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Postpandemic Trends and Missed Opportunities in Prevention and Diagnosis of Pediatric HIV

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Background: Progress against HIV in the US slowed during the COVID-19 pandemic. Associated impacts for pediatric HIV may be substantial amid pandemic-related exacerbations of health inequities. We assessed pre-/post-pandemic trends in pediatric HIV diagnoses and characterized gaps in prevention or diagnosis.

Methods: We performed a retrospective cohort study of children and adolescents with HIV (CAHIV) <18 years of age, treated at Indiana University Health facilities from January 2009 to December 2023. Demographic data, acquisition route, risk factor(s) and diagnosis year were abstracted, and compared pre-/post-2020. To assess trends, an interrupted time series analysis was conducted using an autoregressive integrated moving average model. Postpandemic missed opportunities for prevention or diagnosis were categorized.

Results: Among 126 CAHIV, with perinatal (73%) or nonperinatal (27%) HIV, 104 were diagnosed pre-2020 and 22 were diagnosed 2020 onwards. HIV diagnosis post-2020 was associated with nonperinatal acquisition ($P < 0.001$), older age ($P = 0.004$), US birth ($P = 0.002$) and US diagnosis ($P < 0.001$). Nonperinatal diagnoses in 2022 (n = 6) and 2023 (n = 5) were significantly higher than 1.6/year prepandemic (95% prediction interval 0–3.6). Among 8 CAHIV with perinatal HIV diagnosed post-2020—4 US-born—missed opportunities occurred across the mother-infant/pediatric care cascades. Among 14 CAHIV with nonperinatal HIV diagnosed post-2020, there were missed opportunities for preexposure prophylaxis (79%) and for HIV testing (65%) despite documented risk factors and indications.

Conclusions and Relevance: Nonperinatal HIV diagnoses increased post-2020, with gaps in adolescent prevention and diagnosis. Perinatal diagnoses in US-born infants signal critical gaps in perinatal prevention. Dedicated efforts are needed to prevent new pediatric HIV in the US.

Key Words: HIV, adolescents, care cascade, case detection, prevention

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Pediatric HIV has declined in the US over recent decades.[1] This decline has occurred alongside landmark achievements in HIV treatment, treatment as prevention, care of pregnant individuals with HIV and interventions for infants with perinatal HIV exposure. Further, major innovations for preexposure prophylaxis (PrEP), including long-acting injectable PrEP, have been approved for adolescents, and efforts to increase PrEP access in this group have expanded.[2] At the same time, pediatric HIV epidemiology in the US is marked by health inequities that drive HIV risk.[3] In this context, the COVID-19 pandemic may have exacerbated disparities in pediatric HIV; yet pandemic-related impacts are not fully known. It is critical to understand postpandemic trends in pediatric HIV, particularly in the context of health disparities affecting HIV care access.

The COVID-19 pandemic brought substantial disruptions to public health and HIV services. In 2020, HIV testing and new diagnoses decreased,[4,5] as did PrEP prescriptions to youth 15–24 years old.[6] Modeling suggests that declines in PrEP utilization were greatest for younger persons.[7] Further, COVID-19 had wide-ranging impacts on maternal and infant health, including decreases in postpartum care utilization,[8] worsened maternal and infant health outcomes,[9,10] and maternal income/job loss and food insecurity.[11]

Pandemic-related impacts on pediatric HIV diagnoses are less well known and may include exacerbation of existing gaps in the perinatal and adolescent HIV prevention, diagnosis and care cascades. Prevention of perinatal HIV rests on timely HIV testing and antiretroviral therapy (ART) for the birthing parent, adherence to ART, and sustained viral suppression, ideally prepregnancy. The infant requires close management for antiretroviral prophylaxis, mitigation of risk factors, for example, related to the potential for breastfeeding transmission, and repeated infant testing.[12] Engagement in these complex care cascades is undermined by structural barriers to care. Outside of the perinatal period, 19% of new HIV diagnoses in the US are among adolescents and young adults (ages 13–24).[13] This age group, however, is particularly impacted by low provider adherence to CDC guidelines for routine HIV testing[14] and PrEP underutilization.[15]

Indiana presents an important context for understanding trends in pediatric HIV. Incident HIV infections have increased in Indiana over recent years.[16] Trends in pediatric HIV are less

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K.P.-S., H.X. and L.A.E. had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. K.P.-S., A.K. and L.A.E. designed this study and developed the study protocol. K.P.-S. and L.A.E. led the development and refinement of the data collection instrument. B.B., B.W. and A.K. contributed to revisions to the instrument. K.P.-S. and M.W. independently reviewed electronic medical records for inclusion; L.A.E. reviewed decisions regarding inclusion. K.P.-S. and M.W. abstracted deidentified data for included participants. K.P.-S. and L.A.E. reviewed charts in-depth to characterize clinical presentations and missed opportunities for testing or prevention. K.P.-S. and L.A.E. led the analysis. H.X. provided statistical expertise and conducted the chi-square and ARIMA model analyses. All authors participated in the interpretation of the findings. K.P.-S. and L.A.E. drafted the manuscript. All authors participated in manuscript revisions. All authors have read and approved the final manuscript.

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discernible, with limited publicly available data on incident pediatric diagnoses over time. In 2022, the incidence of HIV among 13–24-year-olds in Indiana was 11.2 per 100,000—higher than most states in the region.[17] By comparison with other US states, Indiana experiences wider health disparities by race;[18] poorer maternal and infant health outcomes;[19,20] and underfunded public health services.[21] Health disparities in Indiana worsened during the pandemic, including worse COVID-19 outcomes among Black residents;[22–25] and major socioeconomic shocks affecting vulnerable populations.[26] The Indiana University Health (IUH) system is the largest healthcare provider in Indiana, and Riley Hospital for Children at IUH is the primary pediatric HIV treatment site for children and adolescents with HIV (CAHIV) in the state. We sought to assess trends in pediatric HIV diagnoses at IUH pre-/post-pandemic and to characterize recent missed opportunities for prevention or diagnosis.

METHODS

We conducted a retrospective cohort study of CAHIV treated at Riley Hospital for Children and all other IUH facilities. The IUH system provides pediatric HIV treatment for most CAHIV in Indiana, with a catchment area that spans the entire rural state. Riley Hospital is located in Indianapolis, Marion County, which has the highest HIV prevalence in the state and is prioritized as an End the Epidemic jurisdiction. We performed a search of the IUH electronic medical record (EMR) system, to construct a screening dataset of patients <18 years of age, with health visit(s) from January 2009 to December 2023, and with International Classification of Diseases (ICD)-9 or ICD-10 codes for HIV diagnosis. Specifically, ICD-9 codes 042, V08, 795.71 and 079.53, and ICD-10 codes B20-B24, R75 and Z21, were used. Medical records in this dataset were reviewed to screen eligibility for inclusion. Individuals in this dataset were included in the cohort if they had 2 molecular tests positive for HIV or if they were documented as having an HIV diagnosis by an infectious disease specialist. They were excluded if they did not meet either of those criteria. Two study team members independently reviewed medical records in the screening dataset to make determinations regarding study inclusion (K.P.-S. and M.W.), with screening decisions reviewed by a pediatric HIV specialist (L.A.E.).

For included CAHIV, medical records were reviewed in-depth by 2 clinicians (K.P.-S. and L.A.E.). Basic, deidentified clinical and demographic characteristics, including age stratum, race, ethnicity, biological sex, risk factor(s), year of HIV diagnosis, whether diagnosed in the US or abroad, and year of entry into care was abstracted. Presumed acquisition route was established from available documentation; when not clearly documented, this was categorized through review and discussion by the investigators. For example, for an adopted child whose biological parent(s) had died, in the absence of known maternal HIV history, having a clinical presentation most consistent with perinatal HIV was categorized as having presumed perinatal HIV.

We described cohort characteristics using summary statistics with stratification by acquisition route. We compared basic demographic and clinical characteristics among those diagnosed with HIV in 2019 or earlier, or during 2020 and later, using chi-square or Fisher exact test. Comparisons were performed both for the total cohort and within strata separated by route of HIV acquisition. To assess trends in nonperinatal HIV diagnoses before and after 2020, we conducted an interrupted time series analysis using an autoregressive integrated moving average (ARIMA) model. Trends were compared for HIV diagnosis during the prepandemic years 2009–2019 in comparison with postpandemic years 2020–2023. Prepandemic observations were used to estimate the ARIMA model, with the best-fitting model selected using the Hyndman-Khandakar algorithm. The final ARIMA model was then used to forecast the postpandemic trend. Trend difference in pre- and post-pandemic periods was inferred if the actual postpandemic diagnoses diverge from the forecasts.

Among CAHIV diagnosed from 2020 onwards, we assessed clinical presentation and missed opportunities for HIV prevention or earlier diagnosis. For CAHIV who previously resided outside the US, missed opportunities were assessed for the period since arrival in the US. Medical encounters were reviewed for the 2 years before HIV diagnosis. Two clinicians (K.P.-S. and L.A.E.) independently performed an in-depth review of available documentation and used a structured form to characterize the individual's clinical presentation (eg, hospitalization, CDC HIV infection stage)[27] and to systematically apply categories for missed opportunities related to perinatal or nonperinatal HIV prevention or timely diagnosis. These included gaps in each stage of the prevention and treatment cascades and missed opportunities for testing in previous encounters. Missed opportunities for testing in previous encounters incorporated CDC HIV testing recommendations, including indications based on age; risk factors for HIV acquisition (eg, sexual activity, sexual risk factors and injection drug use); and previous residence in a high-HIV prevalence setting.[28] They discussed each case and agreed on final determinations for areas of missed opportunities.

The study protocol was determined to be exempt by the Institutional Review Board at Indiana University (#19726). Participants were not approached for consent given the retrospective nature of the study and the use of fully deidentified data.

RESULTS

Characteristics of Children and Adolescents With HIV

On the construction of an EMR dataset, 263 individual records were screened for eligibility, and 126 CAHIV were included in the retrospective cohort (Table 1). Of these, 92 (73%) had perinatal and 34 (27%) had nonperinatal HIV acquisition. Among those with perinatal HIV, 34% were diagnosed in infancy, 43% were diagnosed after infancy and 23% had unknown age at diagnosis. Among those with nonperinatal HIV, 9% were diagnosed in early adolescence (age 10–14) and 91% were diagnosed later in adolescence (age 15–17). Biological males made up 49% of those with perinatal HIV and 74% of those with nonperinatal HIV. Among all CAHIV, race was Black or African American (67%), Asian (10%), or white (17%); and ethnicity was Hispanic for 9%. US-born children made up 25% of those with perinatal HIV and 91% of those with nonperinatal HIV. Among children with perinatal HIV who were born outside of the US, 64% were international adoptees, 23% were refugees and 13% immigrated without refugee status. Thirty-two percent of children with perinatal HIV were diagnosed in the US, while 97% of those with nonperinatal HIV were diagnosed in the US. Among adolescents with nonperinatal HIV, sexual or gender minority status was documented for 50%, heterosexual sexual activity in 35%, sexual abuse in 18% and intravenous drug use in 3%.

Trends in Pediatric HIV Diagnoses

Among all CAHIV, 104 were diagnosed before 2020 and 22 were diagnosed from 2020 onwards (Fig. 1). Twenty CAHIV with perinatal acquisition did not have documented year of diagnosis; all entered HIV treatment at IUH from 2010 to 2018 and were therefore included in the prepandemic group for comparison of characteristics. Pediatric HIV diagnosis postpandemic was associated with nonperinatal HIV acquisition ($P < 0.001$),

TABLE 1. Demographic Characteristics of Children and Adolescents With HIV Included in this Retrospective Cohort Study, With Stratification by Presumed Route of HIV Acquisition

	All N = 126 n (%)	Perinatal HIV N = 92 n (%)	Nonperinatal HIV N = 34 n (%)
Age at HIV diagnosis			
<30 days	12 (9.5)	12 (13.0)	0
30 days to <1 year	19 (15.1)	19 (20.6)	0
1 to 4 years	23 (18.3)	23 (25.0)	0
5 to 9 years	11 (8.7)	11 (12.0)	0
10 to 14 years	9 (7.1)	6 (6.5)	3 (8.8)
15 to 17 years	31 (24.6)	0	31 (91.2)
Not documented	21 (16.7)	21 (22.8)	0
Biological sex*			
Female	56 (44.4)	47 (51.1)	9 (26.5)
Male	70 (55.6)	45 (48.9)	25 (73.5)
Race*			
White	22 (17.5)	18 (19.6)	4 (11.8)
Black or African American	85 (67.5)	56 (60.9)	29 (85.3)
Asian	13 (10.3)	13 (14.1)	0
Other	1 (0.8)	1 (1.1)	0
Not documented	5 (4.0)	4 (4.4)	1 (2.9)
Ethnicity*			
Hispanic	11 (8.7)	7 (7.6)	4 (11.8)
Non-Hispanic	107 (84.9)	78 (85.9)	28 (82.3)
Not documented	8 (6.3)	6 (6.5)	2 (5.9)
Birthplace			
Non-US	72 (57.1)	69 (75.0)	3 (8.8)
US	54 (42.9)	23 (25.0)	31 (91.2)
Among non-US-born (n = 72)			
Refugee	17 (23.6)	16 (23.2)	1 (33.3)
International adoptee	44 (62.0)	44 (64.7)	0
Place of HIV diagnosis			
Non-US	64 (50.8)	63 (68.5)	1 (2.9)
US	62 (49.2)	29 (31.5)	33 (97.1)
Factors related to HIV acquisition	—	—	
Heterosexual sex			12 (35.3)
Sexual or gender minority status			17 (50.0)
Intravenous drug use			1 (2.9)
Tattoos			2 (5.9)
Sexual abuse			6 (17.6)
Other			1 (2.9)
Not documented or unknown			1 (2.9)

*Biological sex, race and ethnicity are as assigned/documented in EMR.

older age ($P = 0.004$), US birth ($P = 0.002$) and HIV diagnosis in the US ($P < 0.001$). Among CAHIV with perinatal HIV, diagnosis postpandemic was associated with HIV diagnosis in the US ($P = 0.001$). Further, the proportion of US-born infants was higher postpandemic, though not statistically significant (50% vs. 22.6%, $P = 0.1$). Among CAHIV with nonperinatal HIV acquisition, demographic characteristics and risk factors were similar pre- and post-pandemic (Table 2). Aside from 1 adolescent diagnosed on arrival to the US in another state, all other CAHIV diagnosed ≥2020 with nonperinatal acquisition were diagnosed in Indiana.

According to the ARIMA model for CAHIV with nonperinatal HIV acquisition, diagnoses in 2022 (n = 6) and 2023 (n = 5) were significantly higher than the forecasted annual average 1.6/year based on prepandemic HIV diagnoses (95% prediction interval 0–3.6). ARIMA modeling of overall trends in pediatric HIV and in perinatal acquisition is not presented given that 20 CAHIV with perinatal HIV in the prepandemic period did not have a year of diagnosis, which may affect the estimation of annual trends.

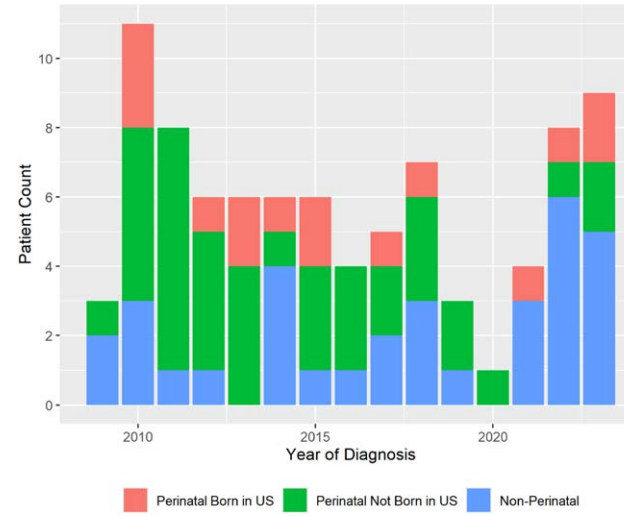

FIGURE 1. Pediatric HIV diagnoses by year for this retrospective cohort of children and adolescents with HIV. Children and adolescents with HIV in this retrospective cohort are presented, by year of HIV diagnosis, limited to those diagnosed 2009 onwards.

Pediatric HIV Clinical Presentations in the Postpandemic Period

For the 8 children with perinatal HIV diagnosed in 2020 or later, laboratory values at diagnosis included a median CD4 count of 1182 cells/mm^3 (range 65–3323 cells/mm^3); median CD4 percentage of 27% (range 4%–64%); and median viral load 53,900 copies/ml (range 1830–2,400,000 copies/mL). Applying CDC criteria, the HIV Infection Stage was classified as stage 1 (n = 3) or stage 3 (n = 4; most advanced).[27] One child was adopted from outside the US and CD4 testing and findings at initial diagnosis were unknown. HIV-associated signs and conditions included lymphadenopathy (n = 2), splenomegaly (n = 1), hepatomegaly (n = 1), wasting (n = 2), cytopenias (n = 2), zoster (n = 1), pulmonary TB (n = 1) and TB uveitis (n = 1).

For the 14 adolescents with nonperinatal HIV diagnosed in 2020 or later, laboratory values at diagnosis included a median CD4 count 534 cells/mm^3 (range 54–1364 cells/mm^3); median CD4 percentage 26% (range 11%–49%); and median viral load 43,200 copies/mL (range 1260–over 10,000,000 copies/mL). HIV infection stage was classified as stage 1 (n = 8), stage 2 (n = 3); or stage 3 (n = 3).[27] Among those with symptoms, these included lymphadenopathy (n = 4), cytopenias (n = 1), chronic diarrhea (n = 1), recurrent parotitis (n = 1), chronic HSV ulcer (n = 1) and *Pneumocystis* pneumonia (n = 1). Three adolescents had presentations consistent with acute HIV.

Missed Opportunities for Pediatric HIV Prevention or Earlier Diagnosis in the Postpandemic Period

Among the 8 children with perinatal HIV diagnosed in 2020 or later, 50% were US-born. Missed opportunities for perinatal HIV prevention and infant HIV testing occurred across the mother and infant care cascades (Table 3). Among the 4 US-born infants, factors driving transmission included delayed maternal ART initiation (n = 1), lack of maternal viral suppression despite ART (n = 2), inadequate infant ARV regimen (n = 1) and incomplete adherence to infant ARVs (n = 1). One infant did not have early infant HIV testing per HHS guidelines despite known perinatal exposure and

TABLE 2. Comparison of Characteristics of Children and Adolescents With HIV by Year of HIV Diagnosis in the Pre- or Post-pandemic Periods

	All CAHIV			Perinatal			Nonperinatal		
	Year of Diagnosis			Year of Diagnosis			Year of Diagnosis		
Characteristics, n (%)	<2020 (N = 104)	≥2020 (N = 22)	*P*-value*	<2020 (N = 84)	≥2020 (N = 8)	*P*-value*	<2020 (N = 20)	≥2020 (N = 14)	*P*-value*
Age at HIV diagnosis			0.004			0.41			0.56
<30 days	11 (10.6)	1 (4.5)		11 (13.1)	1 (12.5)		0	0	
30 days to <1 year	16 (15.4)	3 (13.6)		16 (19.1)	3 (37.5)		0	0	
1 to 4 years	21 (20.2)	2 (9.1)		21 (25.0)	2 (25.0)		0	0	
5 to 9 years	10 (9.6)	1 (4.5)		10 (11.9)	1 (12.5)		0	0	
10 to 14 years	6 (5.8)	3 (13.6)		5 (5.9)	1 (12.5)		1 (5.0)	2 (14.3)	
15 to 17 years	19 (18.3)	12 (54.5)		0	0		19 (95.0)	12 (85.7)	
Not documented	21 (20.2)	0		21 (25.0)	0		0	0	
Biological sex†			0.4			1			1
Female	48 (46.2)	8 (36.4)		43 (51.2)	4 (50.0)		5 (25.0)	4 (28.6)	
Male	56 (53.8)	14 (63.6)		41 (48.8)	4 (50.0)		15 (75.0)	10 (71.4)	
Race†			0.16			0.13			1
White	20 (19.2)	2 (9.1)		18 (21.4)	0		2 (10.0)	2 (14.3)	
Black/African American	67 (64.4)	18 (81.8)		50 (59.5)	6 (75.0)		17 (85.0)	12 (85.7)	
Asian	12 (11.5)	1 (4.5)		12 (14.3)	1 (12.5)		0	0	
Other	0	1 (4.5)		0	1 (12.5)		0	0	
Not documented	5 (4.8)	0		4 (4.8)	0		1 (5.0)	0	
Ethnicity†			0.37			0.72			0.64
Hispanic	8 (7.7)	3 (13.6)		6 (7.1)	1 (12.5)		2 (10.0)	2 (14.3)	
Non-Hispanic	88 (84.6)	19 (86.4)		72 (85.7)	7 (87.5)		16 (80.0)	12 (85.7)	
Not documented	8 (7.7)	0		6 (7.1)	0		2 (10.0)	0	
Birthplace			0.002			0.10			0.56
Non-US	66 (63.5)	6 (27.3)		65 (77.4)	4 (50.0)		1 (5.0)	2 (14.3)	
US	38 (36.5)	16 (72.7)		19 (22.6)	4 (50.0)		19 (95.0)	12 (85.7)	
Among non-US-born (n = 72)									
Refugee	16 (24.2)	1 (16.7)	0.57	15 (23.1)	1 (25.0)	0.3	1 (100)	0	0.33
International adoptee	43 (65.2)	1 (16.7)	0.055	43 (66.2)	1 (25.0)	0.12	0	0	
Place of HIV diagnosis			<0.001			0.001			1
Non-US	63 (60.6)	1 (4.5)		62 (73.8)	1 (12.5)		1 (5.0)	0	
US	41 (39.4)	21 (95.5)		22 (26.2)	7 (87.5)		19 (95.0)	14 (100)	
Route of HIV acquisition			<0.001						
Perinatal	84 (80.8)	8 (36.4)		–	–		–	–	
Nonperinatal	20 (19.2)	14 (63.6)		–	–		–	–	
Factor(s) associated with nonperinatal HIV									
Heterosexual sex	–	–		–	–		8 (40.0)	4 (28.6)	0.72
Sexual/gender minority	–	–		–	–		9 (45.0)	8 (57.1)	0.73
IV drug use	–	–		–	–		0	1 (7.1)	0.41
Tattoos	–	–		–	–		1 (5.0)	1 (7.1)	1
Sexual abuse	–	–		–	–		2 (10.0)	4 (28.6)	0.2
Other	–	–		–	–		0	1 (7.1)	0.41

*P-values are calculated based on Pearson's χ^2 test or Fisher exact test.
†Biological sex, race and ethnicity are as assigned in EMR.

symptoms potentially related to HIV. One infant had maternal HIV acquisition during breastfeeding. Among the 4 CAHIV with perinatal acquisition born outside the US, one was diagnosed in their country of origin, one was diagnosed on initial health screening in the US, and 2 were diagnosed after hospitalization with HIV-associated conditions.

Among the 14 adolescents with nonperinatal HIV diagnosed in 2020 or later, 11 (79%) had documented risk factors at medical encounters before diagnosis (eg, unprotected sex), but were not on PrEP.[29] Nine (65%) had medical encounters with no HIV tests sent before diagnosis. Among these, indications for HIV testing at prior encounters based on available documentation included age 13 or older (78%), symptoms potentially related to HIV (44%) and apparent risk factors for HIV (89%).[28] While 4 adolescents had a documented history of sexual abuse and one of IV drug use, none had a documented medical encounter within the time window for the provision of postexposure prophylaxis.

DISCUSSION

This study elucidated trends and missed opportunities for pediatric HIV prevention and diagnosis before and after the onset of the COVID-19 pandemic in our health system in Indiana. We found rising nonperinatal HIV infections since 2020, and ongoing perinatal HIV transmission to infants, including in US-born infants. New pediatric HIV diagnoses signal gaps in epidemic control affecting this vulnerable age group. Missed opportunities described in this study point to ongoing gaps in prevention and diagnosis of pediatric HIV that should inform public health, health system and provider-level efforts. Findings highlight the importance of attention to regional trends that may differ from national ones. Critically, they provide data that while incredible progress has been made in the HIV epidemic, incident pediatric HIV infections remain an important challenge in vulnerable populations. Vigilance and redoubled efforts are needed to avoid a resurgence of pediatric HIV in communities across the US.

TABLE 3. Missed Opportunities for HIV Prevention or Earlier HIV Diagnosis Among Children and Adolescents Diagnosed With HIV From 2020 Onwards, by Presumed Route of HIV Acquisition*

Perinatal HIV acquisition, N = 8	n (%)†
Born in the US	n = 4
No HIV testing before pregnancy	2 (50)
Transmission during breastfeeding	1 (25)
Pregnant or breastfeeding mother with documented HIV risk factors not on PrEP	1 (25)
Mother diagnosed with HIV, but not on ART or delayed in ART initiation during pregnancy	1 (25)
Mother on ART, but not virally suppressed during pregnancy	2 (50)
Exposed infant not tested per DHHS schedule	1 (25)
Exposed infant not prescribed indicated ARVs	1 (25)
Incomplete adherence to infant ARVs	1 (25)
Born outside the US	n = 4
Not tested before hospitalization with HIV-associated condition	2 (50)
Nonperinatal HIV acquisition, N = 14	**n (%)**
Risk factors present not on PrEP	11 (78.5)
Prior medical encounter(s) with no HIV test sent	9 (64.2)
Indication for HIV testing applicable during previous encounter(s):	
Routine screening based on age	7
Symptoms potentially related to HIV	4
Risk factors for HIV	8
No apparent medical encounter in 2 years before HIV diagnosis	1 (7.1)

*For individuals who previously resided outside the US, missed opportunities for testing and earlier diagnosis are for the period since arrival in the US.

†Individual children may have multiple missed opportunities for HIV prevention or earlier diagnosis.

The widespread and unprecedented healthcare, public health and social crises brought about by the COVID-19 pandemic exacerbated health inequities across states, with disproportionate impacts on Black communities and other communities of color, as well as on rural populations.[23,25,26] This study examined trends in pediatric HIV in Indiana before and after 2020—when the pandemic took hold and societal disruptions were greatest. Rising pediatric HIV diagnoses observed in this study in the postpandemic period, driven by nonperinatal acquisition, may relate to exacerbated gaps in the HIV prevention and care cascades, in the setting of already-strained public health and health systems and preexisting barriers to care.

The increase in nonperinatal HIV diagnoses observed in this cohort contrasts with overall national trends, which saw a 30% decrease in HIV incidence among 13–24-year-olds from 2018 to 2022.[3] This contrast may relate to regional differences; Indiana has had increasing incident HIV diagnoses over the past decade.[16] We did not observe a systematic practice change or trend in referrals during this period that would otherwise account for increasing adolescent HIV diagnoses in the IUH system. Given that IUH has a statewide catchment area and serves the majority of CAHIV in the state, it is most likely that the trends identified in this study reflect increasing adolescent HIV infections in our setting. Indeed, the increasing nonperinatal HIV diagnoses ascertained in this study are almost assuredly an undercount of HIV infections in adolescents, given pervasive barriers to HIV testing in this age group that may preclude timely diagnosis.[14,30–32] The pandemic may have had a disproportionate impact on vulnerable adolescents in our setting, given limitations in adolescent access to HIV testing and prevention. Pandemic-related disruptions have been observed for adolescent access to sexual and reproductive healthcare, including HIV testing, with exacerbated barriers to testing in those younger than 18 years and in Black adolescents.[33]

We identified significant missed opportunities for HIV testing and PrEP for adolescents before their HIV diagnosis, which should inform dedicated efforts. While adolescents make up a significant proportion of new HIV diagnoses, PrEP is underutilized.[34–37] Barriers to PrEP use in this group include lack of awareness among adolescents, lack of provider awareness or knowledge about PrEP for adolescents, ambiguous or conflicting confidentiality and consent laws, effective disclosure to parents in insurance statements, and cost.[35,36] Although the CDC and USPSTF recommend routine HIV testing of persons 13–64 years old,[28] most clinicians do not routinely offer HIV testing to adolescents.[37] While there are drop-in STI testing centers in Indiana, and PrEP costs can be covered through insurance or financial assistance, adolescents face unique barriers to accessing these services. The findings in this study are consistent with others that found missed opportunities for HIV testing in previous medical encounters for adolescents who were subsequently diagnosed with HIV.[30,31,38] Our study highlights a persistent gap in HIV testing and PrEP, which represent key targets to combat increasing HIV diagnoses in adolescents in the postpandemic era.

This study additionally found ongoing perinatal HIV diagnoses in our setting, including in US-born infants. In 2019, the US CDC goals for perinatal HIV elimination were met with a national incidence of 0.9 cases per 100,000 live births and a transmission rate of 0.9%.[1] Few data are currently available regarding postpandemic trends in perinatal HIV in the US. A recent case series described an increase in perinatal HIV infections in Maryland in 2022.[39] Both our study and this case series found missed opportunities for perinatal HIV prevention and diagnosis across the maternal and infant care cascades.[39] Risk factors for perinatal transmission include acute maternal HIV, limited prenatal care, lack of third-trimester HIV testing, and elevated maternal HIV viral load.[40–42] For pregnant individuals who test negative for HIV at initial prenatal screening, ongoing risk of infection during pregnancy and breastfeeding may be underappreciated, and PrEP remains underutilized.[43] Our study and the Maryland case series both underscore missed opportunities and complex barriers throughout the maternal and infant care cascades.[39] Such gaps may be more likely in settings with marked disparities in maternal-child health outcomes.

Our findings align with existing evidence that social determinants of health underlie gaps in HIV care. Gaps in prevention and testing disproportionately impact vulnerable populations—and the impacts of COVID-19 on HIV testing and prevention and maternal/infant health were most acute for Black populations, youth and other underserved communities.[5–7,10] Black adolescents are disproportionately affected by HIV, but less likely to be prescribed PrEP.[34] Sexual and gender minority youth face intersectional stigma, which negatively affects their health outcomes[44] and may be a barrier to HIV testing.[45] Viral suppression in women living with HIV varies by region, race, and urban/rural setting.[46] Racial disparities in HIV infection and outcomes reflect structural barriers to care limiting access to quality HIV services and intersectional stigma.[47] Our study demonstrates the ongoing disproportionate impact of nonperinatal HIV infections among Black and sexual or gender minority youth, and perinatal HIV infections among Black children, along with missed opportunities for prevention and diagnosis that reflect underlying social vulnerabilities in these groups.

Closing the gaps in pediatric HIV prevention and testing will require further public health efforts with attention to social determinants of health and vulnerable populations. HIV testing and prevention services must reach adolescents facing structural barriers to care. Increased awareness, opt-out testing, and PrEP

prescription/linkage are needed in pediatric primary care and ED settings.[48–51] Ending perinatal transmission should include ongoing work integrating HIV prevention and care within comprehensive community-led maternal-child health programs, particularly those addressing the needs of Black birthing parents and other marginalized groups, and mitigating structural barriers to care.[39]

Limitations to this study stem from its retrospective nature, reliance on EMR documentation, and the modest size of the study cohort. EMR documentation of race and ethnicity may not be consistent with individual self-identification; gender identity is not included in EMR demographics; and risk factors for HIV are not systematically captured. In categorizing missed opportunities, we were limited to provider-documented histories and available visit records. A small number of CAHIV with perinatal acquisition had unknown years of diagnosis; therefore, the ARIMA model was focused on CAHIV with nonperinatal acquisition, for whom diagnosis years were complete. Multiple factors strengthen study findings. These include a review of available data from multiple facilities in the largest health system in Indiana, with access to detailed records for all included patients, allowing characterization of risk factors, clinical findings and missed opportunities. Importantly, Riley Hospital for Children at IUH is the only Ryan White-funded pediatric HIV clinic in Indiana and sees the majority of CAHIV in the state. This statewide catchment area of CAHIV lends strength to our assessment of trends in pediatric HIV in our region.

In conclusion, this study found a concerning increase in nonperinatal pediatric HIV diagnoses after 2020, with major gaps noted in adolescent HIV testing and prevention. Ongoing perinatal HIV diagnoses in US-born infants signal persistent gaps in perinatal prevention in our setting. Redoubled efforts and attention to the social determinants of health are needed to prevent new pediatric HIV in the US.

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