73.5±3.9%), Nookat (80.7±1.8%), Uzgen (64.3±2.15%), Karakuld (83.3±1.7%), and Osh (50.6±2.2%) have a high proportion of nosocomial-hemocantact infection. This is due to the in-hospital outbreak of the HIV epidemic in children's hospitals in Osh, Karasu, and Nookat districts, where children from all districts of the region received treatment ($p<0.05$). The incidence of infants infected with HIV before birth has increased since 2013. HIV-positive mothers were responsible for infecting 25.7±1.96% of all HIV-infected children. Osh - 46.9±2.2%, Chon_alai - 50.0±2.2%, Alai -33.4±2.1%, and Uzgens -34.7±2.1% districts were higher than normal regional indicators of the parenteral route of infection in children ($p<0.05$). During the research period, males made up 61.4% of HIV-infected youngsters in the Osh area, with girls accounting for 38.6%. Epidemiological investigation of HIV-infected people's age distribution in dynamics from 2001 to 2023. The age groups with the largest percentage of infection are 0-3 years (40.9 ±2.1%) and 4-6 years (41.8 ±2.2%), which is statistically significant ($p<0.05$), followed by 7-10 years (14.0 ±1.5%) and 11-14 years (3.2 ±0.8%).

## 4. Challenges and Future Direction:

In Kyrgyzstan, where the HIV pandemic still affects underprivileged groups, the transmission of HIV among children via hemocontact pathways in healthcare environments presents a major problem. Our research draws attention to concerning patterns in hospital-related HIV transmission and clarifies various elements aggravating the situation. HIV has been transmitted among young patients mostly in response to the medical environment, poor infection control, and holes in healthcare infrastructure [7].

Direct interaction between children diagnosed with HIV and those hospitalized for other diseases in healthcare institutions is one of the main elements causing this transmission. If we addressed hygienic measures, disinfection, and sterilization of medical tools are not rigorously followed, these youngsters might easily become sick [9]. Furthermore adding to the danger is the hospital surroundings as the tight quarters, frequent invasive medical operations, and sometimes packed situations raise the possibility of transmission [9]. In clinical settings, non-compliance with infection control procedures include reusing medical tools and insufficient sterilization fosters an atmosphere fit for the HIV transmission [10]. Moreover, the circumstances has been exacerbated by area epidemiological elements like the high population HIV incidence combined with human elements including inadequate medical professional training [11]. Often, these elements result in delayed diagnosis, inadequate treatment, and lost chances for prevention.

Addressing to these difficulties, the government and other health groups have developed a series of thorough anti-epidemic and preventative strategies meant to localize the outbreaks and reduce further spread. These policies center on:

*4.1 Localization of HIV epidemics within healthcare facilities guarantees that affected people are quickly found and isolated to stop cross-infection* [12].

*4.2 Enhancing infection control policies at all levels of medical institutions with great focus on sterilization and appropriate disinfection methods* [13].

*4.3 Ensuring that health facilities have sufficient resources, including disposable medical instruments and personal protective equipment, helps to upgrade the infrastructure of healthcare thus reducing the incidence of nosocomial infections* [14].

*4.4 Training and capacity-building for medical staff guarantees they possess the required knowledge and abilities to follow strict infection control policies* [15].

*4.5 Offering families of HIV-infected children social assistance packages guarantees they get the psychological, physical, and financial help required* [16].

*4.6 Investigating scientifically and increasing monitoring to better grasp transmission trends and pinpoint appropriate treatments* [17] .

Implementation of these programs has been much aided by support from the Kyrgyz Republic's Ministry of Health, the Global Fund to Fight AIDS, Tuberculosis, and Malaria, local authorities, and others [18]. Still, there is an urgent need to keep up and increase these initiatives to really eliminate the problems caused by HIV transmission linked to hospitals. The knowledge gained from these initiatives will not only guide next policies but also provide insightful analysis for other areas with comparable issues as Kyrgyzstan develops. The road ahead calls for an ongoing, multifarious strategy combining local communities, healthcare institutions, and worldwide partners to build a safer and healthier future for everyone. In Kyrgyzstan, the battle against HIV is ultimately about guaranteeing the resilience of the healthcare system and safeguarding the most vulnerable elements of society, especially its children, not just about suppressing a virus.

## 5. Conclusions

Considering the outbreak of HIV in Kyrgyzstan, particularly in the Osh region, the epidemiological characteristics of HIV infection in children reveal significant novel insights on the public health issues confronting the whole country. With 15.8±0.6% of the region's overall HIV-infected population included in the research, 513 instances of

HIV infection in children were found With statistically significant differences shown (p=0.05), the frequency was considerably greater in the districts of Nookat (37.2±2.4%), Karasui (23.5±1%), and Chon-Alai (25.0±15.3%). With Karasui at 141.7±10.1 and Nookat at 87.0±10.8, further study found Karasui and Nookat had the highest rates of HIV infection in children. Driven mostly by an epidemic of hemocontact infections in medical facilities and an increase in perinatal transmission, the peak of HIV prevalence in children was between 2007 and 2012. With 71.5±1.9% of cases attributed to nosocomial (hemocontact) infections, perinatal transmission at 25.7±1.9% second most important risk factor. Two-8.8±0.8% of the cases had an unknown transmission path. Inadequate medical supplies, like the absence of disposable tools and the reuse of medical equipment, as well as breaches in sanitary, hygienic, and antiepidemic measures, were contributing elements to the outbreak of hemocontact HIV infections. These results underline the urgent necessity of better infection control strategies in Kyrgyzstan, especially in medical environments, to stop the HIV epidemic and protect the health of underprivileged children.

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**Ethical statement**: This study was performed in line with the principles of the Declaration of Helsinki.

**Consent statement:** Due to the retrospective nature of the study, informed consent was waived

**Data availability statement**: Data will be made available on request.

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**Declaration of competing interest:** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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