

Original Article

HIV infection among children in Malanje province, Angola: a twelve-year follow-up study

Joaquim Sito^{1,2}, Manuel L Nunes^{2,3}, Ana Mafalda L Fonseca^{2,4}¹ Instituto Politécnico de Malanje, Universidade Rainha Njinga a Mbande, Malanje, Angola² Faculty of Health Sciences, University of Beira Interior, Covilhã, Portugal³ Unidade Local de Saúde de Castelo Branco, Castelo Branco, Portugal⁴ CICS-UBI-Health Sciences Research Center, University of Beira Interior, Covilhã, Portugal**Abstract**

Introduction: Human immunodeficiency virus (HIV) / acquired immunodeficiency syndrome (AIDS) infection has been a serious health problem in pediatric age groups globally, and especially in African countries such as Angola. Our aim was to determine the prevalence rate, accumulate incidence rate, and mortality rate of HIV/AIDS infection in children under 14 years of age residing in four municipalities of Malanje (Malanje, Cacuso, Calandula, and Caculama), from 2010 to 2021.

Methodology: This was a documentary research study, with data from 2010 to 2021, developed from a sample size of 10,984 children.

Results: The prevalence rate data showed a certain level of dispersion, and no relationship was identified in its behavior over the years ($R^2 = 0.0036$). On the other hand, the accumulate incidence rate presented a tendency to decrease, indicating a moderate level of correlation in its behavior over the years ($R^2 = 0.4278$). Finally, the mortality rate has been decreasing and presented a high correlation in its association with the years under analysis ($R^2 = 0.8142$). Primary schooling and low purchasing power were frequent (60% and 82%, respectively) among the families of HIV-infected children under study.

Conclusions: Despite the temporal variation of HIV in children under 14 years of age living in the different municipalities, there was a tendency of its diminishing in the later part of the period, from 2010 to 2021. Nevertheless, the key players should focus on strengthening community strategies for prevention, investigation, and diagnosis of HIV infections in this population.

Key words: HIV; AIDS; prevalence; cumulative incidence; mortality; Angola; children.

J Infect Dev Ctries 2024; 18(5):802-808. doi:10.3855/jidc.18015

(Received 31 January 2023 – Accepted 28 July 2023)

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Introduction

Human immunodeficiency virus (HIV) infection remains an important cause of morbidity and mortality worldwide. Since the epidemic began, around 1980, about 84 million people were infected and 40 million people have died from acquired immunodeficiency syndrome (AIDS)-related illnesses. Globally, there were around 39 million [33.1 million–45.7 million] people living with HIV in 2022, and approximately 1.5 million [1.1 million–2.0 million] people became newly infected, of which a great proportion were in Africa. The estimated number of deaths from AIDS-related illnesses in 2022 was 630,000 [480,000–880,000]. The joint United Nations Program on HIV and AIDS (UNAIDS) also estimated that 1.5 million [1.2 million–2.1 million] children (0–14 years) were infected, which is particularly concerning [1].

The occurrence of new HIV-positive cases among children has been declining globally, but remains an

important issue in resource-limited countries such as the ones in West and Central Africa, where more than 50% of HIV-positive pregnant women who do not have access to treatment live; and there are large gaps in measures that are aimed towards the prevention of vertical transmission (from mother to child) of HIV [2]. This vertical transmission of HIV can occur during pregnancy, delivery, and breastfeeding [3]. According to data published by the World Bank in 2021, an average of 40,200 infected children (0 to 14 years of age) per year were identified between 2016 and 2020 in Angola. Among these years, 2020 had the fewest number (39,000) of infected children [4].

In order to eliminate perinatal and postnatal HIV acquisition, it is essential that pregnant and breastfeeding women with HIV, and their infants, receive effective anti-retroviral drugs. In Angola, the population of HIV positive children increased by 582% between 2000 and 2018, and only 32% of the positive

children have access to anti-retroviral drugs [5]. Additionally, new anti-retroviral formulations and products should be developed for neonates, infants, children, and adolescents, particularly in low-income and middle-income countries [6].

Despite advances in the efforts of governments and global health communities, too many people with HIV, or at risk of HIV, still do not have access to preventive measures such as family planning, and to retroviral treatment. In this context, due to the high accumulate incidence rate, prevalence rate, and mortality rate present in this age group, it is necessary to implement measures to eliminate, or at least to reduce, vertical transmission, and to increase maternal and child survival in low-income countries such as Angola.

The HIV/AIDS pandemic can hinder the quality of life of children and adolescents affected by the infection [7], who may suffer successive losses, not only with deterioration of health, but also changes in their coexistence with parents and relatives. Children and adolescents living with HIV/AIDS deserve special attention since they are presented with challenging experiences related to the loss of relatives, discrimination and prejudice, and the imminent possibility of illness and death. The lower quality of life, and difficulties in behavioral and emotional functioning [8] may also lead to mental health issues [9].

HIV/AIDS is a global health problem and has great significance in Angola. This study focused on determining trends in HIV infection among children under 14 years of age in the central province of Malanje in Angola. Our goal was to get a better understanding of the size and geographical distribution of the HIV-positive children, and how these epidemiological tendencies have changed. Our study will contribute to the understanding of the measures available to control this disease burden.

Methodology

This research is a documentary study to obtain the accumulate incidence rate, prevalence rate, and mortality rate associated with HIV/AIDS in children under 14 years of age. The data was used to evaluate the incidence of HIV/AIDS in four municipalities of Malanje province of Angola (Malanje, Cacusó, Calandula and Caculama) from 2010 to 2021. This study was approved by the Province Health Director of Malanje.

The heads of the departments of the municipal centers for counseling and treatment of HIV/AIDS (CATV, in Portuguese, Centro de Aconselhamento e

Tratamento de HIV-SIDA) in each municipality that provided the anonymized data were contacted. The data included the total number of HIV positive cases, number of new cases per year, and deaths from HIV/AIDS.

In addition, demographic data including education levels, number of siblings, age, and standard of living of the family were also recorded. The inclusion criteria were: belonging to the age group of 0 to 14 years; with the address of residence in the municipalities of Malanje, Cacusó, Calandula, or Caculama; having HIV diagnosis and/or receiving treatment for HIV between the years 2010 to 2021; and availability of all the data required. In addition, the preventive actions implemented in each municipality to reduce the incidence of HIV infection in the general population were recorded.

HIV tests were performed by the CATV services and after informed consent was obtained from the participants. Patients who came for medical consultation and medical guidance were directed to these centers to undergo an HIV test to determine their serological status. In addition, pregnant women who came for follow-up prenatal consultations were required to take the HIV test.

The HIV/AIDS accumulate incidence rate, prevalence rate, and mortality rate in the four municipalities of the province of Malanje were analyzed using the SPSS version 25.0 statistical software. The dependent variables were the study regions (Malanje, Cacusó, Calandula and Caculama) and the independent variables were the years of study (2010-2021). The formulae used to calculate the specific accumulate incidence rate, prevalence rate and mortality rate were: a) accumulate incidence rate = the number of current HIV/AIDS cases $\times 10^5$ / average risk population during the same time interval; b) prevalence rate (specific by age) = the number of positives (HIV/AIDS) in the study age $\times 10^5$ / population in the same age group; and c) mortality rate (by cause and age) = deaths due to (HIV/AIDS) in the age group of study $\times 10^2$ / age group of the population [10].

Results

Demographic characterization of the HIV-infected children

A total of 10,984 children under 14 years of age were tested in the period between 2010 and 2021, of which 584 (5.32%) were positive for HIV/AIDS and the majority (57.8%) were females. Among them, 483 (4.39%) were from the municipality of Malanje, 40 (0.36%) were from Cacusó, 29 (0.26%) belonged to

Table 1. Human immunodeficiency virus (HIV) case numbers among children under 14 years old in the province of Malanje in the period from 2010 to 2021.

Cases	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
Tested	1034	163	194	331	1431	1309	1554	1773	1346	800	536	513	10984
Positive cases	46	22	36	28	27	42	41	53	100	80	54	55	584
New cases	29	18	25	17	21	33	36	12	29	42	11	22	295
Deaths	10	8	7	5	6	8	5	4	5	2	1	1	62
Positive cases by municipalities													
Malanje	36	15	26	20	20	28	21	48	97	70	51	51	483
Cacuso	5	3	4	4	3	8	7	1	1	3	0	1	40
Calandula	2	2	3	2	1	3	8	2	1	4	0	1	29
Caculama	3	2	3	2	3	3	5	2	1	3	3	2	32

Calandula, and 32 (0.29%) were from Caculama. The level of primary schooling (60%) and low purchasing power (82%) stood out among the families with diagnosed children. Likewise, families with three children or more were common (75%), concentrated mostly in the municipalities of Malanje (68%) and Cacuso (19%). Among the new cases per year, the age group between 1–4 years predominated and were 38% on average. Table 1 summarizes this data grouped by municipality.

Transmission routes

Since HIV can be transmitted through blood, breast milk, semen, and vaginal secretions from people living with HIV, it is important to mention the transmission routes for HIV infection that we identified in this study. Based on the available information, the major transmission routes were secondary or horizontal transmission (39%), which included contact with semen or vaginal fluids (25%) and contact with blood containing HIV (14%). Perinatal, vertical, or mother-to-child transmission represented 31% of the cases, among which were those who were infected during pregnancy (18%), through breastfeeding (9%) and during

childbirth (through transfer of blood and other fluids) (4%). Intravenous drug use was responsible for 11% of transmissions.

HIV infection prevalence rate, accumulate incidence rate, and mortality rate in the period 2010-2021

The prevalence rate, accumulate incidence rate, and mortality rate of HIV among the population of under 14-year-olds in the Malanje province during the period 2010-2021 is presented in Figures 1, 2 and 3.

As presented in Figure 1, the prevalence rate showed a certain level of fluctuation in its values, with a peak in 2011-2012, followed by a decrease, and a lower peak in 2015; after this peak, there was an increasing trend until 2021. However, this increase is below the earlier values of 2011 and 2012, which shows that there was a decrease in positive cases and therefore in the prevalence rate. No correlation was identified between their behavior and the time-period under study ($R^2 = 0.0036$).

The accumulate incidence rate data (Figure 2) also showed a certain level of dispersion in its values with a marked tendency to decrease (negative slope), showing its highest peak in 2016, and its lowest in 2020. The age

Figure 1. Prevalence rates of HIV infection in the population under 14 years old, in the province of Malanje, in the period between 2010 and 2021.

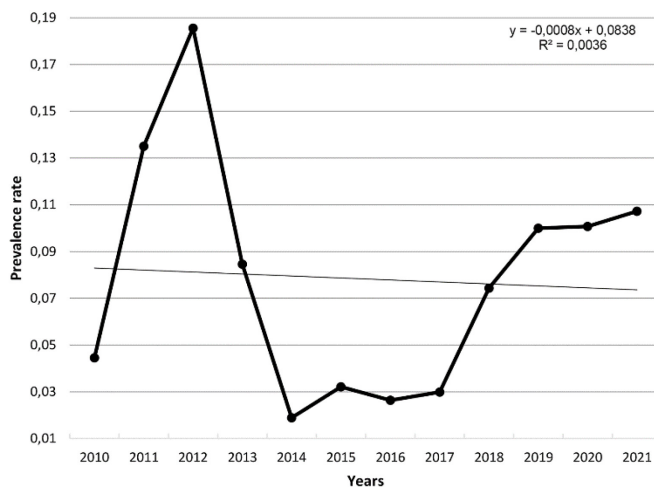
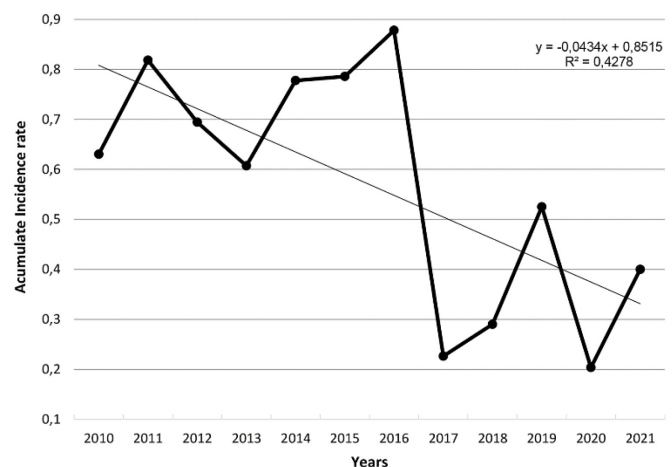


Figure 2. Accumulate Incidence rates of HIV infection in the population under 14 years old, in the province of Malanje, in the period between 2010 and 2021.



group between 0 and 5 years was most affected by new cases. A moderate level of correlation was identified in their behavior over the years ($R^2 = 0.4278$).

The mortality rate showed a tendency to decrease (negative slope), with its highest peak in 2011 and its lowest in 2020 and 2021. Among all the 584 children diagnosed with HIV, most were females (n = 337, 57.8%), and there was a total of 62 deaths in this period. The age group between 5 and 10 years had the highest number of deaths.

HIV prevalence rate, accumulate incidence rate, and mortality rate in the period 2010-2021 by municipality

A detailed analysis of the HIV prevalence rate, accumulate incidence rate, and mortality rate by municipality and by year are presented in Figures 4, 5 and 6.

The trends of the prevalence rate by municipality are presented in Figure 4. There was high dispersion in the years between 2016 and 2021. There were noticeably lower values in the municipality of Caculama. In contrast, high peaks were observed in Malanje (2012), Caculama (2014-2016, and 2021), and Calandula (2019). Cacuso had a higher prevalence rate in 2021.

In the case of the accumulate incidence rate (Figure 5), there was high dispersion during 2014, as well as a noticeably lower values in 2015 in the four municipalities. The highest peaks were observed in Cacuso (2010), Calandula (2012), Caculama (2014), and Malanje (2016).

The mortality rate had downward trend, and a high level of dispersion in 2019 (Figure 6). Malanje (2013-2014) and Calandula (2019) had the highest peaks.

Figure 3. Mortality rates (%) in the population under 14 years old following HIV infection, in the province of Malanje, in the period between 2010 and 2021.

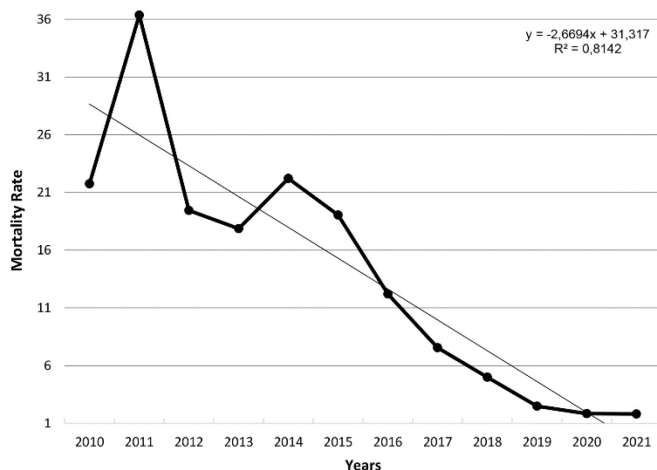


Figure 4. Prevalence rates of HIV infection grouped by municipality in the population under 14 years old, in the municipalities of Malanje province, in the period between 2010 and 2021.

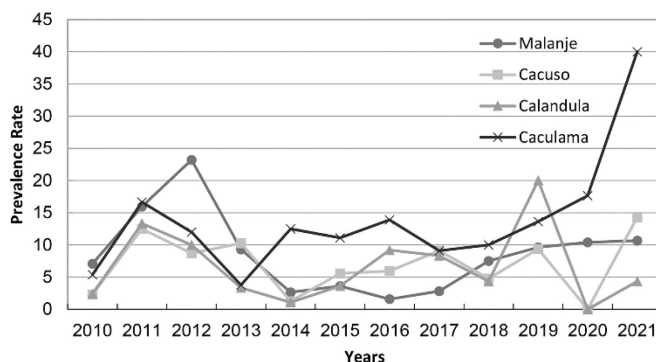


Figure 5. Accumulate incidence rates of HIV infection in the population under 14 years old in the four municipalities of Malanje province in the period between 2010 and 2021 grouped by municipality.

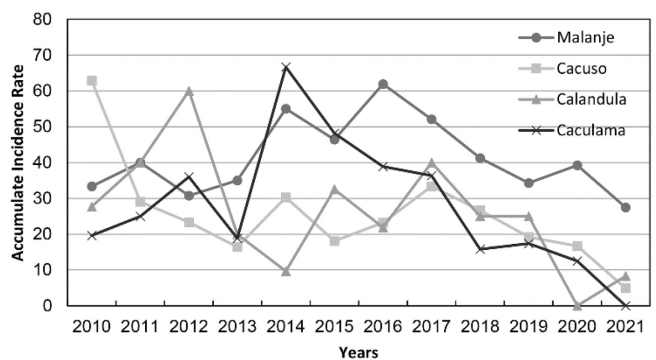
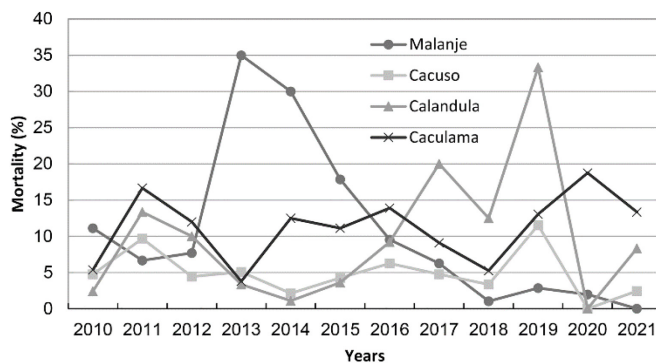


Figure 6. Mortality rates (%) of HIV infection in the population under 14 years old, in the in the municipalities of Malanje province, in the period between 2010 and 2021, grouped by municipality.



Thus, the higher prevalence rates were observed in Caculama and Malanje. The highest accumulate incidence rate was observed in Malanje, which was also the municipality with the higher number of tested and new cases in the twelve-year period analyzed. The municipalities with the highest number of deaths from previously diagnosed positive cases were Malanje, Caculama, and Calandula.

Discussion

The present study aimed to contribute to the knowledge about the trends of HIV/AIDS infection in children aged 0 to 14 years; in the municipalities of the province of Malanje (Angola); specifically in Malanje, Cacuso, Calandula and Caculama; to assist with the development of HIV prevention programs within those communities.

Out of a total of 10,984 children tested in the four municipalities, 584 seropositive children were identified, and the majority (57.8%) were females. It is important to highlight that the children received follow-up treatment for HIV/AIDS during the mentioned period; despite this there were 62 deaths during this period. The results are in agreement with those obtained by Prieto-Tato *et al.* in a study in Equatorial Guinea, where early diagnosis of HIV-1 infection in children and the mother-child transmission prevention program demonstrated an increase in transmission rates mainly caused by late diagnosis [11].

These results are also in agreement with those reported by Badillo-Navarro *et al.* in their initial evaluation of the program for the prevention of mother-child transmission of HIV infection in Equatorial Guinea. In their study, 14 cases were diagnosed with HIV/AIDS, of which 6 died from causes related to the infection. The affected cases were predominantly girls (54.4%) [12].

Consistent with the study by Enane *et al.* we can conclude that children and adolescents living with HIV in sub-Saharan Africa show a high mortality rate primarily due to late diagnosis, delays in starting treatment, poor retention in care and lack of care, and low adherence to treatment [13]. Enane *et al.* suggested that poor documentation, losses to follow-up, poor response to polymerase chain reaction tests, and poor quality of postnatal care continue to be the main deficiencies that threaten pregnancy [13]. Effectiveness of the mother child transmission prevention program is clear; therefore, they suggested that context-informed intervention strategies are needed to address these weaknesses, with the aim of enhancing prevention of mother-child transmission (PMTCT) implementation in

South Africa [13]. Alemu *et al.* identified the following as the main determinants of infection in children: home delivery, mixed feeding, poor maternal adherence to the anti-retroviral drugs, poor adherence to the main drug of treatment, nevirapine, and late inclusion of the infant [14].

On the other hand, Astawesegn *et al.* reported a reduction in the rate of mother-child transmission from 27.18% to 16.90% in sub-Saharan Africa. Similarly, an analysis by subgroups indicated that in southern Africa and in middle-high income groups, there were greater anti-retroviral therapy (ART) coverage and lower rates of mother-child transmission. The result of the fixed effects model showed, among other elements, that the logarithmically transformed HIV incidence/prevalence rate was significantly associated with the HIV transmission rate from mother to child [15].

Our results concerning the main transmission routes in this population (horizontal, vertical and contact with blood contaminated with HIV) are not surprising taking into account the cultural issues and the importance of mother to child transmission [2]

It is possible that in the population analyzed in this study, the educational campaigns implemented for the prevention of infection at the municipal level helped to influence the reduction of HIV transmission. Nevertheless, it is crucial to continue to improve this trend in terms of prevention of spread of the disease, through the three possible routes of its transmission: vertical, sexual, and transfusional. Thus, education on the routes of disease transmission has great public relevance. In addition, training programs for the communities organized by the Malanje provincial government health authority, would be an important step to spread information about the disease, and demonstrate how communities should prevent the progression of the infections. Women with HIV should receive ART during pregnancy and childbirth to reduce the risk of perinatal transmission of HIV and to protect their own health [14,15]. It was also found that a majority of HIV-infected children belonged to families with the low level of primary schooling and low income; thus, social environment influences the rate of new cases of HIV in children.

The accumulate incidence rate, prevalence rate and mortality rate indicated temporal decrease of HIV infection among children and variations in incidence in the four municipalities investigated. The higher prevalence rate in Caculama and Malanje were in accordance with the fact that most HIV tests were carried out in those municipalities. In addition, the municipalities varied in the level of knowledge, timely

access to information, lack of means of transportation for programs at the municipal level, difficulties associated with the quality of the roads, lack of awareness programs in the most remote areas, and the unavailability of well-trained technical personnel in CATV programs. In addition, there was variability in the number of tests done by the municipality each year, and their processing times. Although the operation of the CATVs was in principle the same, the personnel who work in them did not have the same training across all the municipalities, being weaker mainly in the most remote areas (Caculama and Calandula).

The positive trend in the accumulate incidence rate was at least in part due to the actions implemented to reduce new cases per year in the Angolan municipalities under study. One such program was an AIDS awareness campaign designed for educational institutions throughout the province, promoting awareness on HIV/AIDS issues such as transmission methods and safe sex among students. In addition, monitoring of pregnant women during prenatal consultations was increased in the four municipalities of the province of Malanje. The women also participated in HIV/AIDS awareness programs and testing campaigns. The counseling centers for voluntary tests and CATV services in the municipalities were also important for HIV screening in children. Condom distribution campaigns were organized in this region. Awareness programs on issues related to HIV/AIDS and other sexually transmitted diseases (STDs) were also added to radio and television schedules, and these also likely contributed to reduction in infection rates. Finally, the permanence and propagation of the national campaign "Born Free to Shine" (launched in December 2018), aimed to reduce the transmission of HIV/AIDS from mother to child, has certainly played a fundamental role in cutting vertical transmission from mother to child throughout the province of Malanje.

Among the factors associated with the reduction of the HIV prevalence rate in the four municipalities were the administration of anti-retroviral drugs in counseling centers and CATVs to reduce the prevalence and rate of maternal and infant mortality due to HIV/AIDS throughout the province; and the strategies implemented to reduce the spread of HIV/AIDS, through training of professionals and volunteers throughout the province.

Conclusions

The study of the trends of HIV/AIDS infections in children under 14 years identified the inconsistency in the prevalence rate of infection, with greater

representation in the municipality of Malanje. The accumulate incidence rate has been decreasing but the number of children infected with HIV each year remains high.

However, there is limited information regarding the diagnosis of HIV/AIDS in the municipalities studied, and the access to information that allows the diagnosis centers to improve the effectiveness of work at the municipal level is limited. A more comprehensive analysis by municipalities will provide more location-specific information for objective conclusions. Future work should also focus on an analysis of infection routes, and environmental, cultural, and socio-economic factors to develop a better understanding of the epidemiology of AIDS/HIV among Angolan children.

Funding

This work was supported by funds from the CICS-UBI base grant (<https://doi.org/10.54499/UIDB/00709/2020>), and the CICS-UBI programmatic grant (<https://doi.org/10.54499/UIDP/00709/2020>); with national funds registered in the budget of the FCT – Fundação para a Ciência e a Tecnologia, I.P.

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Corresponding author

Ana Mafalda Fonseca, PhD.
Faculdade de Ciências da Saúde, Universidade da Beira Interior,
Av. Infante D. Henrique, 6200-506 Covilhã, Portugal.
Tel: 00351 275 329 056
Fax: 00351 275 329 099
Email: mfonseca@fcsaude.ubi.pt

Conflict of interests: No conflict of interests is declared.