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Disease profile, HIV prevalence and vaccination status of HIV-infected children admitted at a hospital complex, Northern Cape Province, South Africa

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Abstract

Despite the availability of vertical transmission prevention, treatment, and immunisation programmes for better health outcomes, children are still infected and affected by HIV/AIDS. Those accessing treatment are either virally unsuppressed or have severe forms of diseases, while others have missed opportunities for vaccination. HIV infected children are vulnerable to infections, re-hospitalisation, and missing vaccinations. The study determined the disease profile, HIV prevalence, readmission, and immunisation status of children admitted to Robert Mangaliso Sobukwe Hospital in Northern Cape Province, South Africa. This was a retrospective review of 328 medical records of children less than 14 years, admitted from January 2017 to January 2018. The mean age was 3.6 years, and the majority were females. Most children presented with appetite loss and fatigue, and the most common admission diagnoses were lower respiratory tract infection and acute gastroenteritis. The prevalence of HIV in this group was 24%. Over 50% were readmitted, and 17% of those were HIV positive. Most HIV positive children (62%) had missed vaccinations, predominantly measles, and pneumococcal conjugate vaccines. Older children, those infected with HIV, and those who had missed the measles vaccine were significantly associated with readmission. Children of mothers with higher educational status who were either single or married were less likely to be readmitted compared to those with a lower education level and divorced parents. The rate of readmission is relatively high; therefore, improving care and scaling up catch-up immunisations for children, especially among HIV-infected, may offer them better protection and outcomes against vaccine-preventable diseases considering their risk for incomplete immunisation and infectious diseases.

Keywords: Disease profile, HIV prevalence, Hospital readmissions, Missed opportunities for vaccination.

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1. Introduction

In 2022, an estimated 37.7 million people were living with HIV/AIDS globally, and over two-thirds of those individuals,

were in the WHO Afro Region [1]. Furthermore, the world saw an estimated 1.5 million individuals acquire HIV for the first time that year [1]. One of the focus areas of the strategic priorities of the Global AIDS Strategy 2021 – 2026 is ending paediatric AIDS and eliminating vertical transmission [2]. In 2021, the proportion of children below 14 years who had access to antiretroviral therapy (ART) worldwide was about 52%, with an estimated 1.7 million children living with HIV [3, 4]. Globally, the annual number of new HIV infections has dropped by 32% since 2010 [2], with the annualised rate of new infections declining by 3% between 2007 and 2017 [5]. Although new HIV infections due to vertical transmission have declined by about 22% from 2016 to 2021, several children still do not have access to ART, and about 41% of those on treatment are not virally suppressed [2, 4]. To meet the 2025 target of the Global AIDS strategy, 86% of children should be virally suppressed. HIV is a known risk factor for several diseases, especially among children below the age of 5 years.

Sub-Saharan Africa (SSA), which accounts for 59% of new HIV infections, experienced an annualised decline of about 6% [2], with an ART coverage rate of 56% and 48% of children not being virally suppressed [2]. This is mainly due to the failure to test all children exposed to HIV. In South Africa, the total estimated number of people living with HIV (PLWH) was 8.2 million in 2021, with a national prevalence rate of 13.7% [6]. According to Von Mollendorf, et al. [7], South Africa has witnessed a decline in vertical transmission from 12% to 2.5% between 2007 and 2013, and this success is attributed to the prevention of vertical transmission of HIV. The HIV virus can be transmitted to children during pregnancy, labour, delivery, or breastfeeding. Alongside Kenya, Namibia, and Uganda, South Africa is hailed for successfully achieving a viral suppression rate of 73% in 2020 [2]. The leading causes of death among children under 5 years in South Africa include lower respiratory tract infections (LRTI), diarrhoeal diseases, malnutrition, and perinatally acquired HIV [8]. Similarly, children below the age of 5 years, especially HIV infected, are vulnerable to infections and hospitalisation [9]. Lower respiratory tract infections, gastroenteritis, and tuberculosis are among the leading causes of morbidity and hospitalisation among children, and these are more profound among HIV infected children [7-13].

Hospital readmission is a major public health issue, and understanding its determinants will ensure better health outcomes for the population [14]. Hospital readmission is described as the admission to a hospital within a certain time frame following discharge, either to the index or a different one [14, 15]. Readmission can be either planned or unplanned, in the index or different hospital within 7, 15, 30, 60 days, or 12 months [16]. Unplanned readmissions are associated with the quality-of-care patients have received from the index hospital [16]. Several factors are associated with hospital readmissions among patients, and these include disease progression and severity, poor clinical planning, and care coordination while patients are in the hospital, inadequate post-discharge care [16], and lack of social support [14], among other things. The readmission of children poses a serious financial burden not only on the healthcare system but also on the parents or caregivers. This is even more burdensome for children infected with HIV, considering that such children have hospital stays of three or more days longer compared to their HIV negative counterparts [10, 11]. Children who are HIV exposed but uninfected have an elevated risk of morbidity and mortality compared to HIV unexposed and uninfected children, with more severe forms of disease and frequent hospitalisations [9, 17].

The role of immunisation in the prevention of vaccine-preventable diseases (VPDs) is widely acknowledged. It is regarded as one of the greatest advancements and the most cost-effective preventative strategy in public health [7, 18-20]. However, eligible children still miss the opportunity to be vaccinated. The recent national vaccination coverage survey conducted in South Africa has shown that vaccine coverage, which refers to the proportion of children who have received all recommended vaccines up to 9 months, is 84%. This figure decreases to 81% for children up to 12 months and further to 77% for all 14 doses (up to 18 months) [20]. According to the 2022 World Health Statistics report, in South Africa, the proportion of children receiving a third dose of diphtheria tetanus pertussis (DTP3) vaccine, a second dose of measles containing vaccine (MVC 2), and a third dose of pneumococcal conjugate vaccine (PCV3) were 84%, 83% and 76%, respectively [1]. These coverages are often used as indicators for assessing the progress of the Expanded Programme on Immunisation (EPI) in countries. One of the recommendations emanating from the above-mentioned coverage survey is that the EPI programme needs to invest in robust health facilities, community-based interventions, and social media platforms to increase vaccination coverage and ensure that children are fully vaccinated and retained in the programme until all primary vaccinations are completed.

Children who have missed vaccinations and those who have not received a single vaccine dose, referred to as "zero dose children," are vulnerable to vaccine-preventable diseases. HIV infected children and those who are exposed and uninfected are even more vulnerable to vaccine preventable diseases such as LRTI [9, 12, 13, 21-23], invasive pneumococcal diseases [7, 9], diarrhoeal diseases [21], and hepatitis B infections [18], amongst others. Several factors related to missed opportunities for vaccination (MOVs) among children include young maternal age, low parental education, divorce [20] when immunisation decisions are taken by one parent instead of both [24], and maternal HIV status. HIV positive children are more likely to miss vaccination compared to their HIV negative counterparts. Vaccines are recommended for HIV positive children, except for BCG, OPV, measles, and rotavirus vaccines in cases where the child is symptomatic [18, 19]. An audit of the disease profile of children admitted and readmitted, their HIV status, and their vaccination status has never been conducted at Robert Mangaliso Sobukwe Hospital (RMSH) in Kimberley. Therefore, the aim of the study was to determine the prevalence of HIV, disease profile, readmission and vaccination status of HIV positive children admitted to RMSH in the Northern Cape Province of South Africa.

2. Materials and Methods

2.1. Study Design

It was a retrospective cross-sectional descriptive study where medical records of children admitted to the paediatric wards at RMSH from January 2017 to January 2018 were reviewed.

2.2. Study Setting

The study was conducted at the Department of Paediatrics at RMSH, previously known as the Kimberley Academic Hospital Complex. RMSH is a referral hospital located in Belgravia, Kimberley, in the Northern Cape Province. This province is the least populous province in South Africa, with an estimated population of about 1.3 million [25]. It is divided into five district municipalities, and the hospital serves as the only tertiary institution (T1) and a referral hospital in the province. The hospital functions as a level 1 care facility for Sol Plaatje Municipality and provides services to patients attending primary health care (PHC) facilities in the area and beyond. The setting is predominantly rural, and the main spoken languages are Afrikaans and Setswana. The hospital has 714 approved beds, with 671 currently active beds, and offers 33 different specialty disciplines, each led by qualified specialists in their respective fields. The average bed utilisation rate is 72%, and the average length of hospital stay is 6.8 days. Additionally, the hospital serves as a satellite training facility of the University of Free State.

2.3. Study Population

The study population included children aged 3 months to 13 years who were admitted to the paediatric ward. Their medical records spanning over 12 months, from January 2017 to January 2018, were used. The hospital typically admits an average of 1400 children per month.

2.4. Sample Size Determination and Sampling Technique

An online Raosoft sample size calculator (available at www.raosoft.com) was utilised to calculate the sample size. The calculation was based on an estimated 1400 admissions, a 95% confidence level, a 5% margin of error, and a distribution of 50%. The estimated sample size was determined to be 302, and a 10% buffer was included to account for missing information from the files. Therefore, the final sample size was determined to be 332 patient files. To select the sample, every fourth file was sampled until the desired sample size was reached.

2.5. Exclusion Criteria

The exclusion criteria for the study were neonates and children above 13 years. Neonates were excluded as they required special care and have separate wards dedicated to their needs.

2.6. Data Collection

Data were collected by two clerks from the records department and the research team. Demographic and clinical data were collected from medical records of all children admitted from January 2017 to January 2018. Information concerning the children who were admitted was obtained from the admission registers, such as date and year of admission, registration number, patient's name, date of birth and age, admission diagnosis, place of residence, HIV status, and immunisation status, just to name a few. Files were retrieved from the filing room using the registration numbers, while the patient's details were verified at the filing room by the clerks using the filing room's computer. Information about caregivers and the clinical status of the child, including the number of days per hospital stay, was also obtained.

Data collection was conducted in a side room provided specifically for this study to avoid disturbance to normal services. The record clerks were trained on how to extract and handle the data. About 20 to 30 files were extracted daily. An electronic version of the data extraction tool was developed using Google Forms (Google, Limited Liability Company (LLC)) and subsequently used to extract and capture the data from the files. The captured information was transmitted electronically and automatically populated onto an online linked Google Sheets (Google, LLC). A smartphone with internet connectivity was used to collect the data. The data collection process lasted for three weeks, and after that, data was downloaded and exported into small Stata Statistical Software version 13 (StataCorp. 2013, College Station, Texas) for cleaning, coding, and analysis.

2.7. Analysis Plan

Descriptive statistics were used to analyse the data. Frequency distribution was used to analyse categorical variables, and these were presented as percentages in tables or graphs. Summary statistics were used to analyse numerical variables, such as age and income, and these were presented as means and standard deviations (SD). A stepwise forward selection logistic regression model was used to determine factors associated with hospital readmissions. The adjusted odds ratios (aOR) were presented together with their corresponding 95% confidence intervals. A p-value of less than 0.05 was considered statistically significant.

2.8. Validity, Reliability, and Bias

The data extraction tool was developed based on the information contained in the files. Prior to data collection, the tool was assessed by an expert panel consisting of two experts. Furthermore, the tool was pre-tested on 10 randomly selected files to ensure that relevant information was available from the files. Slight modifications were made after the pre-testing, and the pre-test information was not included in the analysis. A systematic random sampling strategy was utilised to reduce sampling bias. To reduce the potential impact of incomplete data, a 10% buffer was added to the initial calculated sample size. About 10% of the captured information was verified using a random selection of patients' files.

2.9. Ethical Issues

Ethical clearance was obtained from the School of Health Care Sciences Research Committee (SHCSREC) and Sefako Makgatho Health Sciences University Research and Ethics Committee (SMUREC) (Reference: SMUREC/H/241/2018:PG).

Permission to conduct the study was granted by the Northern Cape Department of Health (NCDH), the clinical manager, and the Chief Executive Officer (CEO) of RMSH. Confidentiality and anonymity of the patients' information were assured, and the information obtained was strictly utilised for the purpose of this study.

3. Results

3.1. Demographic Characteristics of the Children

Of the 332 medical records reviewed, four files had incomplete or inconclusive information on pertinent variables and were excluded. Therefore, only 328 medical records were included in the study. The results show that the mean age of the children was 3.6 ±3.5 years, ranging from 0.25 (3 months) to 13 years. Table 1 presents the demographic characteristics of the children. The majority of children were between the ages of 1 and 3 years (36.20%), female (53.05%), and resided in rural areas (53.35%).

Table 1.
Demographic characteristics of the children.

Variables	N	Percentage
Age category		
< 1 Year	83	25.46
1-3 Years	118	36.20
4-6 Years	53	16.26
7-9 Years	42	12.88
> 10 Years	30	9.20
Gender		
Male	152	46.95
Female	174	53.05
Area of residence		
Rural	175	53.35
Urban	153	46.65

Table 2.
Presenting signs and symptoms of admitted children by HIV status.

Signs and symptoms	HIV negative		HIV positive		Total	
	N	Column %	N	Column %	N	Column %
Fever						
No	43	17.34	5	6.41	48	14.72
Yes	205	82.66	73	93.59	278	85.37
Myalgia						
No	96	38.71	28	35.90	124	38.04
Yes	152	61.29	50	64.10	202	61.96
Urticaria						
No	235	94.76	77	98.72	312	95.71
Yes	13	5.24	1	1.28	14	4.29
Appetite loss						
No	21	8.47	1	1.28	22	6.75
Yes	227	91.53	77	98.72	304	93.25
Nausea						
No	68	27.42	14	17.95	82	25.15
Yes	180	72.58	64	82.05	244	74.85
Vomiting						
No	147	59.27	45	57.69	192	58.9
Yes	101	40.73	33	42.31	134	41.10
Fatigue						
No	17	6.85	2	2.56	19	5.83
Yes	231	93.15	76	97.44	307	94.17
Diarrhoea						
No	186	75.00	57	73.08	243	74.54
Yes	62	25.00	21	26.92	83	25.46
Cough						
No	149	60.08	35	44.87	184	56.44
Yes	99	39.92	43	55.13	142	43.56

Table 2 shows the presenting signs and symptoms of the children admitted to the hospital. Overall, the majority of children presented with fatigue on admission (94.17%), appetite loss (93.25%), fever (85.37%), nausea (74.85%), and myalgia (61.96%). Among children living with HIV, the most frequent presenting signs and symptoms identified were loss of appetite

(98.72%), fatigue (97.44%), fever (93.59%), and nausea (82.05%). Among HIV negative children, fatigue was the most common at 93.15%, followed by loss of appetite at 91.53%, then fever and nausea.

3.2. Demographic Characteristics of Caregivers

The mean age of caregivers was 32±7.8 years, ranging from 18 to 55 years. Table 3 presents the demographic characteristics of the caregivers. The majority of caregivers were females (90.85%), in the age group of 20-29 years (42.11%), residing in rural areas (53.35%), unemployed (58.23%), and with no formal education (38.11%). Additionally, most caregivers were married (46.34%) and identified as Christians (60.37%).

Table 3.
Demographic characteristics of caregivers.

Variable	Category	N	Column%
Age in years	18-19 Years	4	1.24
	20-29 Years	136	42.11
	30-39 Years	134	41.49
	40-49 Years	41	12.69
	> 50 Years	8	2.48
Gender	Female	298	90.85
	Male	30	9.15
Location	Rural	175	53.35
	Urban	153	46.65
Employment status	Employed	83	25.3
	Unemployed	191	58.23
	Not documented	54	16.46
Educational status	No education	125	38.11
	Primary	101	30.79
	Secondary	68	20.73
	College	34	10.37
Marital status	Married	152	46.34
	Single	117	35.67
	Divorced	40	12.20
	Widow	19	5.79
Religion	Christian	198	60.37
	Islam	31	9.45
	Others	99	30.18

3.3. Prevalence of HIV among Children Admitted to RMSH

Figure 1 shows that of the 328 medical records reviewed from January 2017 to January 2018, the prevalence of HIV among children admitted to the hospital was 24% (n=78).

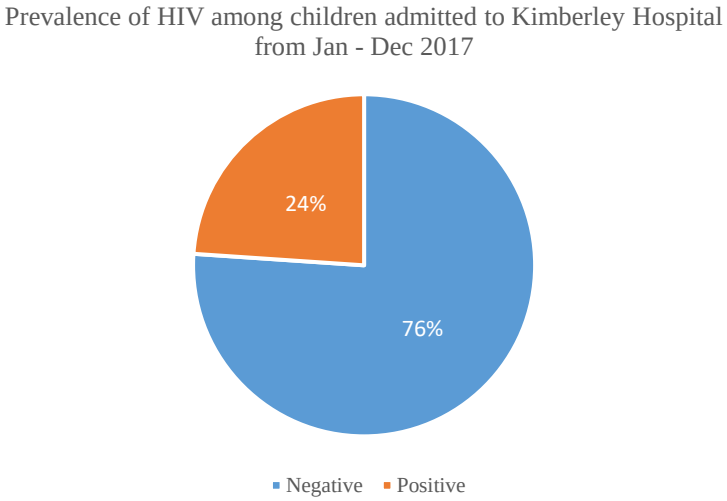

Figure 1.
Prevalence of HIV among children admitted to RMSH (Jan – Dec 2017).

3.4. Disease Profile of Children Admitted to RMSH

Table 4 shows the disease profile of children admitted to RMSH. Most of the admitted children were diagnosed with lower respiratory tract infection (25%), followed by acute gastroenteritis (9.45%), upper respiratory tract infection (8.84%),

febrile convulsion (7.01%), tuberculosis (5.18%), and others. The category "Other" included a few cases of dermatitis, nephrotic syndrome, seizures, sepsis, hepatitis, epistaxis, migraine, osteomyelitis, psychosis, and acute renal failure, among others.

Table 4.
Disease profile among children admitted.

Diagnosis	N	%
Lower respiratory tract infection (LRTI)	82	25.0
Acute gastroenteritis (AGE)	31	9.45
Febrile convulsion	23	7.01
Tuberculosis (TB)	17	5.18
Upper respiratory tract infection (URTI)	29	8.84
Asthma	14	4.27
Diarrhoea	13	3.96
Severe acute malnutrition	12	3.66
Urinary tract infection	11	3.35
Other	96	29.27
Total	328	100

3.5. Readmissions to Hospital

Figure 2 shows the proportion of children readmitted to RMSH, as well as the number of readmissions in the past six months. About 52% (n=170) of children were readmitted to the hospital within six months after discharge. Of those, 30% (n=97) were readmitted at least once within six months after being discharged. Furthermore, about 18% of the children were readmitted twice within six months following discharge. Notably, at least two children (1%) were readmitted four times.

Table 5 shows the proportion of readmitted children by HIV status and admission diagnosis. Of the HIV positive children who were readmitted, the majority, constituting 27.6% (16/58), were diagnosed with LRTI, accounting for 20% of all children diagnosed with LRTI. Of all the children who were diagnosed with TB, 58.82% (n=10) were HIV-infected and they made up 17.2% (10/58) of all readmitted HIV-infected children. Overall, acute gastroenteritis was the second most common diagnosis among all admitted children, and 16.13% (n=5) of those children who were readmitted were HIV-infected. These children (5/58) made up 8.62% of all readmitted HIV-infected children. Among HIV negative children, 71.43% had asthma (10/14), followed by those diagnosed with severe acute malnutrition (58.33%) and diarrhoea (38.46%).

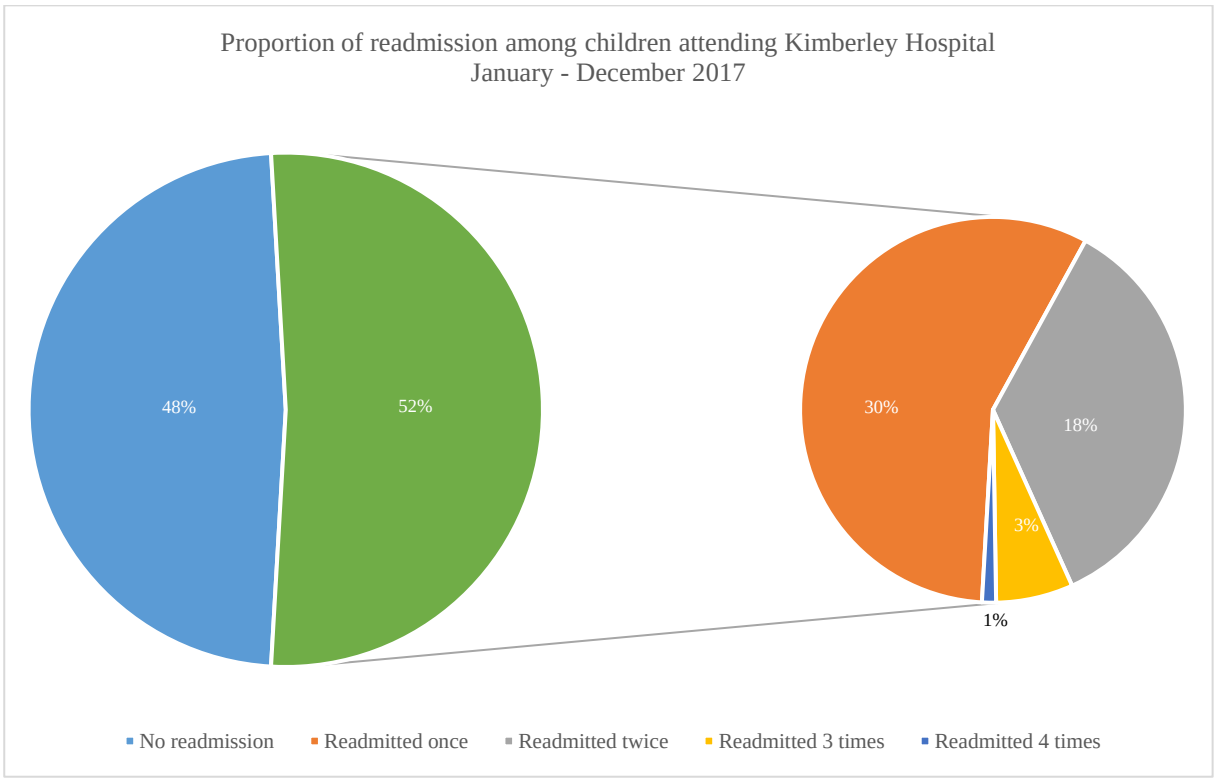

Figure 2.
Proportion of children readmitted to Kimberly hospital from Jan to Dec 2017.

Table 5.
Readmission of children by diagnosis and HIV status.

Diagnosis	HIV negative				HIV positive				Total	
	Not readmitted		Readmitted		Not readmitted		Readmitted			
	N	%	N	%	N	Row %	N	Row %	N	%
Lower respiratory tract infection	32	40.00	24	30.00	8	10.00	16	20.00	80	25.0
Acute gastroenteritis	17	54.84	7	22.58	2	6.45	5	16.13	31	9.45
Febrile convulsion	13	56.52	6	26.09	0	0.00	4	17.39	23	7.01
Tuberculosis	1	5.88	5	29.41	1	5.88	10	58.82	17	5.18
Upper respiratory tract infection	14	48.28	8	27.59	4	13.79	3	10.34	29	8.84
Asthma	3	21.43	10	71.43	1	7.14	0	0.00	14	4.27
Diarrhoea	5	38.46	5	38.46	1	7.69	2	15.38	13	3.96
Severe acute malnutrition	2	16.67	7	58.33	1	8.33	2	16.67	12	3.66
Urinary tract infection	6	54.55	3	27.27	2	18.18	0	0.00	11	3.35
Epilepsy	2	20.00	5	50.00	1	10.00	2	20.00	10	3.05
Others	43	45.74	36	38.30	1	1.06	14	14.89	94	29.27
Total	134	40.85	113	34.45	24	7.32	58	17.38	328	100.00

Table 6.
Immunisation and HIV status.

HIV status	Complete	%	Incomplete	%	Total
HIV negative	127	51.21	121	48.79	248
HIV positive	30	38.46	48	61.54	78
Total	157	48.16	169	51.84	326

Odds ratio (OR) = 1.68, p-value=0.05

Table 7.
The type of vaccines missed by children per HIV status according to the EPI-SA schedule.

Vaccines	HIV negative		HIV positive		Total	
	N	Row %	N	Row %	N	Column%
At birth						
BCG	1	0.4	0	0	1	0.31
OPV 0	1	0.4	0	0	1	0.31
6 Weeks						
OPV (1)	1	0.4	0	0	1	0.31
RV (1)	13	52	12	48	25	7.67
DTaP-IPV-Hib-HBV (1)	13	52	12	48	25	7.67
PCV (1)	13	52	12	48	25	7.67
10 Weeks						
DTaP-IPV-Hib-HBV (2)	21	58.33	15	41.67	36	11.04
14 Weeks						
RV (2)	29	64.44	16	35.56	45	13.8
DTaP-IPV-Hib-HBV (3)	0	0	0	0	0	0
PCV (2)	20	57.14	15	42.86	35	10.74
6 Months						
Measles vaccine (1)	111	71.15	45	28.85	156	47.85
9 Months						
PCV (3)	38	66.67	19	33.33	57	17.48
12 Months						
Measles (2)	5	29.41	12	70.59	17	5.21
18 Months						
DTaP-IPV-Hib-HBV (4)	0	0	0	0	0	0

Note: BCG = Bacille Calmette-Guérin; OPV = oral polio vaccine; RV = Rotavirus vaccine; DTaP-IPV-Hib-HBV = Diptheria, tetanus and acellular pertussis vaccine + inactivated polio vaccine + Haemophilus influenzae type B vaccine combined; PCV = Pneumococcal conjugate vaccine.

3.6. Immunisation Status of HIV-Infected Children

Table 6 shows that the proportion of children in this study with incomplete vaccination, according to the vaccination schedule of the Expanded Programme on Immunisation in South Africa (EPI-SA), was 51.84% (n=169). Furthermore, the results show that most HIV positive children (61.54%) had incomplete vaccinations, meaning they had missed any of the scheduled vaccine doses by 12 months of age. In terms of the relationship between HIV and immunisation status, the results indicate that HIV positive children are almost two times more likely than HIV negative children not to complete immunisations (OR=1.68, p=0.05).

Table 7 presents the vaccine doses that were missed by both HIV positive and HIV negative children. Overall, the majority of the children missed the first dose of the measles vaccine, constituting 47.85%. Of those, 71.15% were HIV negative children, while the proportion of HIV positive children constituted 28.85%. The second vaccine which was missed by most children was the third dose of the pneumococcal conjugate vaccine (PCV), constituting 17.48%, followed by the second dose of the rotavirus vaccine (RV) at 13.8%.

Table 8.
Factors associated with readmissions.

Variable	aOR	p-value	95% Confidence interval	
Child age	1.2	0.0001	1.110	1.297
HIV status	2.7	0.002	1.448	5.037
Educational status	0.7	0.035	0.598	0.989
Marital status	0.7	0.038	0.509	0.975
Measles 1	2	0.005	1.247	3.414
Measles 2	5.5	0.041	1.103	27.758

Table 8 above presents the factors associated with hospital readmission among the study population. The results show that children who have missed the first and second doses of the measles vaccines are 5.5 and 2 times more likely to be readmitted to the hospital (p=0.041 and p=0.005), respectively. Furthermore, HIV positive children are almost 3 times more likely to be readmitted compared to HIV negative children (p=0.002). In terms of caregiver's characteristics, the results illustrate that children whose parents or caregivers are single, married, or widowed are less likely to be readmitted compared to children of divorced parents or caregivers. Similarly, children whose parents or caregivers have a higher educational status are also less likely to be readmitted compared to children whose parents or caregivers have a lower educational status.

4. Discussion

4.1. Socio-Economic and Demographic Characteristics of the Children

Our study has revealed that most children who were admitted to RMSH from January 2017 to January 2018 were below the age of 3 years (61.66%), with a mean age of 3.6 years. They resided in rural areas and were predominantly female. Similar to our findings, previous studies on hospital admissions among children have consistently shown that the majority of admitted children are below 24 months of age [9, 26, 27]. Furthermore, other studies have shown that most children admitted to the hospital were less than 1 year old [11, 12]. In line with our results, studies conducted by Cohen, et al. [9] and Kebede [26] also found a higher proportion of female children than males, constituting 43% and 56%, respectively, with a higher proportion of children residing in rural areas [26].

4.2. The Prevalence of HIV and Admission Diagnosis of the Children

The prevalence of HIV among children admitted to RMSH was 24%. The most common diagnoses on admission were lower respiratory tract infection (23%) and acute gastroenteritis (10%). Similar HIV prevalence figures among children admitted to hospitals namely, 19% and 29%, were observed in these studies [11, 13]. Contrary to several studies, the prevalence of HIV among children admitted to hospitals was relatively low compared to our study, at 12% [9, 21]. In terms of admission diagnosis, Cohen, et al. [9] reported that 78% of the children in their study were admitted with lower respiratory tract infection. Similarly, Mda, et al. [12], found that most children (67%) who were admitted to Dr George Mukhari Academic Hospital also had pneumonia as the leading LRTI. Furthermore, other studies found that 61% and 85% of HIV positive children were diagnosed with LRTI on admission [11, 21]. HIV is considered a risk factor for LRTI among children [9, 28] and this is attributed to the limited protection from maternal antibodies [21]. In this study, acute gastroenteritis (AGE) was the second most commonly diagnosed condition among admitted children. These results are similar to another study where 9% of the admitted children had AGE [21]. The proportion of children diagnosed with AGE on admission was 25% and 21% in those studies, respectively [11, 29]. Additionally, TB was diagnosed in 5% of children admitted to the hospital in our study, which aligns with the findings of Meyers, et al. [11], where 7% of the children in their study had TB on admission. Among those children, 11% were HIV positive. However, a lower proportion of children diagnosed with TB on admission was observed in another study [21].

4.3. Socio-Economic and Demographic Characteristics of Caregivers

In terms of parental demographic characteristics, our study revealed that parents or caregivers of children admitted to the hospital were mainly female, aged less than 39 years (mean=32 years). They were predominantly unemployed and had a low educational status, including those with no education and primary level education. Additionally, most of them were

married and identified as Christians. A study by Olsen, et al. [30] also found similar findings, with parents or caregivers of children admitted to hospitals in Norway having a comparable mean age of 36 years for mothers and 39 years for fathers. Contrary to our study, the same study revealed that most parents or caregivers had a higher educational level (46% with postgraduate education) compared to those with low educational levels (17% with no formal education and primary education). In a study by Kebede [26], 68% of parents or caregivers of children admitted to the hospital had formal education compared to the 31% with no formal education. The results from Ndirangu, et al. [31] also differed from ours, as 61% of parents in their study had a secondary level of education.

4.4. Hospital Readmissions and HIV Positive Children

The readmission rate within 6 months in this study population was 52%, with the majority of children being readmitted only once and 18% being readmitted at least twice. About 17.38% of HIV positive children were readmitted within 6 months after discharge. Other studies have shown lower readmission rates compared to ours at 9.8% [21, 26]. For HIV positive children who were readmitted, a higher proportion of readmissions (48%) was observed in a study by Meyers, et al. [11]. This study highlights the significant financial burden that readmissions pose to the health care system and the parents because these children require increased care and result in parental days of work loss. It was found, that on average, HIV positive children stayed in the hospital for at least three days longer (up to 8 days) compared to HIV negative children. Similar results were obtained from other studies where HIV positive children stayed up to 8 days (3 days longer) compared to HIV negative children [12, 21].

4.5. Missed Vaccination Opportunities Among Admitted Children

More than half of the children in this study had an incomplete primary vaccination series, and this proportion was particularly high among HIV positive children (61.54%). Furthermore, these children were almost twice as likely to miss vaccinations compared to HIV negative children. The most commonly missed vaccines among all children were the first dose of the measles vaccine, followed by the third dose of PCV, rotavirus vaccine, and DTaP-IPV-Hib-HBV containing vaccines. These results are consistent with other studies where similar proportion of children missed measles vaccine doses (22.7% and 24%) [9, 12]. Most children who missed the DTaP-IPV-Hib-HBV containing vaccine constituting 15% and 22%, were observed in these studies [9, 31]. To successfully eliminate vertical transmission of hepatitis B (HBV) to children, the WHO recommends that all HIV exposed children receive the timely HBV birth dose and complete all three primary HBV doses [4].

4.6. Factors Associated with Hospital Readmission Among Admitted Children

In terms of factors associated with hospital readmission, the results of our study showed that older children, being HIV positive, and having missed measles vaccine doses were significantly associated with readmission to the hospital within 6 months. Similar findings have been observed in another study, where older children were more likely to be readmitted to the hospital [32]. However, contrary to our findings, another study found that younger children were more likely to be readmitted than older children [33]. Several studies have shown that HIV positive children were more than twice as likely to be readmitted to the hospital compared to children who are HIV negative [10, 32]. Furthermore, Cohen, et al. [9] reported a fourfold risk of death among HIV positive children who were readmitted to the hospital.

In terms of vaccination, another study has demonstrated that fully vaccinated children were 7 times more likely to recover from severe acute malnutrition treatment compared to children who were not fully vaccinated. This emphasises the importance of vaccination in disease prevention and strengthening the immune system among children [21].

In our study, we found that a higher parental educational status was inversely associated with the likelihood of children being readmission to the hospital. This finding is confirmed with the findings of Olsen, et al. [30]. This issue may be attributed to the level of understanding of parents, as a function of their educational status, regarding the information provided by healthcare professionals on how to care for their children after discharge, which may also be associated with less coping difficulty among parents post-discharge [34].

5. Conclusion and Recommendations

The prevalence of HIV in this study population was relatively high. The leading causes of hospital admission among children admitted to RMSH were LRTI, TB, and AGE, especially among those living with HIV. There is also evidence suggesting a substantial level of MOV among these children in relation to measles, pneumococcal conjugate, and rotavirus vaccines. Undoubtedly, children living with HIV are vulnerable to infections, have an elevated risk of readmissions, and stay relatively longer in hospital compared to their HIV negative counterparts.

In addition to HIV status of the child, factors such as MOV and increase in age among this study population were also associated with hospital readmissions. On the other hand, children whose parents or caregivers had a higher educational level and social support were less likely to be readmitted to the hospital. These findings underscore the need for concerted efforts to implement remedial actions to intensify early HIV testing and treatment, upscaling of PMTCT and EPI programmes, and retention to care, to ensure that vertical transmission is eradicated.

Intensification of catch-up immunisation efforts among children is also vital to limit their vulnerability to vaccine-preventable diseases. Lastly, continuous health education of parents and caregivers is important to enhance compliance with treatment and care of children, for better health outcomes.

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