

# **Success with antiretroviral treatment for children in Kigali, Rwanda: Experience with health center/nurse- based care**

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# **Abstract**

## **Background**

Although a number of studies have shown good results in treating children with antiretroviral drugs (ARVs) in hospital settings, there is limited published information on results in pediatric programs that are based in health centers, and that use nurses to provide care.

## **Methods**

Program treatment and outcome data were reported from two government-run health centers that were supported by Médecins Sans Frontières (MSF) in Kigali, Rwanda between October 2003 and June 2007. Interviews were held with health center staff and MSF program records were reviewed to describe the organization of the program. The program emphasized family-centered care addressing the psychosocial needs of both caregivers and children to facilitate early diagnosis, good adherence and follow-up. Innovative techniques included playgroups, stories, fairy tales and a specifically-designed work book on HIV. Other important aspects included adequate training and supervision of nurses to manage ARV treatment.

## **Results**

A total of 315 children (< 15 years) were started on ARVs, at a median age of 7.2 years (range: 0.7-14.9). Sixty percent were in WHO clinical stage I/II, with a median CD4 % of 14%. Eighty-nine percent (n=281) started a stavudine-containing regimen, mainly using the adult fixed-dose combination. The median follow-up time after ARV initiation was 2 years (interquartile range 1.2-2.6). Eighty-four percent (n=265) children were still on treatment in the program. Thirty (9.5%) were transferred out, eight (2.6%) died and 12 (3.8%) were lost-to follow-up. An important feature of the

study was that viral loads were done at a median time period of 18 months after starting ARVs and were available for 87% of the children. Of the 174 samples, VL was < 400 copies/ml in 82.8% (n=144). Two children were started on second-line ARVs. Treatment was changed due to toxicity for 26 children (8.3%), mainly related to nevirapine.

### **Conclusions**

This report suggests that providing ARVs to children in health centers using nurses is both feasible and very effective. Adequate numbers and training of nursing staff and an emphasis on the psychosocial needs of caregivers and children have been key elements for the successful scaling-up of ARVs at this level of the health system.

## **Background**

Treatment of children with the acquired immunodeficiency syndrome (AIDS) using antiretroviral drugs (ARVs) has been a major challenge in the fight against the human immunodeficiency virus (HIV), especially in resource-constrained settings. While there have been a number of studies showing good outcomes in treating pediatric populations with ARVs in these contexts [1-10], these programs have essentially been carried out in hospital settings with significant physician involvement.

In resource-poor settings, reliance on doctor and hospital-centered care hampers the ability to scale-up, and task shifting has become a recognized strategy [11-13]. The use of nurses based in health centers to provide front-line ARV care increases the coverage but it is not clear whether this compromises quality in terms of treatment outcomes. There have been virtually no studies demonstrating detailed outcomes of treatment in health centers staffed by nurses and little published information on the details of how to provide this type of care, particularly in addressing the psychosocial issues at this basic level.

This report describes the pediatric ARV program implemented in two government health centers in Kigali, Rwanda, using nurses, with details of its psychosocial aspects, and treatment outcomes.

# Methods

## Design

Retrospective analysis of routinely collected outcomes from the ARV program in two health centers in Kigali, combined with interviews with key health center and MSF staff. MSF reports since program inception were also reviewed.

## Setting

Rwanda, with a population of around 9 million inhabitants, has an overall HIV prevalence of 3% and more than 7% in urban areas [14]. The latest estimate in 2006 by TRAC (Treatment and Research AIDS Center) of the number of HIV-infected children was 13901 with half of them (6951) in need of ARVs [15]. By the end of May 2007, almost half (3255) had benefited from antiretroviral treatment (ART).

The two clinics in this report were Kimironko and Kinyinya health centers, located in Kigali. Kimironko was an urban government health center with a catchment area of about 75.000 people while Kinyinya was semi-rural, being located at the outskirts of Kigali, with an estimated population of 17.000.

In addition to routine health care, the health centers provided comprehensive HIV care and started offering ARVs at a decentralized level, beginning in October 2003 in Kimironko and followed in January 2004 in Kinyinya. They were among the first services in the country to offer ART. By July 2007, 3252 patients had been started on ART within these two clinics and of these, 332 children were enrolled in the ART

program. These two clinics have been supported by Médecins Sans Frontières (MSF) since 2002.

### **Sample**

The sample included all children enrolled in the HIV program who qualified for ARVs from the launch of the ART program from October 2003 till Jan 1/2007. With data collected until June 30/2007, all children had been on ART for at least six months. See Figure 1 for details about how children were selected for ARVs and their treatment paths.

### **Description of the Pediatric HIV program**

#### *National government's commitment and external support*

The pediatric program in the two clinics was part of the Rwandan national ART program, essentially run by government health care staff. The national program has seen a successful scaling-up over the last years, organized through the CNLS (National AIDS Control Commission) and TRAC. A constructive collaboration with various international partners has taken place, with substantial financial support provided by the Global Fund to fight AIDS, Tuberculosis and Malaria (GF). The government's commitment was demonstrated by providing additional nursing and laboratory staff as well as ongoing laboratory services, training and ARV procurement. Retention of government staff was facilitated by performance-based financial incentives, continuous training and promotion of responsibilities for the staff in the project. MSF's contributions included refurbishing clinic buildings, training and supervising staff, providing financial incentives and upgrading the labs.

### Nurse-based treatment and care

From the onset, nursing staff received theoretical and bed-side training in comprehensive HIV care in general, and in pediatric aspects in particular, from the HIV physician, gradually increasing their knowledge and confidence. Using this knowledge, they were able to initiate and change ARV treatment, with medical confirmation, and perform routine follow-up of the children, aided by simplified treatment protocols and growth curve charts provided in the consultation rooms. The approach towards recognizing side-effects of ARVs was standardized through basic protocols, and indications for referral to the physician were defined. Ongoing training and supervision was ensured by having one full-time equivalent physician per health center, who was ultimately responsible for the medical care. As the program matured, physician involvement decreased to a presence three times a week. A great deal of emphasis was placed on comprehensive care with a family-centered approach including methods to address the psychosocial issues of HIV. ARVs were dispensed by a nurse with extensive practical experience in ARVs and additional training through the national program.

Initially, children were followed medically together with the adult patients, but had their support groups on separate days. Subsequently, a special consultation for children, integrating both medical and psychosocial aspects, was introduced once a week, reducing the amount of traveling and out-of-school time for the children. It also allowed them to receive care and follow-up in the presence of other children, making the whole experience more child-friendly.

### *Voluntary Counselling and HIV testing (VCT) for children: overcoming barriers*

Early in the program, we observed that several barriers existed among the patients and staff towards testing of children. Caregivers themselves were distressed by their own recent HIV diagnosis. They were reluctant to discuss testing of their children, since they felt guilty, fearing the reaction of the child to their own and the child's disclosure, and being worried about the health and future of the child. From the start of the program, support and discussion groups were organized for the caregivers, designed to increase the acceptance of their own HIV-positive status, a prerequisite for discussing testing of their children. In addition, prior to starting ARVs, individual in-depth counseling sessions were held to discuss testing of children in detail. Subsequently, the health center-based support groups were transformed into community-based support groups. Within these, the group leaders, serving as role-models of positive living with HIV, helped to make HIV more easily discussed within the community and to raise issues like testing of partners and children.

### *Adequate disclosure and ongoing psychosocial support*

In our experience, adults and children were generally not well prepared when they came for testing of the child. Few children knew exactly why they were there, had little knowledge of HIV and rarely knew about the status of the caregiver. However, the children preferred to be informed about their and their caretaker's status from the caretaker and felt cheated when they were not told the truth. Consequently, we tried to involve the caretaker as much as possible during disclosure. Caretakers were first counselled on why it was important to talk openly with their children about HIV, why their active participation was important for the child, how the child might react, and how they should respond to questions. During disclosure, we tried to have the

caregiver explain their and the child's status, supported by the counsellor. The use of a booklet explaining HIV provided a common language around HIV (Figure 2).

Testing of children was done on a separate day, ensuring that enough time was available for every child, making the environment/event more child-friendly and facilitating on-site training of health care staff in counseling of children. Individual disclosure was considered when the child was > 6 years old.

Within the child support groups, an environment was created where the children could express themselves, raise their questions and worries and develop a positive attitude towards life with HIV. Most of the issues discussed were raised by the children themselves and reflected their deeper feelings: HIV (what, why and how?), life and death, sexuality, manipulation in the caregiver-child relationship and discrimination. The issues were addressed in several ways using open discussions, games, fairy-tales and drawings. These groups (consisting of 12-15 children) were organized into groups according to age (7-11; 12-14; 15-18 years) and were open to all children from the age of 7 years on, irrespective of taking ARV. Caregivers were invited to participate in some of these sessions to ensure they were aware of the children's knowledge and feelings towards their diagnosis. If individual problems were identified through the groups, individual follow-up was offered. More recently, the child support groups were combined with the medical consultation; while at the same time, a support group for caretakers was taking place.

#### Who were the caregivers ?

Close to 65 % of the children were taken care of by one or both parent(s), 25% received care from the extended family (grand-parents, brothers/sisters, cousins,...),

and about 10 % of children were orphans with adoptive caregivers. In general, no child was tested without the caretaker being tested.

### **ART eligibility, regimens, and safety**

Children were started on ART according to the national guidelines, based on the World Health Organization (WHO) immunological and clinical eligibility criteria and using WHO-recommended first line regimens [16]. To simplify treatment regimens and limit calculation errors, four weight categories were used to choose the appropriate dosing of the ARVs, as has been described elsewhere [5,17]. Generic, scored fixed-dose combinations (FDC) were prescribed as much as possible (Triviro 30/40, Ranbaxy), containing stavudine/lamivudine/nevirapine. No quarter-tablets were used (as use of these had not been validated), only whole or half tablets were prescribed. When scored FDCs were not available, children were given either separate medications or were switched to a zidovudine-containing FDC (Duovir-N, Cipla). Initially, small children needing syrup formulation were referred to the central referral hospital in Kigali (CHUK) but from mid-2005, the syrup was available at the health center level.

For most children (orphans in particular), a home-visit was done before ARV initiation to assess the socio-economic situation of the family and to provide support where necessary. Adherence to treatment was evaluated by self-report using calendars, regular clinical attendance (monthly visits after start-up period) and pill counts. As well, viral load counts were performed routinely after the first year of treatment from 2005 [18]. HIV care, including ARVs, consultations, lab tests and OI

medications, were provided free of charge. Transport costs for the children were covered on indication.

Side effects were evaluated at each follow-up visit, and treatment changes were made for grade 3 and 4 events [16]. Liver function tests were performed at baseline, 2, 4, 8 weeks and then every 6 months and on clinical grounds. A full blood count was done at baseline, 12 weeks and then every 6 months and on clinical grounds. For children on zidovudine, an additional control was done at 4 and 8 weeks.

Absolute CD4 counts and percentages, checked every 6 months, were measured with the FACSCalibur™ Flow Cytometry System (Becton-Dickenson) at the National Reference Laboratory (NRL). However, from 2003-2004, the FACSCount apparatus (Becton-Dickenson) was used and percentage counts were calculated based on total lymphocyte counts of a separate sample.

CD4 percentage counts at baseline were missing for several reasons (n=33). First, due to limitations in the number of samples that could be handled at the NRL in the initial stages of the program, some children had no baseline CD4 counts because they met clinical criteria for starting ART. Second, for some children transferred from other sites, the information was not known. Finally, if the total lymphocyte count was not known, the CD4 percentage could not be calculated, and absolute CD4 counts were used for consideration of ART. The median time from baseline CD4 sample collection to initiation of ARVs was 53 days (interquartile range 30-79). Viral loads were analyzed at the NLR by the Ultrasensitive Amplicor assay, version 1.5 (Roche). All other biochemical tests were performed at Kinyinya health center.

### **Data collection and statistical analysis**

Data were routinely collected during the consultations using Access® software. Treatment and safety outcomes of the cohort were analyzed by Stata software 9.0® (STATA Corp., College Station, Texas, USA). Kaplan-Meier survival methods were used to estimate the probability of remaining in care (failure defined as death or lost-to follow-up). CD4 percentages were used for children under 5 years to evaluate immunological status and both CD4 counts and absolute counts used for children above 5 years. Weight-for age Z-scores (WAZ) were calculated with Epi-Info (version 4.3.1; Centers for Disease Control and Prevention). Data for this study were collected until June 30/2007.

### **Ethics**

This study analyzed routinely collected data from the pediatric HIV program. Approval for publication of this data and report was received from the CNLS and TRAC. Confidentiality was maintained with no patient identifiers being used. The Ethics Review Board of MSF and the Rwandan National Ethics Committee gave exemption from formal ethical review.

## **Results**

### **Characteristics of the study population**

Over a period of about 3 years, 315 children were started on ARVs, with a median age of 7.2 years. Table 1 describes their characteristics. Approximately 25% were less than 5 years of age, 7 were started before the age of 18 months. Sixty percent were in WHO stages I and II at treatment initiation. Fifteen tuberculosis (TB) cases were recorded of which 4 had extra-pulmonary manifestations. Baseline CD4 counts percentages were available for 282 children with a median value of 14%. The median WAZ-score was  $-1.9$ . The vast majority of children, 89%, started on stavudine/lamivudine/nevirapine, with adult FDC tablets used for 282 children. The remaining 33 commenced syrup formulation of whom, by the time of analysis, all but five had changed to tablets. The median time on ART was 2 years. Four fifths of all children were followed for more than one year with a total of 589 patient years of follow-up.

### **Clinical, immunological and virological outcomes**

By June 2007, 84% (265) were still alive and being followed up in the clinics (Table 2). Thirty (9.5%) had been transferred to another health facility offering ART. Eight (2.6%) had died, only 12 (3.8%) were lost to follow-up (defined as not coming to their last scheduled visit for more than 2 months). Of the 8 deaths, 2 were clearly not linked to HIV. Kaplan-Meier estimates showed a probability of remaining in care of 94.7% and 92.9% at 12 and 24 months respectively (with failure defined as death or lost-to follow-up). CD4 results, hemoglobin and WAZ all showed progressive improvement over the treatment interval. Most viral load results were obtained between and 15 and

23 months and were available for 87% by 18 months on treatment (n=174). Viral load was less than < 400 copies/ml in 82.8% of children and showed satisfactory viral suppression in 86.8%. For 13 children among whom viral loads were detectable, a second sample was made available after adherence counseling. The median time from first viral load collection to the repeat sample was 5.8 months (interquartile range 2.7-8.8). Four out of the 13 positive viral loads became undetectable and 1 decreased significantly. Two children were switched to second line treatment. For the remainder, adherence problems were still being addressed or criteria to switch were not met.

We only had complete data on clinical attendance as an indirect measure of adherence to therapy. Allowing a delay of up to two days (accounting for the security stock), we defined excellent, good and poor adherence as being punctual for > 95%, 80-95% or < 80% of the visits respectively. Poor adherence was observed for 5% of the children, with the majority having excellent (49 %) or good (46 %) adherence.

### **Safety and tolerance**

Among all children placed on ART, a change in therapeutic regimen was required for 46 children (14.6%), out of whom only 26 (8.3%) were due to toxicity. The start of TB treatment provoked 18 switches. Toxicity was mainly related to nevirapine, requiring a treatment change to efavirenz (n=24). Sixteen cases were due to grade 3-4 skin manifestations of which two were Stevens-Johnson syndromes occurring within 1 month of therapy. Both recovered. Five early changes (within 3 months) were made for severe hepatitis, with 4 children showing clinical signs, and 1 child having asymptomatic grade 3 liver toxicity. An additional three children were changed late (median 9 months) due to symptomatic hepatitis. We observed an additional 11 children with grade 2 and 3 with grade 3 liver toxicities, mostly occurring within the

first months of ART. In general, these were transient and well tolerated and did not require treatment change.

Stavudine was changed for one child with severe neuropathy, and two cases of lipoatrophy were reported (one requiring treatment change). No lactic acidosis or anemia requiring treatment change were observed. Thirteen children were found with a hemoglobin level < 7 mg/dl of which 5 were present at baseline and generally improved on stavudine-containing ART. Of the others, none were related to zidovudine and were transient and/or related to intercurrent infections.

## **Discussion**

This report offers reassuring evidence that health center-based ART delivery for children using nurses is both feasible and very effective. The morbidity and mortality results are comparable to or better than those of other reported studies, which are essentially hospital-based [1-10]. One of the strengths of the study is that the therapeutic responses were confirmed with virological evidence in the majority of children. This is very important since it suggests that clinic-based programs can provide high quality care that offer a way forward in scaling-up ARV treatment to a larger pediatric population. The good outcomes are likely due to a number of factors.

### **A relatively healthy cohort that was detected early**

We started ART in a relatively healthy cohort of children, as seen from the clinical and immunological baseline data. This, in turn, was due mostly to our ability to identify children earlier in their disease via the process of working through HIV-infected caregivers. Our experience demonstrates that there is a significant burden of HIV illness in children that is readily identifiable through HIV-infected adult caregivers. Over 90% of the children in this cohort came from this source.

### **Health center/nurse-based care**

The fact that this program was based at a decentralized level might have contributed to earlier diagnosis in a number of ways. First, geographical proximity is likely to have facilitated increased access and acceptability for both caregivers and children. Centralized HIV care at the hospital level tends to create additional bottlenecks in treatment initiation, and creates difficulties with transport and time off work for the patients [16,19-20]. In contrast, we were able to provide comprehensive and patient-

centered care, within a family-based approach, close to the community. Convenient scheduling of visits facilitated accessibility as did comprehensive care that was provided free of charge.

Second, the health center-based care was provided to a large extent by the nurses. Combined MoH and MSF physician training and supervision assured that the nurses were confident and skilled in their assessments and treatment, as is reflected in the results. In addition, the MoH contributed to a substantial increase in staffing at the health centers so that they could meet the increased demand. The combination of accessibility and acceptability of services and adequate staff to meet the demand allowed rapid scaling-up to occur that led to the good outcomes. This could never have been achieved with doctor and hospital-based care. Although considerable energy and time were spent on training and supervising the nurses, especially early in the program, in our experience it clearly paid off in the end. Having all staff trained in HIV/ARV care meant that they were sensitized to the issues in all service areas, an advantage over having only a few specially trained nurses with limited coverage.

### **Psychosocial Care**

Third, from the start of the program, a family-centered approach was implemented with a strong focus on the psychosocial aspects of HIV care (Table 3). This played a crucial role in overcoming barriers to routine testing of children. Dealing with the HIV-infected adults' psychosocial issues allowed the staff to introduce the idea of testing children, and in turn helped them prepare the children for disclosure. This sensitive approach, combined with the goal of routine testing of all children of adult HIV-infected patients, facilitated the early diagnoses reflected here.

In addition, once children tested positive, the psychosocial emphasis provided effective means for handling disclosure and subsequent commencement of ARV treatment. The preparation of both caregivers and children contributed to good adherence and treatment outcomes. This supports previous research that emphasizes that HIV care is more than getting CD4 counts and prescribing ARVs. Addressing the many psychosocial aspects of the illness is crucial to effective treatment programs [21].

### **Safety**

In our program, ART was safe and very well tolerated, with few treatment-changing side-effects reported. In concordance with others [1, 8], tolerance of ART seems to be as good or better in children than in adults, arguing against the need of specialist care for pediatric ART and in favor of providing ART treatment to children at a decentralized level. In addition, treating a healthier population is also likely to reduce side-effects.

Virtually all treatment changes were initiated by the nurses, and confirmed by the physicians, in patients with clinically recognizable symptoms. This is reassuring for decentralized pediatric treatment in rural areas where laboratory monitoring might not be available. Few children had to change therapy due to rashes or hepatitis. No adverse effects resulted in death. No cases of severe anemia or lactic acidosis reported, while neuropathy and lipoatrophy were extremely rare. One could argue that the low rate of side-effects could be explained by their having been missed by the nurses. However, within this program, side effects were documented and treated by

the same nurses in our adult cohort [22,23], at a frequency similar to other studies [20,24-26].

### **Replication/sustainability**

We suggest that this kind of program could be replicated in other settings and is sustainable. The program was run in MoH health centers that were already providing a full range of other primary care services. The success of the program depended, to a large extent, on the commitment of the government MoH. The increased staffing was a critical factor. Whereas the health center's staff included 7 trained nurses before the launch of the HIV program in 2002, this had increased to 28 by the end of 2004, when scaling-up began. Overall, around 50 % of the entire staff's time was dedicated to HIV care. External support of the program by MSF was targeted at certain areas such as training, laboratory services and financial incentives for extra work by staff. The external support decreased gradually over the years, and MSF is handing over the project to the Ministry at the end of 2007.

As a result, we believe that the elements required to provide quality pediatric ARV care during scaling-up include:

- (a) Suitable clinic space
- (b) Adequate numbers of staff
- (c) Training and supervision of the nurses
- (d) Laboratory backup
- (e) Emphasis on family-centered care incorporating psychosocial support

(f) Free ARVs, drugs for opportunistic infections, lab work and consultations

It is important to note that this program, especially the psychosocial elements, was developed over several years and in response to perceived needs of the children and caregivers. This helps explain the ongoing changes we describe – in effect we were aiming at a “moving target”. It is not necessary that the full structure described here be operational at the outset of a program, but could be developed over time, depending on facilities and staffing availability.

### **Remaining challenges**

A relatively large number of children in our program were adopted either by extended family or non-family. Although caregivers are generally more reluctant to have the adopted children tested, through in-depth counselling and providing assistance in communicating with the child, most can be convinced. However, irrespective of HIV, adopted children tend to be treated differently from the natural children, receiving less attention and affection. Being HIV-infected can further aggravate the situation, especially if the child is the only one infected within the family. Adherence of some of these children remains a problem and calls for a specific focus within pediatric ART programs.

In addition, increasing problems of acceptance and adherence can be expected in the long run, especially during adolescence. To what extent these will be successfully managed within the program remains to be seen.

## **Limitations**

Given our relatively healthy cohort, we are cautious in suggesting that similar outcomes would be possible with a sicker population. Since CD4 counts were not available for all children, and some children were started on clinical grounds, the missing baseline CD4 counts might have biased the baseline values to some extent. Consequently, it is possible that the comparison between baseline and follow-up CD4 counts is not entirely accurate, but we believe the differences would be minor. Similarly, we only recorded 87% of viral loads by 18 months. Given the similar baseline characteristics, we have no reason to believe that the results of patients with missing values would be substantially different. We also note that this cohort included few young children and we cannot be sure if similar outcomes would apply to them.

The health centers received targeted support from MSF that has been gradually withdrawn. Although the program seems to be sustainable, with quality of care remaining high, its future success will depend on the MoH's ongoing commitment and resources.

To what extent local factors have influenced the outcomes of the program remains to be determined. This program was part of and has benefited from the successful scaling-up of the Rwandan National HIV program. The HIV prevalence rate in Rwanda is lower than most Sub-Saharan African countries. The context of HIV has certain particularities linked to the history of genocide.

In addition, with few children being tested before presenting in our health centers, the need for "damage repair" due to misinformation and inadequate previous disclosure might be less than in other settings.

Finally, although the program appears to have been successful, at least in treatment outcome terms, patients' perceptions and satisfaction were not known and should be assessed to support the impression that it met their needs adequately.

### **Future research**

This study points to further research to see whether this health center setting model could be successful with sicker and/or younger populations. It is also important to see whether this approach could be established in other contexts without external support. Qualitative research into understanding how the psychosocial aspects of care were received would be useful to refine this part of the program.

### **Conclusions**

Our program shows that providing ARVs to children in health centers using nurses is both feasible and very effective. This requires a commitment to certain essential elements especially adequate numbers and training/supervision of staff and an emphasis on the psychosocial needs of caregivers and children. Given these conditions, scaling-up of ART can be achieved, thereby addressing the challenge of delivering ARVs to all children in need.

## **Competing interests**

We declare that we have no conflicts of interest.

## **Authors' contributions**

All authors read and approved the final manuscript. JVG and LDN were physicians treating the children, CG was coordinator of the MSF HIV project. JU worked as psychologist within the pediatric program. AA is director of TRAC (national ART program). JVG, LDN, JU and CG conceived the project. JVG performed the data analysis and the program evaluation/description; JVG and TR co-drafted the manuscript. LDN, AA, CG and JU critically reviewed the manuscript and TR performed the editing.

## **Acknowledgements**

We are grateful to the staff of Kinyinya and Kimironko health centers. This program was part of and has benefited from the successful scaling-up of the Rwandan National HIV program, organized through the CNLS (National AIDS Control Commission) and TRAC (Treatment and Research AIDS Center) and in collaboration with various international partners. The CNLS is mainly focussing on general policy, coordination and resource mobilization. TRAC is mainly working on medical and technical issues (protocols, training, monitoring, surveillance). We are particularly grateful to all children and caregivers in our program. We wish to thank Line Arnould, Myrto Schaeffer, David Olson, Rony Zachariah and Ana Corthouts for their useful comments on the manuscript. We acknowledge the financial support for the

HIV/ARV program provided by MSF-Brussels operational centre, the Global Fund to fight AIDS, Tuberculosis and Malaria, the Belgian Development Cooperation (DGCD) and the European Union. The World Food Program provided nutritional support.

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## Figures

**Figure 1 - Flow diagram of the pediatric HIV program.**

ART: antiretroviral treatment; PMTCT: Prevention of Mother To Child Transmission

**Figure 2 - Picture from the booklet used to explain HIV/AIDS to children.**

The booklet is used by caregivers and health center staff. This picture is used to explain "what actually is blood ?" to the child.

## Tables

**Table 1 - Characteristics of children started on antiretroviral treatment (n=315)**

Age at start <sup>a</sup>	7.2 (4.5 – 10.4)
< 3 years <sup>b</sup>	38 (12%)
3 – 4.9 years <sup>b</sup>	51 (16%)
5 – 14.9 years <sup>b</sup>	226 (72%)
Sex (male/female) <sup>b</sup>	157/158 (50/50%)
Clinical WHO-stage <sup>b</sup>	
WHO stage I	43 (13.7%)
WHO stage II	145 (46.0%)
WHO stage III	115 (36.5%)
WHO stage IV	12 (3.8%)
Weight for age (Z-score) (n=293) <sup>a</sup>	-1.9 (-3.0;-0.9)
Baseline CD4 count % (n=282) <sup>a</sup>	14% (9-18)
< 15% <sup>b</sup>	158 (56.0%)
15-25% <sup>b</sup>	118 (41.8%)
> 25% <sup>b</sup>	6 (2.1%)
Baseline absolute CD4 counts (n= 302) <sup>a</sup>	345 (229-572)
Baseline hemoglobin (mg/dl)(n=268) <sup>a</sup>	11.0 (10.3-11.8)
ART regimen <sup>b</sup>	
d4T/3TC/NVP	281 (89.2%)
d4T/3TC/EFV	6 (1.9%)
AZT/3TC/NVP	19 (6.0%)
AZT/3TC/EFV	9 (2.9%)
Time on ART (years) <sup>c</sup>	2.0 (1.2-2.6)
Total patient years of follow-up	598
On tablets (FDC)	577
On syrup	21
< 1 year vs. ≥ 1 year <sup>b</sup>	59 (19 %) vs 256 (81 %)

<sup>a</sup> Values are expressed as median (interquartile range)

<sup>b</sup> Values are expressed as n (%)

<sup>c</sup> As of June 30/2007 (closing date of dataset)

WHO: world health organization; ART: antiretroviral treatment; d4T: stavudine; 3TC: lamivudine; NVP: nevirapine; EFV: efavirenz; AZT: zidovudine; FDC: fixed-dose-combination

**Table 2 - Clinical, immunological and virological outcomes**

<u>Started on ART</u>	<u>Active cohort</u>	<u>Transferred out</u>	<u>Death</u>	<u>Lost-to FU<sup>a</sup></u>	
315 (100 %) <sup>b</sup>	265 (84.1 %)	30 (9.5 %)	8 (2.6 %)	12 (3.8 %)	
	<b>Baseline</b>	<b>6 mo</b>	<b>12 mo</b>	<b>24 mo</b>	<b>36 mo</b>
Survival (%) <sup>c</sup>	100	96.8	94.7	92.9	92.9
N	315	297	258	152	40
CD4 count					
<u>&lt; 5 years (%)<sup>d</sup></u>	16	30	32	33	35
IQR	(12-19)	(23-35)	(26-34)	(28-36)	(28-40)
N	84	59	48	39	7
<u>≥ 5 years (%)<sup>d</sup></u>	13	25	26	29	29
IQR	(9-17)	(18-29)	(21-32)	(24-34)	(19-33)
N	198	175	117	80	24
<u>≥ 5 years (abs)<sup>d</sup></u>	297	550	624	704	616
IQR	(181-405)	(377-747)	(459-840)	(562-866)	(492-865)
N	217	183	120	80	24
Hb (mg/dl) <sup>e</sup>	11.0	12.1	12.6	12.9	13.7
WAZ <sup>c</sup>	-1.9	-1.6	-1.6	-1.5	-1.5
IQR	(-3.0;-0.9)	(-2.6;-0.8)	(-2.6;-0.7)	(-2.5;-0.6)	(-2.7;-0.6)
Viral load <sup>b</sup>	<u>Months on ART<sup>d</sup></u>	<u>&lt; 40 c/ml</u>	<u>&lt; &lt; 400 c/ml</u>	<u>&lt; 5000 c/ml</u>	
(N=174)	18 (15-23)	127 (73.0%)	144 (82.8%)	151 (86.8%)	

<sup>a</sup> Lost-to follow-up: defined as not coming to their last scheduled visit for more than 2 months

<sup>b</sup> Values are expressed as N (%)

<sup>c</sup> Kaplan-Meier survival estimates: failure defined as death or lost-to follow-up

<sup>d</sup> Values are expressed as median (interquartile Range (IQR));

<sup>e</sup> Values are expressed as median;

abs: absolute CD4 count (in cells/μL); Hb: hemoglobine; ART: antiretroviral treatment; WAZ: Weight-for-age Z-score

**Table 3 - Psychosocial aspects of the pediatric HIV program**

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**Caregiver-centered approaches**

- organization of discussion/support groups, at health center and in community
- family-based approach to identify eligible children
- individual counseling (pre-ART)
- psychosocial issues addressed in follow-up care

**Child-centered approaches**

- adapted counseling for children for disclosure and ART (child-adapted tool)
- designated days for children's clinics
- child support groups
- integrated care, including disclosure, with their caregivers

**Health-staff centered approaches**

- discussion groups for health care staff
- training on psychosocial implications of HIV
- practical training by psychosocial team (check-lists,...)
- supervision and mentoring

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ART: antiretroviral treatment

HIV: human immunodeficiency virus

## **Additional files**

### **Additional file 1 – Figure 1**

Word-file

### **Additional file 2 – Figure 2**

Word-file

## **ARV CARE FLOW**

### **Recruitment**

- Children of HIV+ adult patients (~90 %)
- Orphans (~10 %)
- PMTCT and in/out patient services (< 1%)
- Transfer from other ART programs (< 1%)



### **Pre-test counselling**

- Group session - caregivers only
- Group session caregivers + children



### **Post-test counselling**

- Individual - caregivers
- Individual - caregivers + children



### **First Assessment Consultation (N=672)**

- Check caregiver/child treatment literacy
- Clinical staging
- CD4 count measurement
- Cotrimoxazol (CTX) prophylaxis started
- Treatment of opportunistic infections
- Family testing
- Evaluation of psychosocial situation



## WHO criteria for ART



### Pre-ART Consultation (N=315)

- Medical assessment
- Exclude tuberculosis
- Baseline blood tests
- Counselling/psychosocial assessment: two sessions with caregiver/child and one at home (if indicated)

### Follow-up Consultation (q 1-3 mo) (N=357)

- Family-testing
- Clinical assessment
- CD4 follow-up
- CTX adherence and tolerance
- Counselling/literacy
- Referral for ART if criteria met

### Start ART

### Follow-up consultation (q 1-2 mo):

Children's and caregivers attend **medical consultation** and **support groups** on the same day.

- Clinical assessment
- Growth evaluation
- Follow-up family testing
- Psychosocial assessment: school, nutrition, stigma
- ART-tolerance, adherence
- Follow-up of CD4 count and viral load

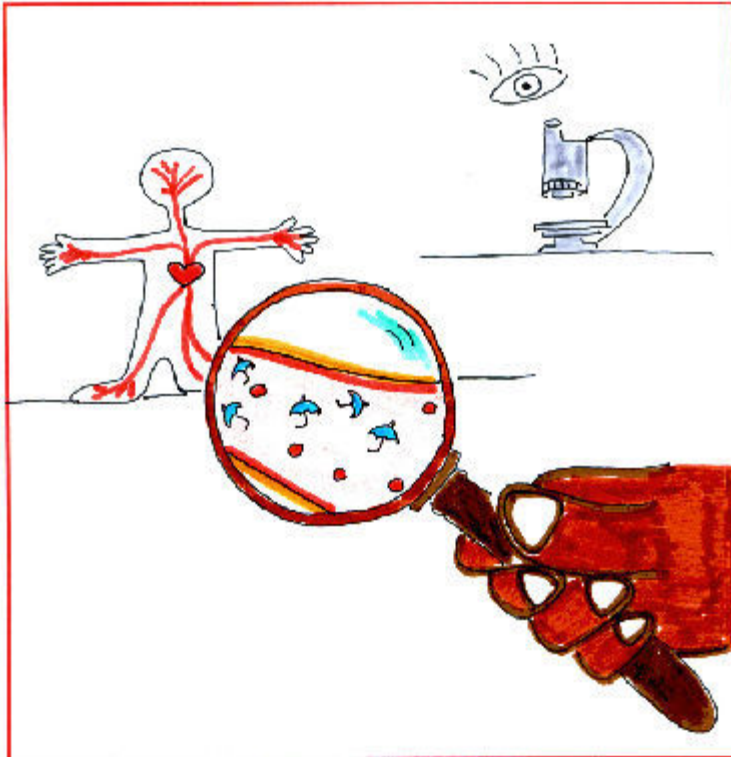


Figure 2