

Post-exposure prophylaxis and follow-up in children and young persons presenting with sexual assault

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ABSTRACT

Introduction: Paediatric sexual assault (SA) victims should be assessed for post-exposure prophylaxis (PEP) to mitigate the risk of sexually transmitted infections (STIs). We describe the clinical characteristics of children and young persons (CYPs) presenting with SA at KK Women's and Children's Hospital in Singapore, viral PEP (human immunodeficiency virus [HIV] and hepatitis B virus [HBV]) prescribing practices, and STI evaluation at follow-up.

Method: Medical records of CYPs ≤16 years who presented with SA between January 2022 and August 2023 were reviewed, including assault and assailant characteristics, baseline and follow-up STI screening, PEP prescription, adherence and follow-up attendance. CYPs with SA in the preceding 72 hours by HIV-positive or HIV-status unknown assailants with high-risk characteristics were eligible for HIV PEP.

Results: We analysed 278 CYPs who made 292 SA visits. There were 40 (13.7%) CYPs eligible for HIV PEP, of whom 29 (82.9%) received it. Among those tested at baseline, 9% and 34.9% of CYPs tested positive for *Chlamydia trachomatis* and *Gardnerella vaginalis*, respectively. None tested positive for *Neisseria gonorrhoeae*, *Trichomonas vaginalis*, HIV, HBV or hepatitis C. Majority of CYPs tested were HBV non-immune (n=167, 67.6%); only 77 (46.1%) received the vaccine. Out of 27 CYPs eligible for HBV PEP with immunoglobulin, only 21 (77.7%) received immunoglobulin. A total of 37 CYPs received HIV PEP, including 8 who were retrospectively deemed ineligible. Only 10 (27%) completed the course. Overall, 153 (57.7%) CYPs attended follow-up, and none seroconverted for HIV or HBV.

Conclusion: We report suboptimal rates of HBV post-exposure vaccination, and low compliance to HIV PEP and follow-up among paediatric SA victims. Factors contributing to poor compliance should be examined to optimise care for this vulnerable population.

Keywords: hepatitis B, HIV, infectious diseases, paediatrics, sexual assault

CLINICAL IMPACT

What is New

- We report a large proportion of HBV non-immunity among our paediatric sexual assault victims.
- There was low compliance to HIV post-exposure prophylaxis and follow-up in our population.

Clinical Implications

- Rates of opportunistic HBV vaccination among HBV non-immune victims can be improved.
- Further studies should examine factors relating to non-compliance to devise interventions to optimise care for these patients.

INTRODUCTION

Sexual assault (SA) in the paediatric population is an under-recognised but significant public health burden.^{1,2} Effective management requires addressing the psychosocial issues involved and mitigating the risks of transmission of sexually transmitted infections (STIs) such as human immunodeficiency virus (HIV) and hepatitis B virus (HBV) with the appropriate use of post-exposure prophylaxis (PEP).¹

As the occurrence of STI transmission in children attributable to SA is low,^{3,5} the question is whether current strategies used to risk-stratify patients to determine the need for PEP, particularly for HIV, are well-informed.^{4,6} Making a decision is often challenging due to limited information on assailant risk,^{3,6} and lack of physician consensus beyond the first 72 hours of presentation post-assault.³ Additionally, despite increased accessibility to healthcare resources and advancements in sexual health education, compliance to HIV PEP remains poor.^{3,5,6}

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The primary objectives of our study were to describe the clinical characteristics of children and young persons (CYPs) presenting with SA in a multi-ethnic paediatric population in Singapore, and to describe PEP prescribing practices. We aimed to describe rates of medication adherence and follow-up, as well as identify gaps in care for future improvement.

METHOD

Study design, patient population and setting

A clinical audit was conducted using electronic medical records of CYPs aged ≤ 16 years who presented to the children's emergency (CE) of KK Women's and Children's Hospital (KKH), a tertiary paediatric institution in Singapore, between January 2022 to August 2023. CYPs with the CE diagnosis codes of "sexual abuse" and "sexual assault" were captured. Cases lacking sufficient information or determined not to involve assault were excluded. We defined sexual assault as any non-consensual sexual act, with or without penetration, including touching of ano-genitalia or breasts, which may have occurred because of physical or psychological coercion on victims, or any sexual act involving CYPs aged ≤ 16 years who cannot consent or understand the consequences of their choice because of their age.⁷

Data collection and variables

Data collected included CYP demographics, medical history, assault and assailant characteristics, results of baseline and follow-up STI screening, PEP prescription, adherence and follow-up. Information about the CYPs' social background was also collected to determine predisposing and protective social factors for PEP compliance. Predisposing social factors for poor PEP compliance included the presence of family history of mental health issues, domestic violence, high-risk behaviours (smoking, alcohol, vaping, self-harm) and/or residence in Girls' or Boys' Home (indicating previous juvenile delinquency or a complicated home environment).² Protective factors included regular follow-up with a medical social worker, psychologist or external community agency, active school attendance and/or presence of an intact family (defined as a complete nuclear family with paternal and maternal figures irrespective of biological relationship).^{2,7,8}

Definitions

CYPs were categorised into 2 groups based on eligibility for HIV PEP, determined by timing of presentation, the nature of SA exposure and assailant risk factors. CYPs eligible for HIV PEP were defined as CYPs with a penetrating SA encounter (genital-

genital, genital-anal, genital-oral) presenting within 72 hours and fulfilling the following criteria: (1) known HIV-positive assailant; (2) unknown HIV-status assailant aged >18 years; (3) assailant with multiple sexual partners or multiple assailants during the assault; (4) assailant who is a known intravenous drug user; or (5) male assailant known to have sex with men. CYPs were deemed to be HBV non-immune and eligible for vaccination if their hepatitis B surface antibody (HBsAb) levels were below 10 mIU/mL. Eligibility for HBV immunoglobulin (HBIG) as HBV PEP was determined based on the CYP's immune status, assailant HBV status and if unknown, high-risk assailant characteristics or high-risk exposures as defined in the guide to assess for HIV PEP eligibility (used as a proxy indicator) (Supplementary Appendix S1). This was adapted from guidelines on PEP by the Centres for Disease Control and Prevention (CDC) and World Health Organization (WHO).^{9,10}

At our institution, CYPs presenting with SA undergo a thorough medical evaluation and follow a protocol for STI screening (Supplementary Appendix S2), evaluation for PEP eligibility and outpatient follow-up (Supplementary Appendix S1). HIV PEP is offered to CYPs fulfilling the guiding points for HIV PEP eligibility who present within 72 hours, with varying regimen according to different weight bands (Supplementary Appendix S1). CYPs seen after 72 hours and before 7 days are reviewed on a case-by-case basis for eligibility for HIV PEP depending on the ascertained degree of risk of exposure for HIV. An initial 14-day medication supply is provided, followed by continuation of post-outpatient infectious disease specialist review. Follow-up serologies are routinely performed at 2 and 6 months post-assault or earlier if clinically indicated. Additionally, all CYPs are referred to a medical social worker. All CYPs undergo a comprehensive biopsychosocial assessment assessing for flashbacks and trauma symptoms, with further referral to community support services or a trauma-informed psychologist as needed.

Statistics

Pearson's chi-square or Fisher's Exact tests were used to evaluate for differences between 2 categorical variables. Non-normal continuous variables were expressed as medians with interquartile ranges. STATA version 18 (StataCorp, College Station, Texas, US) was used for statistical analysis. A *P* value of <0.05 was taken to be statistically significant.

This study was performed as part of a clinical audit for quality improvement; requirement for informed consent was waived by KK Women's and Children's Hospital, SingHealth (Reference number: KKH-2023-05-00148).

RESULTS

Demographics of CYPs presenting with sexual assault

Between January 2022 and August 2023, 297 CYPs made 325 visits for SA. Nineteen CYPs were found to have inconclusive evidence for SA and excluded from analysis. The remainder comprised 278 CYPs, accounting for 292 CE visits for SA, of whom 281 (96.2%) were females and the median age was 14.0 years (Table 1). A total of 189 (64.7%) CYPs presented more than 1 week post-SA. Among them, 129 (44.2%) were Malay and 122 (41.8%) were Chinese. Assault and assailant characteristics are detailed in Table 1. Penile-vaginal exposure was most common (n=180, 61.6%). Barrier contraception was reported in 21 (7.2%) of CYPs (Table 1). No assailants were known to be HIV- or HBV-positive. After retrospectively applying the criteria described in the Methods, 40 CYPs (13.7%) were eligible for HIV PEP.

Baseline screening and post-exposure prophylaxis for *Chlamydia trachomatis*, *Neisseria gonorrhoeae* and *Trichomonas vaginalis*

Among 251 (85.9%) CYPs who received *Chlamydia trachomatis* and *Neisseria gonorrhoeae* polymerase chain reaction tests, 27 (9.2%) tested positive for *Chlamydia trachomatis* and none for *Neisseria gonorrhoeae* (Table 2). No cases of *Trichomonas vaginalis* were detected among those tested (n=214, 73.3%). Three CYPs tested positive on the *Treponema pallidum* particle agglutination assay and chemiluminescent microparticle immunoassay but had subsequent negative Venereal Disease Research Laboratory test results and *Treponema pallidum* antibodies, indicating false positives (Table 2). Among the 281 females, 196 (69.8%) received baseline pregnancy testing (Table 2 and Supplementary Appendix S2), with 5 (1.7%) testing positive, 4 (80%) of whom continued their pregnancies.

There were 85 (29.1%) CYPs who received empirical oral azithromycin against *Chlamydia trachomatis*, 68 (23.2%) who received parenteral ceftriaxone for prophylaxis against *Neisseria gonorrhoeae*, and 75 (25.7%) who received oral metronidazole for prophylaxis against *Trichomonas vaginalis*.

Baseline testing and post-exposure prophylaxis for hepatitis B (HBV)

Fig. 1 summarises the baseline HBV and HIV serological status of our population, PEP prescription and subsequent follow-up. Two hundred and forty-seven (84.6%) CYPs received a baseline HBV serology where none had detectable hepatitis B surface antigen (HBsAg). One hundred and sixty-seven (67.6%) CYPs were found to be HBV non-immune, of whom 102 (61%) were offered HBV vaccination

(Fig. 1). Of these 102 patients, 77 (75.0%) received the vaccine within our institution while the remaining 25 (24.5%) were instructed to receive HBV vaccine from primary care clinics. Among the 40 CYPs eligible for HIV PEP, there were 27 (67.5%) CYPs who were also HBV non-immune; 23 were given the HBV vaccine, 3 were instructed to receive the vaccine at a polyclinic and 1 absconded from the CE. Twenty (74.0%) out of 27 HIV PEP-eligible, HBV non-immune CYPs were also eligible for HBIG, due to the high-risk nature of the SA or the assailant (Fig. 1). Among the 252 CYPs ineligible for HIV PEP, 140 (67.6%) were HBV non-immune but only 75 (53.6%) were offered vaccination, of whom 54 (72.0%) received the vaccine at our institution. No person who received HBV immunoglobulin reported any adverse events. Of 77 HBV non-immune CYPs who received a HBV vaccine, 37 (48.0%) received a follow-up HBV serology test, of whom 33 (89.2%) achieved HBV immunity. All 37 CYPs with follow-up HBV serology tests were HBsAg-negative.

Baseline testing and post-exposure prophylaxis for HIV

Of 245 (83.0%) CYPs who had a baseline HIV serology, none tested positive (Fig. 1). Among the 40 CYPs eligible for HIV PEP, 35 (87.5%) were offered HIV PEP and 29 (72.5%) accepted it (Fig. 1). Six eligible CYPs declined due to financial constraints or parental perception that the assault was low risk. Five CYPs retrospectively deemed eligible were not offered HIV PEP due to initially underestimated risk or details that were disclosed only later. There were 9 (3.5%) CYPs retrospectively assessed to be ineligible for HIV PEP who were offered PEP—all of whom had presented within 72 hours post-SA but did not report additional high-risk assailant or assault characteristics. Of these 9 CYPs, 8 (88.8%) accepted the recommendation. All CYPs offered HIV PEP were female and older than 13 years.

Among the 37 CYPs who accepted and received HIV PEP, adherence dropped from 62.2% (n=23) at 14 days to 27.0% (n=10) at 28 days. Eight CYPs reported adverse effects, including nausea (n=6, 75.0%) and abdominal pain (n=3, 37.5%). Non-adherence was attributed to (1) forgetfulness (n=1, 3.7%); (2) nausea and abdominal pain (n=1, 3.7%); (3) competing priorities (n=2, 7.4%); and (4) financial constraints (n=2, 7.4%). Fifty-five (18.8%) CYPs received a follow-up HIV serology (irrespective of HIV PEP administration) and none were positive (Fig. 1). All CYPs who were PEP-compliant had at least 1 protective social factor, including established access to social services.

Baseline testing and follow-up testing for hepatitis C

There were 245 (83.9%) CYPs with negative hepatitis C serology at baseline; 54 (22.0%) had repeat serology

Table 1. Demographics and social background of children and young persons presenting to children's emergency with sexual assault.

	Total (n=292)	CYPs eligible for HIV PEP ^a (n=40)	CYPs ineligible for HIV PEP ^b (n=252)	P value ^c
Patient demographics				
Female, no. (%)	281 (96.2)	40 (100)	241 (95.6)	0.17
Age >13 years, no. (%)	209 (71.6)	35 (87.5)	174 (69.0)	0.02
Age, median (IQR), years	14.0 (12.0–15.0)	14.0 (14.0–15.0)	14.0 (12.0–15.0)	0.004
Ethnicity, no. (%)				
Chinese	122 (41.8)	17 (42.5)	105 (41.7)	0.92
Malay	129 (44.2)	16 (40.0)	113 (44.8)	0.56
Indian	21 (7.2)	5 (12.5)	16 (6.3)	0.16
Others	20 (6.8)	2 (5.0)	18 (7.1)	0.62
Presence of any comorbid psychiatric illness, no. (%)	31 (10.6)	12 (30.0)	19 (7.5)	<0.001
Depression/anxiety	21 (67.7)	7 (58.3)	15 (78.9)	0.01
Eating disorder	3 (9.7)	1 (8.3)	2 (10.5)	0.32
Attendance for multiple episodes of sexual assault, no. (%)	26 (8.9)	4 (10.0)	22 (8.7)	0.79
Assault and assailant characteristics				
Time of presentation to children’s emergency from assault, no. (%)				
<72 hours	93 (31.8)	37 (92.5)	56 (22.2)	<0.001
72 hours to 7 days	10 (3.4)	3 (7.5)	7 (2.7)	
>7 days	189 (64.7)	0 (0)	189 (75.0)	
Assailant characteristics, no. (%)				
Multiple assailants	28 (9.6)	7 (17.5)	21 (8.3)	0.06
Assailant with multiple partners	8 (2.7)	5 (12.5)	3 (1.2)	0.04
Stranger	71 (24.3)	23 (57.5)	48 (19.0)	<0.001
Male	282 (96.6)	39 (97.5)	243 (96.4)	0.05
Known HIV-positive assailant	0 (0)	0 (0)	0 (0)	NA
Male assailant known to have sex with men	5 (1.7)	1 (2.5)	4 (1.6)	0.38
>18 years or unknown age	134 (45.8)	34 (85.0)	100 (39.6)	<0.001
Known intravenous drug user	1 (0.3)	0 (0)	1 (0.4)	NA
Use of protection	21 (7.2)	3 (7.5)	18 (7.1)	0.94
Type of exposure involved, no. (%)				
Penile-vaginal	180 (61.6)	37 (92.5)	143 (56.7)	0.004
Penile-anal	14 (4.8)	1 (2.5)	13 (5.2)	
Others ^d	199 (68.2)	18 (45.0)	181 (71.8)	
Social background				
Presence of any protective social factors, no. (%)	274 (93.8)	39 (97.5)	235 (93.2)	0.30
Presence of intact family	141(51.5)	25 (64.1)	116 (49.4)	0.05
Regular follow-up with medical social worker/ psychologist/ external community agency	146 (53.5)	22 (56.4)	124 (52.8)	0.49
Active school attendance	253 (92.3)	34 (87.2)	219 (93.2)	0.74
Presence of any predisposing social factors, no. (%)	151 (51.7)	26 (65.0)	125 (49.6)	0.07
Presence of family history of mental health issues and/or domestic violence	68 (45.0)	10 (38.5)	58 (46.4)	0.78
Presence of other high-risk behaviours (smoking, alcohol, vaping, self-harm)	114 (75.5)	25 (96.2)	89 (71.2)	<0.01
Living in Girls’/Boys’ Home	25 (16.6)	3 (11.5)	22 (17.6)	0.79

CYPs: children and young persons; HIV: human immunodeficiency virus; IQR: interquartile range; NA: not available; PEP: post-exposure prophylaxis

^a CYPs eligible for HIV PEP were defined as CYPs presenting within 72 hours since exposure with a penetrating sexual assault encounter

(genital-genital, genital-anal, genital-oral), and fulfilling the following: (1) known HIV-positive assailant; (2) unknown HIV-status assailant aged >18 years; (3) assailant with multiple sexual partners or multiple assailants during the assault; (4) assailant who is a known intravenous drug user; or (5) male assailant known to have sex with men. This was adapted from guidelines on PEP by the Centres for Disease Control and Prevention (CDC) and World Health Organization (WHO).

^b CYPs ineligible for HIV PEP were defined as CYPs presenting >72 hours since exposure with known HIV-negative assailant, protected intercourse with condom use; as adapted from guidelines by the CDC and WHO.

^c P values in bold are statistically significant. Statistical significance taken as $P < 0.05$, comparing the presence of variable between the 2 groups.

^d Other exposures include penile-oral, finger-vaginal, finger-anal and/or insertion of foreign body into vaginal and/or anal orifices.

Table 2. Baseline investigations of children and young persons presenting to children's emergency with sexual assault.

Baseline investigations	Total (n=292)
Urine pregnancy test, no. (%)	
Positive	5 (1.7)
Negative	191 (65.0)
Not done (females)	85 (29.5)
Not done (males)	11 (3.8)
<i>Chlamydia trachomatis</i> PCR, no. (%)	
Positive	27 (9.2)
Negative	224 (76.7)
Not done	41 (14.0)
<i>Neisseria gonorrhoeae</i> PCR, no. (%)	
Positive	0 (0)
Negative	251 (86.0)
Not done	41 (14.0)
Vaginal panel DNA swab test for <i>Trichomonas vaginalis</i> , no. (%)	
Positive	0 (0)
Negative	214 (73.3)
Not done (females)	67 (22.9)
Not done (Males)	11 (3.8)
Vaginal panel DNA swab test for <i>Gardnerella vaginalis</i> , no. (%)	
Positive	102 (34.9)
Negative	112 (38.4)
Not done (females)	67 (22.9)
Not done (males)	11 (3.8)
Syphilis screen, no. (%)	
TPPA CMIA positive	3 (1.0)
TPPA CMIA negative	243 (83.2)
VDRL positive	0 (0)
VDRL negative	3 (1.0)
Not done	46 (15.8)
Hepatitis C CMIA, no. (%)	
Positive	245 (83.9)
Negative	0 (0)
Hepatitis B serology, no. (%)	
Hepatitis B non-immune ^a	167 (67.6)
Hepatitis B immune	80 (32.3)
Hepatitis B surface antigen positive	0 (0)
HIV serology, no. (%)	
Positive	245 (83.9)
Negative	0 (0)

CMIA: chemiluminescent microparticle immunoassay;

DNA: deoxyribonucleic acid; PCR: polymerase chain reaction;

TPPA: Treponema pallidum particle agglutination;

VDRL: Venereal Disease Research Laboratory

^a Hepatitis B non-immunity is defined as hepatitis B surface antibody (HBsAb) levels <10 mIU/mL.

at follow-up, with no seroconversions occurring in this group.

Follow-up at outpatient clinical services

There were 267 (90.7%) CYPs referred to outpatient services, such as paediatric medicine/adolescent medicine service, infectious diseases service and/

or psychological medicine service (Table 3). Only 19 (47.5%) of 40 HIV PEP-eligible CYPs attended follow-up with the adolescent medicine service. Of the 37 CYPs who received HIV PEP, 31 were referred to the infectious diseases service and only 22 (71.0%) attended their follow-up.

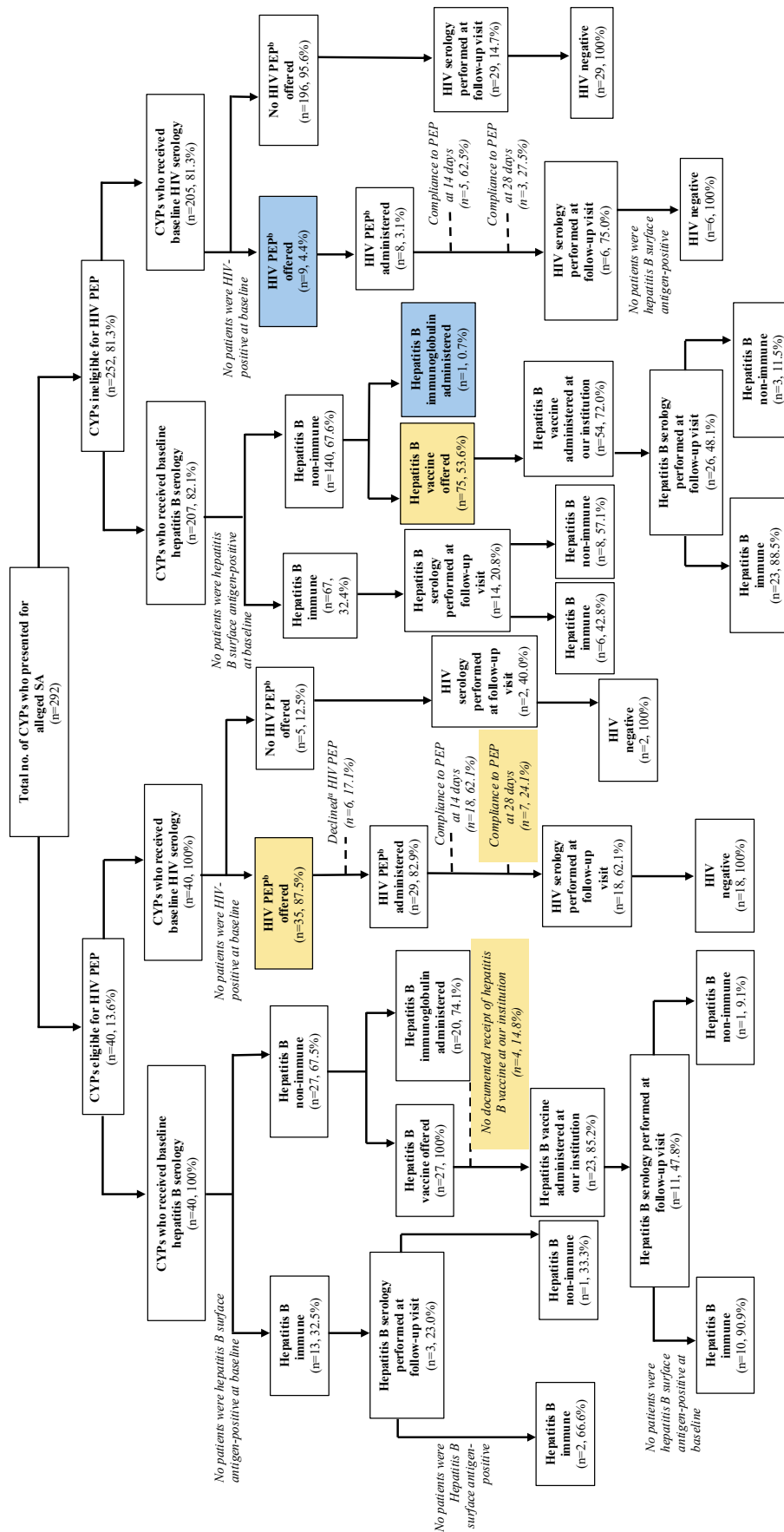
DISCUSSION

In this retrospective, single-centre study of CYPs with SA, we observed a high prevalence of HBV non-immunity in our adolescent population with suboptimal rates of booster vaccinations. While most eligible CYPs were offered HIV PEP, uptake (72%) and adherence (27.0%) were low, as were outpatient follow-up rates (57.5%). These rates were comparable to those reported in current literature.¹¹

Despite our childhood HBV immunisation programme achieving high rates of success with 95% completing a 3-dose vaccine course before 2 years of age,¹² a significant proportion (67.6%) of CYPs tested were HBV non-immune. This statistic was higher than international figures, including an audit performed in Melbourne, Australia between 2007 and 2016 that reported a 45.5% rate of non-immunity among adolescents with alleged SA.⁴ Although our rates of HBV immunity (33.4%) exceeded local adolescent HBV seroprevalence (24%),¹³ this suggests waning protection by the teenage years and warrants routine booster reviews for at-risk youths. Although an anamnestic response may still allow previously vaccinated individuals with HBsAb levels <10 mIU/mL to mount an immunological response to HBV infection after exposure,¹⁴ measurement of HBsAb levels remains the gold-standard for assessing HBV immunity and determining the need for HBV PEP.⁴ Singapore's HBsAg seroprevalence rate of 2.1%¹³ classifies Singapore as having intermediate endemicity as per WHO guidelines, indicating the need for HBV PEP for HBV non-immune SA victims. We report a proportion of HBV non-immune CYPs who were either not offered the vaccine at presentation or who were lost to follow-up with unclear receipt of HBV vaccine after referral to the outpatient clinics. These findings highlight areas for improvement in clinical care. It should be emphasised that the first medical attendance post-SA is an opportune time for prophylactic intervention. Routine HBV booster vaccinations at the initial clinical encounter should be implemented.

In our study, the majority of CYPs prescribed HIV PEP were retrospectively assessed to be eligible, and therefore PEP prescription was appropriate. However, 5 eligible CYPs were missed, stressing the need for greater clinician awareness of HIV risks and thorough history-taking. While extant literature recommends offering PEP within the first 72 hours post-assault—

Fig. 1. Hepatitis B and HIV baseline testing, post-exposure prophylaxis and follow-up serologies for children and young persons presenting to children's emergency for sexual assault.



CYPs: children and young persons; HIV: human immunodeficiency virus; PEP: post-exposure prophylaxis; SA: sexual assault

^a Reasons for declining HIV PEP included parental perception that perpetrator was low-risk or financial costs of HIV PEP.

^b All CYPs received oral dolutegravir and oral emtricitabine and tenofovir combination (Truvada; Gilead Sciences, Foster City, CA, US).

CYPs eligible for HIV PEP were defined as CYPs presenting within 72 hours since exposure with a penetrating sexual assault encounter (genital-genital, genital-anal, genital-oral), and fulfilling the following: (1) known HIV-positive assailant; (2) unknown HIV-status assailant and aged >18 years old; (3) assailant with multiple partners or multiple assailants; (4) assailant who is a known intravenous drug user; or (5) male assailant who has sex with male. This was adapted from guidelines on PEP by the Centres for Disease Control and Prevention and World Health Organization. Immunity to hepatitis B denotes a negative hepatitis B surface antigen, and hepatitis B surface antibody level >10 mIU/mL. Serologies were repeated at varying time points at any follow-up, with a minimum duration of 1 month post-SA.

Table 3. Follow-up outpatient visits for children and young persons presenting to children's emergency with sexual assault.

	Total (n=292)	CYPs eligible for HIV PEP ^a (n=40)	CYPs ineligible for HIV PEP ^b (n=252)	P value ^c
Referred to any outpatient health service, no. (%)	267 (90.7)	40 (100)	227 (89.7)	0.03
Attended any follow-up clinic, no. (%)	153 (57.7)	28 (70.0)	125 (54.9)	0.07
Referred to infectious diseases outpatient clinic, no. (%)	44 (15.0)	31 (77.5)	13 (5.2)	<0.01
Attended 1st follow-up clinic	32 (72.7)	22 (71.0)	10 (76.9)	0.68
Attended 2nd follow-up clinic	13 (29.5)	7 (22.6)	6 (46.1)	0.18
Did not attend any follow-up clinic	12 (27.2)	8 (25.8)	3 (23.0)	0.85
Referred to adolescent medicine clinic, no. (%)	257 (88.0)	40 (100)	217 (86.1)	0.01
Attended 1st follow-up clinic	126 (49.0)	19 (47.5)	107 (49.3)	0.83
Attended 2nd follow-up clinic	50 (19.5)	15 (37.5)	35 (16.2)	<0.01
Did not attend any follow-up clinic	130 (50.6)	21 (52.5)	109 (50.2)	0.79

CYPs: children and young persons; HIV: human immunodeficiency virus; PEP: post-exposure prophylaxis

^a CYPs eligible for HIV PEP were defined as CYPs presenting within 72 hours since exposure with a penetrating sexual assault encounter (genital-genital, genital-anal, genital-oral), and fulfilling the following: (1) known HIV-positive assailant; (2) unknown HIV-status assailant aged >18 years; (3) assailant with multiple sexual partners or multiple assailants during the assault; (4) assailant who is a known intravenous drug user; or (5) male assailant known to have sex with men This was adapted from guidelines on PEP by the Centres for Disease Control and Prevention (CDC) and World Health Organization (WHO).

^b CYPs ineligible for HIV PEP were defined as CYPs presenting >72 hours since exposure with known HIV-negative assailant, protected intercourse with condom use; as adapted from guidelines by the CDC and WHO.

^c P values in bold are statistically significant. Statistical significance taken as $P < 0.05$, comparing the presence of variable between the 2 groups.

especially for SA cases with oral, vaginal or anal penetration, with known HIV-positive assailants or assailants with high-risk behaviours—clinical application is often complicated by unclear histories,^{9,10,15,16} and the young age of victims leading to difficulty describing the degree of penetration (labial versus vaginal), uncertainty regarding condom use and ejaculation.¹⁷ This is further hampered by a lack of consensus on the administration of HIV PEP in at-risk populations who present beyond the recommended window for PEP initiation. Given concerns about drug toxicities and adherence, it is thus unsurprising that decisions around PEP are weighted and require careful, shared discussion among the victims, caregivers, and healthcare providers. A structured risk-assessment calculator that generates an objective score based on the aggregation of risk factors, may be beneficial, as evidenced by a Belgian study that reported modest improvements in HIV PEP prescription quality and reduction in overuse after piloting a computer-based decision-making programme.¹⁸

Similar to our findings, compliance with the 28-day HIV PEP regimen and follow-up remained poor across most single-centre studies.^{11,19,20} In our cohort, follow-up was suboptimal among the CYPs who were eligible for HIV PEP, who should have ideally achieved a 100% follow-up rate as they represented the cohort at heightened risk for both STIs and assault-related trauma. Factors influencing poor compliance in paediatrics are underexplored, although it has been postulated to be due to unstable living conditions.¹¹ A systematic review performed in 2019 linked PEP

adherence to improved patient health literacy on the necessity and indication of PEP, monetary support for transport to follow-up, healthcare provider support and counselling, while contextual barriers included poor social support.²⁰ In our study, those who completed PEP had at least 1 protective social factor, including access to social services, which provided social support and counselling. As such, to improve outcomes in our centre, we need to evaluate the effectiveness of our protocols in education and counselling. Strategies that support the emerging adolescent autonomy to empower and encourage personal responsibility for health management, may also be useful for improved compliance among adolescents.²¹ Mitigating the substantial financial costs and considering increased subsidy of PEP (ranging from SGD109.73–377.70 [approx. USD86–296] in Singapore despite subsidies)^{22,23} should be considered in tandem. To improve convenience, our institution has also recently embarked on efforts in providing courier of PEP to CYPs' residence.

In our cohort, follow-up was suboptimal among the CYPs eligible for HIV PEP, who should have ideally achieved a 100% follow-up rate as they represent the cohort at heightened risk for both STIs and assault-related trauma. Follow-up evaluation post-SA extends beyond PEP compliance and includes addressing other medical and psychosocial needs. We report poor outpatient follow-up rates, which are lower than those in other single-centre studies,⁸ especially in the HIV PEP-eligible group, who are at heightened risk not just for STIs but for assault-

related trauma. To improve this, recent efforts at our institution include providing teleconsultations. While international telemedicine programmes have shown promising results in improving clinical follow-up²⁴ future audits should evaluate the long-term effectiveness of these interventions.

The incidence of *Chlamydia trachomatis* (9.2%) and *Neisseria gonorrhoeae* (0%) in our cohort remains similar to Singapore's pre-COVID-19 data from 2016 to 2020 (5.6% and 0.9%, respectively).² In addition to viral STIs, there should be continued bacterial STI screening and appropriate PEP administration for eligible CYPs with SA in the paediatric population.

Established risk factors for SA among CYPs include parental divorce, history of psychiatric or behavioural issues and high-risk behaviours including smoking, alcohol use and illicit drug use.^{2,8} Our findings were congruent with this knowledge. There was an increased prevalence of high-risk behaviours in CYPs who had a high-risk SA encounter. As these high-risk behaviours can also significantly impact their health, comprehensive adolescent health counselling would benefit these CYPs by providing anticipatory care and increased visibility to community services.

The primary limitation of our study is its retrospective design, which precludes consistent data collection and led to incomplete documentation of additional considerations influencing PEP prescription decisions at initial presentation. Additionally, diagnostic miscoding could have led to under-capturing of SA cases. Nonetheless, a standardised data collection form was used to improve data reliability.

CONCLUSION

Improving HBV booster vaccination uptake, HIV PEP adherence and follow-up among CYPs presenting with SA should be prioritised. Our findings build on prior studies examining the clinical characteristics, prescribing practices of PEP and follow-up among paediatric SA victims. Prospective studies using standardised treatment protocols and risk-stratification tools will be crucial in establishing definitive PEP prescribing guidelines. Understanding barriers to PEP compliance and follow-up is key in ensuring optimal care for this vulnerable group.

Supplementary materials

Appendix S1. Overview of institutional protocol for post-sexual assault prophylaxis and follow-up.

Appendix S2. Institutional protocol for evaluation of children and young persons presenting with sexual assault.

Ethics statement

This study was performed as part of a clinical audit for quality improvement; requirement for informed consent was waived by KK Women's and Children's Hospital, SingHealth (Reference number: KKH-2023-05-00148).

Declaration

The authors declare there are no affiliations with or involvement in any organisation or entity with any financial interest in the subject matter or materials discussed in this manuscript.

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