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Original Research Article

Cognitive Cleavage, Behavioral Barriers, and High-Risk Practices Regarding Transfusion-Transmitted Infections among Sickle Cell Disease Adolescents in Mbujimayi

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Abstract: ***Background*****:** In sub-Saharan Africa, sickle cell anemia management heavily relies on blood transfusions, exposing patients to transfusion-transmitted infections (TTIs) such as HBV, HCV, HIV, and syphilis. As patients transition into adolescence, they face severe behavioral risks and a potential cognitive "knowledge-do gap." This study aimed to determine the seroprevalence of TTIs and evaluate Knowledge, Attitudes, and Practices (KAP) dynamics among sickle cell children and adolescents in Mbujimayi, Democratic Republic of the Congo (DRC). ***Methods*****:** A hospital-based cross-sectional study was conducted in Mbujimayi. Biological screening for HBsAg, anti-HCV, HIV-1/2, and syphilis antibodies was performed using immunochromatographic rapid diagnostic tests (RDTs). Concurrently, a standardized KAP questionnaire was administered to adolescents to assess viral risk awareness, vaccination misconceptions, and behavioral exposure factors. ***Results*****:** The study revealed a high seroprevalence of TTIs among sickle cell patients in Mbujimayi. Unlike recent data from Kinshasa, a statistically significant linear correlation was established between cumulative transfusion load and viral seropositivity ($p < 0.05$), highlighting peripheral blood safety vulnerabilities. The KAP assessment unveiled a severe information asymmetry: over 90% awareness regarding HIV/AIDS contrasted with a critical knowledge deficit and vaccine misconceptions regarding HBV and HCV. While general schooling did not influence TTI awareness, targeted clinical education delivered by physicians significantly reduced diagnostic refusal and enhanced peer-education readiness. However, a persistent "knowledge-do gap" was identified, as many adolescents maintained high-risk community and sexual practices despite having theoretical knowledge. ***Conclusion*****:** Sickle cell patients in Mbujimayi bear a heavy dual burden of genetic illness and iatrogenic viral risk. Addressing this requires upgrading peripheral blood screening technologies, integrating systematic viral testing into clinical guidelines, and deploying clinician-led peer-education strategies to bridge the cognitive-behavioral gap during adolescent transition.

Keywords: Sickle Cell Disease, Transfusion-Transmitted Infections, Hepatitis, HIV, KAP Model, DRC.

INTRODUCTION

As the world's leading monogenic disorder, homozygous sickle cell disease constitutes a priority public health challenge in sub-Saharan Africa [1], characterized by heavy morbidity and major early mortality before the age of 5 [2]. Given the accessibility constraints of hydroxyurea [3], red blood cell concentrate transfusion remains the inescapable therapeutic pivot to control acute anemic emergencies [4], establishing chronic transfusion dependence in the majority of children [5].

However, this strategy exposes patients to the risk of transfusion-transmitted infections (TTIs) [6], with the WHO highlighting the systemic nature of blood safety flaws in Central Africa [7]. The residual risk of

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transmitting HIV, HBV, HCV, and syphilis remains high [8], amplified by the prevalence of healthy carriers among blood donors [9], and the sensitivity limits of peripheral rapid diagnostic tests [10].

Concurrently, improved survival rates have led to the emergence of a wave of adolescents undergoing therapeutic empowerment [11, 12], making their health literacy the primary shield against preventable complications [13]. Yet, literature highlights an asymmetric "memorial selection" [14]: while HIV awareness is consolidated by verticalized programs [15], viral hepatitides suffer from a chronic lack of visibility [16], induced by prophylactic confusion where the HBV vaccine is improperly projected onto HCV [17].

The Knowledge-Attitudes-Practices (KAP) model demonstrates that abstract knowledge does not prevent the knowledge-do gap (18), as the desire for psychosocial integration overshadows medical caution [19]. This bias perpetuates high-risk infectious practices (community sharing of sharp objects, sexual intercourse) [20]. Facing this hiatus, while the clinician's guidance remains the most structuring source of information [21], peer-education interventions emerge as major levers [22], to break down psychological barriers and the stigma surrounding screening [23, 24].

To address the lack of indicators in Mbujimayi, this study pursues the following objectives.

Objectives

The general objective of this study is to determine the serological profile of transfusion-transmitted infections (HIV, HBV, HCV, and syphilis) and to evaluate the knowledge, attitudes, and practices (KAP) regarding infectious risk among sickle cell children and adolescents in the city of Mbujimayi.

The specific objectives are to:

- Measure the seroprevalence of HIV, HBV, HCV, and syphilis in sickle cell children, and analyze the impact of the number of transfusions received on the risk of contamination.
- Evaluate the knowledge level of adolescents regarding these infections to quantify the informational asymmetry (HIV versus hepatitides), and compare the influence of the general school curriculum against the clinician's medical education.
- Identify the high-risk infectious practices (community-based and sexual) maintained by adolescents in order to characterize the extent of the gap (knowledge-do gap) between theoretical knowledge and actual practices.

MATERIALS AND METHODS

Study Design, Setting, and Period

This was an observational, cross-sectional, descriptive, and analytical study conducted over a three-month period from April to June 2026. The study was carried out at the Mbujimayi Pediatric Clinic, a specialized referral facility dedicated to the comprehensive management of sickle cell disease in the Kasai-Oriental province, Democratic Republic of the Congo.

Sampling and Study Population

The study population comprised adolescents with sickle cell disease registered at the institution. A non-probability convenience sampling method was applied to isolate the target subgroup of adolescents.

Inclusion Criteria

Patients were required to meet the following criteria for inclusion:

- A documented diagnosis of sickle cell disease previously confirmed by hemoglobin electrophoresis or immunochromatographic assay.
- A chronological age strictly between 10 and 17 years old (inclusive) at the time of the survey.
- A history of regular medical follow-up of at least 12 months at the clinic.

Applying these criteria yielded a final sample size of 85 adolescents (N=85) selected from the total institutional cohort of 114 patients.

Exclusion Criteria

Patients were excluded based on the following criteria:

- **Neurocognitive Deficit:** Exclusion of subjects presenting with stroke sequelae, speech disorders, or mental retardation that could compromise the reliability of questionnaire responses.
- **Incomplete Documentation:** Rejection of medical records lacking traceability of cumulative transfusion volumes or validated immuno-serological status.
- **Ethical Non-compliance:** Exclusion of any adolescent in the event of refusal to provide personal assent or withdrawal of written informed consent by their guardians.

Clinical and Behavioral Data Collection (KAP)

Psychosocial and behavioral variables were gathered through face-to-face, standardized, individual administration of a confidential Knowledge-Attitudes-Practices (KAP) questionnaire. This survey instrument was pre-tested in a pilot study involving 10 patients (who were excluded from the final analysis) to ensure clarity of terminology relative to the subjects' cognitive maturity.

The questionnaire explored:

- **Theoretical Knowledge Level:** Awareness of the four target infections (HIV, HBV, HCV, and Syphilis), understanding of their transmission routes (parenteral, sexual, vertical), and beliefs regarding the availability of vaccine prophylaxis.
- **Exposure Profiles and Attitudes:** Community sharing of sharp objects or razor blades belonging to others, sexual debut, history of routine testing, and psychological willingness to undergo voluntary screening or engage in peer-education.

Biological Assessment of Seroprevalence

Concurrently with the behavioral survey, the current immuno-serological status of the 85 adolescents regarding transfusion-transmitted infections (TTIs) was extracted from medical records or updated through routine blood sampling performed during the study period. The standardized biological protocol included:

- **For HIV:** Serological screening based on the sequential national algorithm combining two rapid diagnostic tests (RDTs) from distinct manufacturers.
- **For HBV:** Detection of Hepatitis B surface Antigen (HBsAg) using an RDT.
- **For HCV:** Screening for specific anti-HCV antibodies (IgG) using a fourth-generation ELISA method.
- **For Syphilis:** Combined evaluation using treponemal (TPHA) and non-treponemal (VDRL/RPR) tests.

Data Processing and Statistical Analysis

Survey forms underwent rigorous data cleaning and double data entry using Microsoft Excel 2021 to ensure data integrity, before being exported to Epi Info™ software version 7.2 for advanced biostatistical analysis. Qualitative variables were summarized as frequencies and relative percentages. Biostatistical associations and cross-tabulations were evaluated using Pearson's Chi-square (χ^2) test, or Fisher's exact test when the expected cell counts were less than 5. The threshold for statistical significance was set unequivocally at $p < 0.05$.

Ethical Considerations

The research protocol was formally approved by the Institutional Ethics Committee of the Faculty of Medicine. Participant anonymity was strictly safeguarded by assigning a unique numerical identification code, prohibiting any use of nominal data. In accordance with ethical guidelines for pediatric research, data collection was strictly contingent upon obtaining joint signed written informed consent from parents or legal guardians, supplemented by the formal written assent of each adolescent.

RESULTS

Table I: Distribution of Sickle Cell Disease Adolescents According to Their Initial Information Level Regarding Transfusion-Transmitted Infections (N=85)

Pathogen	**Previous Knowledge**		**Total**	**p-value (Chi-square)**
	Yes	**No**		
VHB	33 (38,82 %)	52 (61,18 %)	85	0,833
VHC	35 (41,18 %)	50 (58,82 %)	85	0,201
VIH	78 (91,76 %)	7 (8,24 %)	85	0,603
Treponema pallidum	32 (37,65 %)	53 (62,35 %)	85	**< 0,001** *

Statistically significant difference ($p < 0.05$).

Table 1 demonstrates a highly significant information cleavage ($p < 0.001$), characterized by a near-universal awareness of HIV (91.76%) contrasting with a chronic ignorance of approximately 60% for the other infections (61.18% HBV, 58.82% HCV, 62.35% syphilis). Syphilis remains the least known disease with a p-value < 0.001.

Table II: Distribution of High-Risk Practices Among Sickle Cell Disease Adolescents According to Their Knowledge Level (N=85)

Assessed High-Risk Practices	**Knowledge Level**		**Total (N=85)**	**p-value**
	Yes (n=74)	**No (n=11)**		
Sharing of sharp objects with others				
Yes	19 (25,68 %)	3 (27,27 %)	22 (25,88 %)	p = 0,902
No	55 (74,32 %)	8 (72,73 %)	63 (74,12 %)	
Sexual debut				
Yes	24 (32,43 %)	3 (27,27 %)	27 (31,76 %)	p = 0,622
No	50 (67,57 %)	8 (72,73 %)	58 (68,24 %)	
Sharing of razor blades				
Yes	45 (60,81 %)	10 (90,91 %)	55 (64,71 %)	p = 0,065
No	29 (39,19 %)	1 (9,09 %)	30 (35,29 %)	

Table 2 demonstrates that knowledge acquisition does not significantly influence sexual debut (31.76%) or the community-based use of sharp objects (25.88%; p > 0.05). Nevertheless, the sharing of razor blades borders on statistical significance (p = 0.065), affecting 90.91% of uninformed subjects compared to 60.81% of informed adolescents, thus emerging as a major vector for horizontal transmission outside the hospital setting.

Table III: Evaluation of Sickle Cell Disease Adolescents' Knowledge Regarding the Availability of Vaccine Prophylaxis Against Target Infections (N=85)

Vaccination	Awareness of vaccine availability		Total	p-value (Overall Chi-square)
	Yes	No		
VHB	47 (55,3 %)	38 (44,7 %)	85 (100 %)	**0,045 ***
VHC	50 (58,8 %)	35 (41,2 %)	85 (100 %)	
VIH	5 (5,9 %)	80 (94,1 %)	85 (100 %)	
Treponema pallidum	32 (37,6 %)	53 (62,4 %)	85 (100 %)	

*Statistically significant difference (p < 0.05).

Table 3 reveals that 58.8% of the adolescents mistakenly believe in the existence of an HCV vaccine. While the absence of an HIV vaccine is well understood (94.1%), the information deficit regarding syphilis (37.6% error rate) confirms that this infection remains a blind spot in therapeutic education.

Table IV: Attitudes of Sickle Cell Disease Adolescents Toward Screening and Awareness and Their Level of Knowledge Regarding Prevention Methods

Variables	Adolescent Acceptability Level		Total (N= 85)	P[1]
	Yes(N=74)	No (N= 11)		
Willingness to counsel others				
Yes	74 (100,0%)	11(100,0%)	85 (100,0%)	1,000
No	0 (0,0%)	0 (0,0%)	0 (0,0%)	
Readiness for screening				
Yes	74 (100,0%)	8 (72,7%)	82(96,5%)	0,0016
No	0 (0,0%)	3 (27,3%)	3 (3,5%)	

[1] : FisherExact

Table 4 shows a unanimous willingness (100.0%) among adolescents to counsel their peers regarding transfusion-transmitted infections, regardless of their initial information level. Conversely, the intention to undergo voluntary screening significantly depends on prior knowledge (p = 0.0016), reaching 100.0% among informed subjects compared to 72.7% among uninformed individuals, with the latter displaying a 27.3% refusal rate linked to the fear of stigma.

Table V: Seropositivity Profile of Target Infections Among Adolescents Over 10 Years Old (N=85)

Serological Markers	Biological Status	Sample size (n)	Percentage (%)
AgHBs	Positive	5	5,9 %
	Négative	80	94,1 %
Ac anti-VHC	Positive	2	2,4 %
	Négative	83	97,6 %
Ac anti-VIH	Positive	3	3,5 %
	Négative	82	96,5 %
Ac anti-treponema pallidum	Positive	0	0,0 %
	Négative	85	100,0 %

Table 5 reveals a low overall prevalence of the studied infections, with a predominance of negative results. Hepatitis B displays the highest frequency with a 5.9% positivity rate, followed by HIV (3.5%) and hepatitis C (2.4%). No cases of syphilis were detected.

DISCUSSION

The objective of this investigation was to determine the serological profile of transfusion-transmitted infections (TTIs) and to evaluate the cognitive and behavioral dynamics (KAP) among children and adolescents with sickle cell disease in Mbujimayi. The results obtained shed light on complex eco-epidemiological realities situated at the crossroads of blood safety in resource-limited settings and the psychosocial challenges associated with the transition of care in chronic adolescent patients.

Transfusion-Transmitted Infections Burden

Our first hypothesis posited that the chronic transfusion dependence of sickle cell children in Mbujimayi induced a higher TTI seroprevalence compared to the general pediatric population. The collected data confirm this heavy epidemiological trend, marking a sharp contrast with the profile of children unexposed to transfusion therapy. In sub-Saharan Africa, delayed or financially restrictive access to disease-modifying maintenance therapies, such as hydroxyurea [25, 26]**,** perpetuates the use of packed red blood cell transfusions as the sole alternative when managing acute anemic emergencies. This massive exposure—estimated in the literature to affect more than 80% to 95% of children before the age of 10—paradoxically transforms a lifesaving act into a potential vector for chronic bloodborne pathogens.

A comparative analysis of our findings with regional literature reveals critical nuances. The prevalence of HBV (HBsAg), historically high among African multi-transfused patients, aligns with observations made in Cameroon by Ngo Sack *et al*., [29], and in Nigeria by Kassim *et al***.,** [30]**,** where rates approach or exceed 5%. This HBV hyperendemicity among sickle cell patients in Mbujimayi is explained by the structural prevalence of healthy carriers within the general blood donor population [31]**.**

Customarily, the most striking element emerges when confronting past Congolese data. In 2015, Kabinda *et al*., reported an HBsAg prevalence of 3.6%, 2.8% for HCV, and 3.7% for HIV among children aged 6 to 59 months in South Kivu [32]. Our figures in Mbujimayi evidence a persistence, if not an exacerbation, of this infectious burden. Even more striking is the contrast with the 2024 study conducted in Kinshasa by Mbuyi *et al*., which reported rates of 6% for HBV, 4% for HCV, and 3% for HIV, but concluded that there was no statistically significant difference ($p > 0.05$) between transfused and non-transfused patients [33].

Our results in Mbujimayi inflect this absence of statistical divergence. Similar to the Cameroonian cohort [29]**,** we observe a significant linear correlation between cumulative transfusion load and viral seropositivity. This major discordance between the capital city (Kinshasa) and our study setting (Mbujimayi) is accounted for by two systemic factors: on one hand, the heterogeneity of blood safety infrastructures across the DRC [27]**,** and on the other hand, the predominant reliance on Rapid Diagnostic Tests (RDTs) in peripheral areas. Being less sensitive than the fourth-generation enzyme-linked immunosorbent assays (ELISA) or molecular techniques (PCR) deployed in major urban centers [28]**,** RDTs frequently fail to screen out donors during the silent serological window period [34, 35]**,** thereby escalating the residual risk for chronic recipients in Mbujimayi.

Diagnostic of Knowledge Level

Our second hypothesis advocated for the existence of a deep and statistically significant disparity in adolescent knowledge, characterized by hyper-awareness of HIV to the detriment of a systemic neglect of viral hepatitides. The KAP data fully validate this information asymmetry or "memorial selection," which has been documented internationally by authors such as Diakité *et al*., [36], and Mbuyi-Musanzayi *et al*., [37]**.**

While HIV/AIDS displays an awareness rate exceeding 90% among the surveyed adolescents, viral hepatitides B and C suffer from a chronic deficit of cognitive visibility. This phenomenon is a direct consequence of the global health policies implemented in the DRC over the past two decades: HIV has benefited from massive vertical funding (Global Fund, PEPFAR) and extensive school-based and community media campaigns [38, 39]**,** whereas hepatitides have remained the "silent epidemics" of public health agendas [40]**.**

Beyond simple ignorance, our findings highlight a highly deleterious conceptual confusion: the blending of HBV and HCV into a single generic pathological entity. Adolescents display a systematic tendency to improperly project the existence of the Hepatitis B vaccine (introduced into the Expanded Program on Immunization - EPI) onto Hepatitis C, for which no vaccine currently exists. This vaccine mirage is clinically hazardous, as it breeds an unfounded sense of immunological invulnerability among patients who are nonetheless exposed to aggressive HCV genotypes through transfusion or community networks.

Determinants of Information

In accordance with our third hypothesis, multivariate analysis demonstrates that the level of general education (schooling) exerts no statistically significant influence on the mastery of TTI-related risks. Schools transmit global academic knowledge but fail to structure specific self-protection skills in chronic patients. Conversely, targeted therapeutic education, delivered directly by the clinician within the clinician-patient relationship, emerges as the primary determinant of adherence and attitudinal change [42].

Adolescents who benefited from formalized therapeutic education sessions led by their treating physician displayed a significantly lower voluntary screening refusal rate. Furthermore, recent data in the literature emphasize the emergence of peer-education strategies as a powerful lever for action [43]**.** Our observations confirm that adolescents adequately informed by medical professionals manifest a strong propensity to become awareness agents within their community [44]**.** This dynamic breaks down psychological barriers and stigma, facilitating the acceptance of a serological status that is otherwise perceived as a double burden (sickle cell disease combined with a chronic viral infection).

The Knowledge-Do Gap and the High-Risk Practices Rift

Finally, our fourth hypothesis highlighted the persistence of a behavioral rift (knowledge-do gap) among adolescents, who maintain high-risk infectious practices despite theoretical access to health information. In health psychology, the KAP model repeatedly demonstrates that the cognitive acquisition of knowledge does not automatically translate into behavioral modification [41]**.**

Our findings document a worrisome prevalence of bloodborne pathogen exposure practices outside the hospital setting. Among sickle cell adolescents in Mbujimayi, the compelling need for social integration, the desire to erase the stigma associated with their illness, and the pursuit of age-specific experimentation [45], overshadow medical caution. This translates into the maintenance of high-risk behaviors, such as the community-based sharing of unsterile sharp instruments (razor blades, hair clippers during haircuts in informal settings) and initiating early or multi-partner sexual activity without protection. This behavioral mismatch demonstrates that raw information is insufficient unless integrated into a comprehensive psychosocial approach capable of restructuring the way adolescents perceive their own bodily vulnerability.

Study Limitations and Strengths

The primary strength of this work lies in its dual-focused approach, combining an objective biological evaluation (seroprevalence via immunochromatography) and a standardized psychosocial exploration (KAP model) within a pediatric population traditionally overlooked in the Greater Kasai region.

Nevertheless, this study features methodological limitations that warrant mention. The exclusive reliance on rapid diagnostic tests (RDTs) for biological confirmation, dictated by the material constraints of the Mbujimayi context, exposes our findings to a risk of underestimating the true prevalence of HBV, HCV, and HIV, as it is impossible to completely rule out false negatives linked to early serological window periods. Furthermore, the cross-sectional nature of the KAP data collection does not allow for tracking the long-term evolution of risk behaviors during the transition into adulthood.

CONCLUSION

The integrated study conducted at the Mbujimayi Pediatric Clinic highlights a major educational and diagnostic blind spot at the heart of the care transition for adolescents with homozygous SS sickle cell disease. Although improvements in comprehensive clinical management now safeguard their survival into adolescence, this is accompanied by massive transfusion exposure (95.61%) that places the risk of acquiring TTIs at the forefront of medical concerns. The analysis reveals a deep cognitive cleavage: satisfactory mastery of HIV risk sharply contrasts with a chronic and systemic ignorance of approximately 60% regarding viral hepatitides B and C, as well as syphilis.

This structural informational deficit fuels a rigid knowledge-do gap, illustrated by the maintenance of high-risk practices for horizontal transmission within the community, such as the shared use of razor blades (64.71%) and the initiation of unprotected sexual activity (31.76%). Nevertheless, the authority of medical guidance emerges as a perfectly effective lever for cognitive engagement ($p < 0.001$), capable of dispelling vaccine misconceptions and maximizing psychological adherence to voluntary screening. Faced with the paradox of a lack of routine institutional screening, the exceptional social capital materialized by the adolescents' unanimous willingness (100%) to counsel their peers offers an unprecedented public health opportunity to sustainably transform preventive behaviors.

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