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Healthcare Resource Utilisation in untreated HIV-infected children in a paediatric programme, Abidjan, Côte d'Ivoire, 2004–2009

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Abstract

Background—We describe healthcare resource utilisation (HCRU) among HIV-1-infected children who have not yet undergone antiretroviral treatment (ART) in Abidjan, Côte d'Ivoire.

Methods—HIV-infected children enrolled prospectively in an HIV care programme in two health facilities in Abidjan (2004–2009) were followed up from date of inclusion until: database closeout, death, ART initiation, or loss to follow-up (no clinical contact for >6 months). Incidences of HCRU (outpatient care, inpatient daycare, hospitalisation) were described according to severe morbidity and mixed effect log linear models were computed to identify associated factors.

Results—Overall, 405 children were included, entering care at a median age of 4.5 years, 66.9% were receiving cotrimoxazole prophylaxis, and 27.7% met 2006 WHO criteria for immunodeficiency by age. The median follow-up time was 11.6 months (IQR: 1.4;30.7). Overall, 371 clinical events occurred in 162 children yielding to an incidence rate (IR) of 60.9/100CY (95% CI: 55.1–67.2): 57% of clinical events led to outpatient care (IR: 33/100CY), 38% to inpatient daycare (IR: 22/100CY), and 10% to hospitalisation (IR: 5.9/100CY). Further medical examinations were made allowing confirmed diagnoses in 40% of those (IR: 22.4/100CY). Outpatient care was less common among immunodeficient children than those not (RR=0.32, IC 95%: 0. 18–0.56), in those whose main caregivers are both parents compared to those who are primarily cared for by their mother only (RR= 0.34, IC 95%:0.15–0.77)

Conclusion—Untreated HIV-infected children require substantial inpatient and outpatient care in a context where ART is scaling-up but still not available to all.

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Keywords

HIV; paediatrics; healthcare resource utilisation; morbidity; West Africa

Introduction

The implementation of programmes aimed at preventing mother-to-child transmission (PMTCT) and providing antiretroviral therapy (ART) have dramatically improved paediatric HIV care in sub-Saharan Africa.[1–4] However, in Côte d'Ivoire, as in many low-income countries in West Africa, scaling-up comprehensive care for HIV-infected children still encounters many barriers.[5–7]

First, although PMTCT coverage has improved greatly, reaching 54% in 2009[8], mothers continue to transmit the disease to their children[6–9] leading to an ongoing paediatric HIV epidemic. Second, the uptake of early infant diagnosis is poor in Côte d'Ivoire, and requires routine PCR techniques[10] which are expensive and not available to all. Consequently, children are diagnosed belatedly, at an advanced clinical and/or immunological stage of the disease. In addition, providing a continuum of care between postnatal HIV diagnosis, paediatric care and ART remains a challenge in Côte d'Ivoire. Without ART, HIV-infected children in Côte d'Ivoire also experience severe morbidity and mortality.[11–13] The proportion of HIV-infected children with access to ART in Côte d'Ivoire remains unacceptably low; it was estimated to reach only 15% in 2010[4], despite the scaling-up of ART since 2004.

While many studies describe the effects of ART both in adults[14,15] and children[5,16,17], few have assessed the utilisation of healthcare resources in HIV-infected children before their access to ART. These data would be helpful in assessing changes in paediatric healthcare utilisation before and after access to ART and guiding the "when to treat" question which remains unanswered in HIV-infected children aged > 2 years[18].

In this study, we analysed healthcare resource utilisation (HCRU) according to severe morbidity among ART-untreated HIV-1 infected children waiting for access to ART over the 2004–2009 scaling-up period of access to ART in Abidjan, Côte d'Ivoire.

Methods

Settings

This study was carried out in Abidjan, in Côte d'Ivoire. In 2004, the estimated HIV prevalence in this setting in pregnant women was 8.3%[19,20]. In 2008, PMTCT coverage was 40% and the HIV prevalence in new-born infants was 2.5%[21].

The Aconda programme is a non-governmental association whose main objective is providing care to HIV-infected patients in Côte d'Ivoire. Children enter the Aconda programme in one of two ways: (i) after an HIV diagnosis at a paediatric clinic following presentation with AIDS-related symptoms, or (ii) after referral for HIV testing because their mother was identified as HIV-infected. In partnership with the Bordeaux School of Public Health (ISPED, France), Aconda launched in 2004 a five-year programme of access to HIV care and treatment delivering ART according to the 2006 WHO guidelines. In addition to a number of public and private healthcare facilities, the programme relies mostly on two healthcare facilities entirely dedicated to paediatric care: the CePReF- Enfant (*Centre de Prise en Charge, de Recherche et de Formation*), and the MTCT-*Plus* programme (Mother-To-Child-Transmission prevention programme). The CePReF provides care for one of the

largest active paediatric ART cohorts in Abidjan[5]; the MTCT-Plus programme follows infants born to identified HIV-infected mothers[22].

Standard of care

The Aconda programme delivers a comprehensive model of paediatric HIV care covering three components: psychological care (diagnosis disclosure), clinical care (diagnosis and treatment, including ART and prophylaxis of opportunistic infections) and prevention (HIV screening). In addition, clinical research studies are also conducted in the CePReF and the MTCT-Plus sites. Partly financed by the President's Emergency Plan for AIDS Relief (PEPfAR) through the Elizabeth Glaser Paediatric AIDS Foundation (EGPAF), antiretroviral treatments, cotrimoxazole prophylaxis and blood analyses are free of charge. However, X-rays, in-patient daycare and other medication (such as antibiotics and antimalarial treatment) are only partially subsidised, while routine medical examinations (blood smears, cultures and microscopy) are still mostly paid for by patient families.

Study design and participants

Eligibility criteria for inclusion in our study included all those aged ≤ 15 years who had not initiated any form of ART other than a PMTCT intervention and who were enrolled in the Aconda programme (CePReF and MTCT-Plus) between 1st January 2004 and 31st December 2009 after a confirmed HIV diagnosis by PCR or a serology if aged ≥ 18 months.

Data collection and analysis

Patient data were mainly stored in paper-based medical records at the CePReF. The data were collected retrospectively using a standardised data collection instrument issued specifically for this purpose. A thorough description of the data collection has been described elsewhere[11]. We analysed HCRU among children followed-up at least once between 2004 and 2009, from their inclusion in the Aconda programme until ART initiation or closeout date (death or lost-to-follow-up, defined as no clinical contact > 6 months).

Events were classified as "severe morbidity" if they were suspected WHO stage 3 or 4 events, or led to inpatient daycare, hospitalisation or death. Because there was no standard diagnosis validation tool, events were defined as "definite "or "probable" according to the WHO case definitions of HIV surveillance (2006)[23]. In addition, malaria was considered to have occurred if the diagnosis was either confirmed by a positive blood smear, or suspected by the presence of a high temperature leading to a prescription for an antimalarial treatment.

To be consistent with the study period, immunodeficiency was defined according to the WHO recommendation issued in 2006[24].

HCRU was defined as either *(i)* outpatient care: *(i.a)* medical examination with complementary diagnosis method (such as complete blood count [CBC], X-ray, blood smear) and *(i.b)* any of the following drug prescription: antibiotics, antimalarial treatments, tuberculosis treatment not involving any kind of hospitalisation; or *(ii)* inpatient care: *(ii.a)* inpatient day-care by periods of 24 hours and *(ii.b)* hospitalisation. All HCRU initiated within 24 hours of the diagnosis were considered.

Baseline categorical data are presented as frequencies (%) and continuous variables as median (interquartile range [IQR]). Incidence rates (IR) of HCRU (complementary diagnosis, drug prescription, inpatient day-care and hospitalisation) occurring per 100 child-years (CY) of follow-up were computed with their 95% confidence interval (95%CI). IRs were described overall and according to age groups.

Factors associated with the IR of HCRU were described with a Poisson regression approach, allowing variance adjustment for non-independence when multiple observations were included for a single patient. Relative risks were estimated using the generalised estimating equations approach[25]. Analyses were performed using *proc gemnod* in SAS 9.2.

Results

Baseline characteristics

Overall, 405 children were included in our study: 313 from the CePReF and 92 from the MTCT-plus database. The baseline characteristics are presented in Table 1. Briefly, children were diagnosed at a median age of 4.5 years (IQR: 1.9 – 7.5); 46.7% were female. Overall, 12.3% were classified as CDC stage C with a significantly higher proportion in those aged 10–15 years (22.1%, p<0.0001). Immunological data (CD4 percent or count) were available for 308 children (76.1%), of these children, 27.7% met the 2006 WHO criteria for immunodeficiency by age. The proportion of immunodeficient children was highest amongst the 10–15 year olds (55%, p<0.0001). Of the 74.1% of children eligible for cotrimoxazole prophylaxis according to the 2007 WHO recommendations for the use of cotrimoxazole[26], 90.3% were under treatment. Only 36% of children aged < 1 year were prescribed cotrimoxazole prophylaxis.

Patient follow-up and severe morbidity

Overall 405 children were included and followed up for a median length of 11.6 months (IQR: 1.4 – 30.7). At baseline, 136 (33.6%) were eligible for ART initiation; of these children 113 initiated ART (83.1%), after a median time of 0.9 months (IQR:0.5–3.1), 8 died (5.9%) and 6 were loss-to-follow-up (14.6%). The remaining 268 children not yet eligible for ART at baseline were followed up for a median time of 16.1 months (IQR: 7.9–26.2)); 127 (47.2%) initiated ART, 13 (4.8%) died and 35 (13%) were lost to follow-up. The total follow-up period was 642.31 child-years of observation.

During this period, 371 severe morbid events were registered in 162 children (40%). The median time, from the date of enrolment until the occurrence of the first event was 9.1 months (IQR: 1.2 – 26.3). The overall observed severe morbidity IR was 60.9 per 100 child-years of follow-up (CY) (95%CI: [55.1–67.2]). %); this was significantly more frequent in children aged >10 years, varying from 29.0 per 100 CY in children aged < 1 year to 95.5 per 100 CY in children aged 10–15 years (p<0.0001) (Table 2). The leading cause of severe morbidity was malaria, including clinical diagnoses of malaria (35%). Lung diseases, including bronchiectasis, and diarrhoea were also frequent causes of morbidity (respectively 20% and 14%) (Table 3).

Healthcare resource utilisation

Outpatient care—Of the 371 severe morbid events, 212 led to any outpatient care, either complementary diagnosis or a prescription, yielding an estimated IR of 33.0 per 100 CY of follow-up (95%CI: 28.9–37.8) (Table 2).

Complementary diagnosis IR was 22.4 per 100 CY (95%CI: 19.1 – 26.4). Radiology was the most frequent diagnosis tool (15%), mostly used to investigate probable chronic lung diseases (53%) and pulmonary tuberculosis (57%). Of the 21 suspected cases of pulmonary tuberculosis, only 5 diagnoses led to complementary diagnoses by sputum culture. Although suspected malaria was the leading cause of severe morbidity, only 11% of the presumptive diagnoses were confirmed by blood smear. Consequently, less than half of the documented severe morbidity had confirmed diagnoses.

The overall estimated outpatient prescription IR was 15.3 per 100 CY (95%CI: 12.5 – 18.6); antibiotics were the most frequent (IR= 10.1/100CY, 95%CI: 7.9–12.9). Age specific IRs and their 95%CI are described in Table 2. There were no records of treatment prescriptions for children aged > 10 years. We observe the higher rates of prescriptions among children aged 2–5 years (20.4, 11.0 and 9.9 per 100 CY, overall, antibiotics and antimalarial treatment respectively).

Table 3 describes HCRU according to severe morbid events. Of the 135 malaria cases, 69 (51%) led to outpatient care. Chronic lung disease led to a high rate of outpatient care (96%). Moreover, the 21 suspected TB cases led to 24 different outpatient healthcare resources (114.3%), corresponding to 20 complementary diagnoses and 4 TB treatment prescriptions,

When adjusted for age, immunodeficiency at baseline and primary caregiver, children presenting evidence of immunodeficiency and children with no immunological follow-up were less disposed to receive outpatient care (RR= 0.32, 95%IC: (0.18 – 0.56) and RR = 0.27, 95%CI: (0.13 – 0.56) respectively) compared to children with no evidence of immunodeficiency. Moreover, we observed lower outpatient HCRU in children primarily cared for by both parents compared to those whose primary caregiver was their mother alone (RR: 0.34, 95%CI: (0.15 – 0.77).

Inpatient care—The overall inpatient care IR (daycare and hospitalisation) was 27.7 per 100 CY of follow-up, 95%IC: (23.9–32.1). The estimated inpatient day care rate was 21.8 per 100 CY of follow-up; the rate of hospitalisation was 5.9 per 100 CY (Table 2). There were no significant differences in inpatient care IR in the difference age groups (p= 0.49).

Inpatient daycare was mostly accompanied by intravenous therapy and many events led to more than 12 hours of care (percentages > 100%). Overall, it was more frequent following suspected malaria or lung disease (55% and 4% with and without IV therapy respectively) (Table 3).

We had records for 38 hospitalisations; malaria, bacterial infections and severe anaemia were the leading causes. However, 16 of these hospitalisations were for undocumented reasons and represented 94% of the unknown morbidity, most of which had already led to outpatient care or inpatient daycare.

Factors associated with inpatient care are presented in Table 4. As for outpatient care, we observe significantly low inpatient HCRU in children whose primary caregivers are both parents compared to those primarily cared for by their mothers only (RR = 0.30, IC95%: (0.14 – 0.65)). On the other hand, inpatient care was significantly highest in children with no available CD4 data compared to those with documented CD4 suggesting no signs of immunodeficiency at baseline (RR = 2.91, IC95%: (1.66; 5.11)).

Discussion

This cohort study documents healthcare resource utilisation in HIV-1 infected children who had not yet undergone ART initiation, in Abidjan, Côte d'Ivoire, and who were followed up in a paediatric HIV care programme between 2004 and 2009. In this context, we make three main observations. First, the severe morbidity rate is high, and highest in older children, reaching 95.5/100 CY in children aged > 10 years. Second, the overall coverage of cotrimoxazole prophylaxis at baseline is very low in children aged < 1 year, reaching only 36%. Third, HCRU is defined by severe morbidity and is not systematic, as only 57% of the severe morbid events led to further investigation and/or treatment. HCRU was less frequent

among children whose primary caregivers were both parents compared to mother alone; outpatient care was higher in children not yet immunodeficient whereas we observed an inverse pattern in inpatient care.

Severe morbidity in untreated HIV-infected children is early and frequent. In previous work we showed that the risk of developing a severe morbid event was not associated with immune status, suggesting substantial morbidity attributable to other co-infections and the need for optimal prevention and care in untreated HIV-infected children[11]. Indeed, these children are vulnerable to numerous serious opportunistic infections and infectious morbidity; our study showed high rates of probable malaria, lung disease, diarrheal disease and tuberculosis. This is in agreement with well-documented high risks in sub-Saharan African HIV-infected children for malaria[27], tuberculosis[28], respiratory tract infections[12,13], and diarrheal disease[29]. Prophylactic cotrimoxazole has been shown to be effective to help prevent each one of these diseases[30–32] and is an affordable intervention. However, even in an HIV healthcare programme, it is still not available to all, despite the fact it is recommended from 6 weeks of age in HIV-exposed infants before HIV diagnosis[26]. These findings highlight the need for a greater utilisation of diagnostic and therapeutic services, and most importantly the operational difficulties healthcare centres face in the management of paediatric HIV. Resources for diagnosis and treatment have become available through HIV/AIDS control programmes, but there remains a deficiency in the pre-ART care of paediatric HIV; less than 50% of the severe morbidity triggered examinations or treatment. Radiology and blood analyses were the most commonly used diagnosis tools. We explain this lack of use mainly because of the costs for the families for more elaborate examinations that would not be subsidised. Consequently, diagnoses are made relying on clinical symptoms or approximate diagnosis methods. Costs of HIV care could also explain, in part, the low rate of HCRU: although both inpatient daycare and HIV treatments are subsidised by the Aconda programme, there still remains a cost for the families to access these treatments that they may not always be able to pay. Moreover, much of the inpatient daycare exceeded 48 hours, comparable to hospitalisation, and probably occurred in a context where actual hospitalisation would have been more favourable if had been affordable. We suspect this is a common option which families may select because inpatient daycare is subsidised by the care programme, limiting patient costs but delaying care. While ART remains free, other paediatric care must be paid for in part by patients/caregivers. As such care is often not affordable, many patients experience poor retention in care, severe avoidable morbidity and early mortality.

Outpatient care was less frequent in children who were immunodeficient at baseline. These children were already at an advanced stage of disease and were more likely to initiate ART, leading to less observed time at risk. However, these children were already at an advanced stage of disease and faced a higher risk of death[33]; they may have been more likely to die at home before they could reach healthcare facilities. We hypothesize that these children may account for a larger proportion of undocumented deaths and lost to follow-up than non-immunodeficient children[34].

We can explain the inverse observation in inpatient care by the severity of the event. Indeed, children with no available immunological data tend to be children with very severe clinical conditions and who die or are transferred to hospitals for long term care.

HCRU was lower in children cared for by both parents. Indeed, having both parents as primary caregivers implies that when medical decisions are necessary, both parents should consent. Recent studies have pointed out the social barriers often encountered in paediatric HIV care programmes when disclosing the child's and mother's HIV status to the father.[35,36] The results observed in the "both parents" group can be explained by this and we

hypothesise that the father of most of these children is unaware of his child's and possibly wife's HIV status.

Our model does not allow observing the effect of cotrimoxazole prophylaxis on HCRU. Indeed, coverage of cotrimoxazole prophylaxis was correlated with age and significantly less frequent in infants < 1 year, who constitute a too small proportion of our cohort to allow the model to converge. Nevertheless, we report incidences of severe morbidity and associated HCRU, showing substantial morbidity attributable to other co-infectious diseases and the need for pre-ART care despite cotrimoxazole prophylaxis.

There are two major limitations inherent in our retrospective study design. First, our cohort is exposed to a left truncation bias: the less symptomatic children are the ones more likely to still be alive and therefore our study is based on a selected population of the more healthy untreated HIV-infected children. Our study population is comprised of children diagnosed at a later age, having consequently survived many events and who have been included in an HIV programme where the healthcare support might have been better than that offered outside of the Aconda context. However, this survivorship bias is existent in many other studies.[37,38] Second, severe morbidity and HCRU are likely under-documented in our dataset. For example, the completion of medical charts may vary from one paediatrician to another and over time, and diagnoses could not be routinely confirmed using standardised diagnosic procedures. We acknowledge that the reliability of clinical events is questionable; however we attempted to ensure the accuracy of severe morbidity by requiring specific documentation, such as clinical findings, laboratory examinations and radiographic results. Social stigmatisation of HIV among the African population also leads to withheld information concerning events during follow-up[39].

Despite these considerations, our study provides original data on pre-ART severe morbidity and healthcare resource utilisation in a large paediatric cohort, reflecting as best as possible the current clinical practices in Côte d'Ivoire. Managing HIV in children remains challenging in an era where ART is scaling-up[40,41]. Free cotrimoxazole prophylaxis according to the WHO recommendations and other diagnostic and therapeutic interventions are still not available to all, leading to avoidable severe morbidity in those HIV-infected children who have not yet initiated ART. This study took place in 2004–2009, during the roll-out of ART in Côte d'Ivoire. However, because of operational limitations, such as delays in diagnosis or presentation to care, stigma associated with HIV care, limited ART availability, and the requirement for self-pay for a number of diagnostic and therapeutic services we observed many missed opportunities to put eligible children on ART. Although the WHO has revised its guidelines now recommending ART for all HIV-infected children < 24 months, the coverage in resource-limited settings remains low[8]. Identifying HIV-infected infants is a challenge in West Africa. In addition to the sophisticated and expensive techniques required for early infant diagnosis of HIV, PMTCT coverage is low; PMTCT services are estimated to have reached only 54% of pregnant, HIV-infected women in Côte d'Ivoire in 2009. Although PMTCT interventions are scaling up today, this emphasises the need for efforts to strengthen the link between PMTCT and childcare programmes. Improving pre-ART care remains a priority in the management of the paediatric HIV epidemic and access to cotrimoxazole must remain a priority in such a population.

Additional research must be undertaken in a paediatric population, to better understand the severe morbidity in HIV-infected children and retention in care as well as associated costs in order to guide public health interventions, as it has recently been done in developed countries[42]. The data presented here represent a base case scenario against which we could compare more frequently reported outcomes for children receiving ART, and we therefore believe that these data can inform current debates about the impact of universal ART

initiation (regardless of CD4) for children of various ages, particularly in those older than 2 years. Furthermore, llifetime pre-ART treatment costs will probably be overweighed after ART access, as paediatric HIV infection becomes a chronic disease leading to greater healthcare utilisations. This will have to be assessed and will highlight the cost-effectiveness of preventing MTCT in low income countries.

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Table 1

Baseline characteristics by age in 405 untreated HIV-infected children in a paediatric HIV care programme

CePReF and the MTCT-Plus programme, Abidjan, Côte d'Ivoire (January-2004 – December 2009).

	Overall N = 405	Age < 1 year N = 64	Age [1 – 2] years N = 42	Age [2 – 5] years N = 108	Age [5 – 10] years N = 142	Age [10 – 15] years N = 49
Age, years, median (IQR)	4.5 *(1.9; 7.5)*	0.3 *(0.01; 0.6)*	1.7 *(1.6; 1.8)*	3.4 *(2.6; 4.1)*	7 *(5.9; 8.5)*	12.1 *(11.2; 13.1)*
Female, n (%)	189 *(46.7)*	30 *(46.9)*	19 *(45.2)*	47 *(43.5)*	75 *(52.8)*	18 *(36.7)*
CD4 cell %, median (IQR)	19 *(14; 25.5)*	18.3 *(14.1; 26)*	17.9 *(11.7; 23.3)*	20.7 *(14; 26.2)*	NA	NA
CD4 count/µL, median (IQR)	403 *(151; 665)*	NA	NA	NA	507.5 *(234; 723)*	213.5 *(55; 413)*
Immunodeficient children*, n (%)	112 *(27.7)*	10 *(15.6)*	10 *(15.6)*	26 *(24.1)*	39 *(27.5)*	27 *(55.1)*
CDC stage C, n (%)	50 *(12.3)*	7 *(10.9)*	6 *(14.3)*	12 *(11.1)*	14 *(9.9)*	11 *(22.1)*
Baseline cotrimoxazole prophylaxis n (%)	271 *(66.9)*	23 *(35.9)*	33 *(78.6)*	74 *(68.5)*	102 *(71.8)*	39 *(67.4)*
History of PMTCT intervention, n (%)	65 *(18.1)*	50 *(78.1)*	10 *(23.8)*	5 *(4.6)*	NA	NA
Principal caregiver, n (%)						
Mother alone	40 *(9,9)*	-	7 *(16,7)*	5 *(4,6)*	18 *(12,7)*	10 *(20,4)*
Father alone	23 *(5,7)*	-	-	4 *(3,7)*	16 *(11,3)*	3 *(6,1)*
Both parents	149 *(36,8)*	19 *(29,7)*	22 *(52,4)*	60 *(55,6)*	46 *(32,4)*	2 *(4,1)*
Other	193 *(47,7)*	45 *(70,3)*	13 *(30,9)*	33 *(36,1)*	62 *(43,6)*	34 *(69,4)*

NA: Not Available

*According the 2006 WHO definitions

Table 2

Overall and age at baseline specific incidence density rate per 100 child-years (IR*) of severe morbidity, complementary diagnosis, outpatient care and inpatient care in ART-naïve children. CePReF and the MTCT-Plus programme, Abidjan, Côte d'Ivoire (January-2004 – December 2009). n=405

	Overall N = 405	Age < 1 year N = 64	Age 1 – 2 years N = 42	Age 2 – 5 years N = 108	Age 5 – 10 years N = 142	Age 10 – 15 years N = 49
Number of child-years of follow-up	642.3	93.0	58.7	181.5	271.4	37.7
At least 1 severe event, n (%)	162 *(40)*	13 *(20.3)*	12 *(28.6)*	43 *(39.8)*	70 *(49.3)*	24 *(49.0)*
Morbidity events, n (%)	371 *(100)*	27 *(7.3)*	30 *(8.1)*	115 *(31.0)*	163 *(43.9)*	36 *(9.7)*
IR*, (95%CI)	60.9 *(55.1 – 67.2)*	29 *(20 – 42.2)*	51.1 *(35.9–72.9)*	63.4 *(52.8 – 76.1)*	60.1 *(51.5 – 70)*	95.5 *(69.1 – 132.2)*
Overall oupatient care, n (%)	212 *(100)*	23 *(10.8)*	15 *(7.1)*	72 *(34.0)*	82 *(38.7)*	20 *(9.4)*
IR*, (95% CI)	33.0 *(28.9–37.8)*	24.7 *(16.5–37.1)*	25.6 *(15.6–42.1)*	39.7 *(31.5–50)*	30.2 *(24.4–37.5)*	53.1 *(34.5–81.9)*
Complementary diagnoses, n (%)	144 *(100)*	17 *(11.8)*	9 *(6.3)*	43 *(29.9)*	55 *(38.2)*	20 *(13.9)*
IR*, (95% CI)	22.4 *(19.1 – 26.4)*	18.3 *(11.5 – 29.3)*	15.3 *(8.2 – 29.1)*	23.7 *(17.6 – 31.9)*	20.3 *(15.6 – 26.4)*	53.1 *(34.5 – 81.9)*
Outpatient prescriptions, n (%)	98 *(100)*	12 *(12.2)*	6 *(6.1)*	37 *(37.8)*	43 *(43.9)*	-
IR*, (95% CI)	15.3 *(12.5 – 18.6)*	12.9 *(7.4 – 22.5)*	10.2 *(4.8 – 22.2)*	20.4 *(14.8 – 28.1)*	15.8 *(11.8 – 21.3)*	
Antibiotics, n (%)	65 *(100)*	8 *(12.3)*	1 *(1.5)*	20 *(30.8)*	36 *(55.4)*	-
IR*, (95% CI)	10.1 *(7.9 – 12.9)*	8.6 *(4.4 – 16.9)*	1.7 *(0.4 – 9.5)*	11 *(7.2 – 17)*	13.3 *(9.6 – 18.4)*	
Antimalarial, n (%)	39 *(100)*	4 *(10.3)*	4 *(10.3)*	18 *(46.2)*	13 *(33.3)*	-
IR*, (95% CI)	6.1 *(4.5 – 8.3)*	4.3 *(1.8 – 11)*	6.8 *(2.8 – 17.4)*	9.9 *(6.3 – 15.7)*	4.8 *(2.8 – 8.2)*	
TB treatment, n (%)	4 *(100)*	1 *(25.0)*	-	1 *(25.0)*	2 *(50.0)*	-
IR*, (95% CI)	0.6 *(0.3 – 1.6)*	1.1 *(0.3 – 6)*		0.6 *(0.1 – 3.1)*	0.8 *(0.2 – 2.7)*	
Overall inpatient care, n (%)	178 *(100)*	20 *(11.2)*	14 *(7.9)*	60 *(33.7)*	77 *(43.3)*	7 *(3.9)*
IR*, (95% CI)	27.7 *(23.9–32.1)*	21.5 *(13.9–33.2)*	23.9 *(14.3–40)*	33.1 *(25.7–42.6)*	28.4 *(22.7–35.5)*	18.6 *(9.2–38.3)*
Inpatient daycare, n (%)	140 *(100)*	10 *(7.1)*	10 *(7.1)*	50 *(35.7)*	67 *(47.9)*	3 *(2.1)*
IR*, (95% CI)	21.8 *(18.5 – 25.7)*	10.8 *(5.9 – 19.8)*	17 *(9.4 – 31.2)*	27.6 *(20.9 – 36.3)*	24.7 *(19.5 – 31.2)*	7.9 *(2.3 – 23.3)*
Hospitalisations, n (%)	38 *(100)*	10 *(26.3)*	4 *(10.5)*	10 *(26.3)*	10 *(26.3)*	4 *(10.5)*
IR*, (95% CI)	5.9 *(4.3–8.1)*	10.8 *(5.9–19.8)*	6.8 *(2.8–17.4)*	5.5 *(3.1–10.1)*	3.7 *(21.–6.8)*	10.6 *(4.3–27.2)*

Table 3

Inpatient care described according to the 371 severe morbid events occurring 162 ART-naïve children

CePReF and the MTCT-Plus programme. Abidjan. Côte d'Ivoire (January-2004 – December 2009).

	Overall	Any outpatient care *	Daycare with IV therapy	Daycare without IV therapy	Hospitalisation
Malaria n, %	135 *(36.4)*	69 *(51.1)*	74 *(54.8)*	5 *(3.7)*	7 *(5.2)*
Chronic Lung Disease n, %	78 *(21.1)*	75 *(96.2)*	15 *(19.2)*	1 *(1.3)*	2 *(2.6)*
Diarrhea n, %	53 *(14.3)*	18 *(33.9)*	10 *(18.9)*	1 *(1.9)*	3 *(5.7)*
Bacterial infection n, %	24 *(6.5)*	18 *(75.0)*	5 *(20.8)*	-	3 *(12.5)*
Pulmonary tuberculosis, n %	21 *(5.7)*	24 *(114.3)**	-	-	-
Failure to thrive n, %	15 *(4.1)*	3 *(20.0)*	1 *(6.7)*	-	2 *(13.3)*
Anaemia n, %	7 *(1.9)*	3 *(42.9)*	4 *(57.1)*	-	2 *(28.6)*
Fever n, %	2 *(0.5)*	-	4 *(200.0)**	-	-
Other non-AIDS defining events, n %	15 *(4.1)*	5 *(33.3)*	2 *(13.3)*	-	2 *(13.3)*
Other WHO Stage 4 events, n %	4 *(1.1)*	3 *(75.0)*	-	-	1 *(25.0)*
Unknown n, %	17 *(4.6)*	15 *(88.2)*	11 *(64.7)*	7 *(41.2)*	16 *(94.1)*
Total	371 *(100)*	233 *(62.8)*	126 *(33.9)*	14 *(3.8)*	38 *(10.2)*

* One event can lead to more than one resource to healthcare, leading to % > 100%

Table 4

Factors associated with resource to healthcare (outpatient and inpatient care respectively) in ART-naïve children

CePReF and the MTCT-Plus programme. Abidjan. Côte d'Ivoire (January-2004 – December 2009). n=405

	Outpatient care			*Inpatient care*		
	RR	**IC95%**	***p***	***RR***	**IC95%**	***p***
Age			***0.448***			***0.279***
< 1 year	1	-		1	-	
1 – 2 years	0.50	*(0.15 – 1.63)*		0.53	*(0.18 – 1.57)*	
2 – 5 years	1.01	*(0.38 – 2.67)*		1.10	*(0.50 – 2.45)*	
> 5 years	0.80	*(0.31 – 2.10)*		0.86	*(0.40 – 1.83)*	
Immunosuppression *			***0.009***			***0.008***
No evidence	1	-		1	-	
Evidence	**0.32**	***(0.18 – 0.59)***		0.83	*(0.47 – 1.47)*	
CD4 count unknown	**0.27**	***(0.13 – 0.56)***		**2.91**	***(1.66 – 5.11)***	
Principal caregiver			***0.006***			***0.004***
Mother alone	1	-		1	-	
Father alone	0.66	*(0.33 – 1.33)*		0.54	*(0.28 – 1.05)*	
Both parents	**0.34**	***(0.15 – 0.77)***		**0.30**	***(0.14 – 0.65)***	
Other	1.09	*(0.47 – 2.52)*		1.01	*(0.44 – 2.29)*	

*According the 2006 WHO definitions