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Evolution of HIV epidemic trends and diagnostic delays in French Guiana: how can we make further progress?

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Abstract

Background As antiretroviral treatment indications evolved, an increasing proportion of patients have been treated; since 2017, most patients receive antiretroviral treatment, irrespective of their CD4 count, in French Guiana and neighboring countries. In this context, we aimed to model the epidemic and to study the evolution of the estimates of the intervals between HIV-infection and HIV diagnosis in French Guiana.

Methods The study was descriptive and comparative. Anonymous data from all persons in the DAT'AIDS HIV cohort based on quality-controlled clinical records was aggregated into yearly statistics between 2000 and 2023. We estimated year of infection using the rate of CD4 decline between the CD4 count at diagnosis and the estimation of the CD4 count at the time of HIV infection. The HIV modelling platform version 3.0.2 used the annual number of new HIV infections, the number of new AIDS cases, the number of new HIV infections that had AIDS, and CD4 strata to compute incidence, number of diagnosed and undiagnosed persons, and diagnostic delay.

Results All indicators improved markedly over time. Incidence declined, diagnostic delay declined, the proportion of undiagnosed patients declined, and deaths declined. However, the estimated interval between HIV infection and diagnosis was heterogenous between groups: It was about 2 years longer among males than among females, and it was about 3 years longer among Surinamese or Brazilian immigrants. Overall, 5% of all persons with HIV were undiagnosed, 9% of diagnosed persons were not on antiretroviral therapy and 6% of those on antiretroviral therapy were in virological failure. For a population of about 4,000 persons with HIV this represents a residual source of transmission.

Conclusions The scaling up of testing, antiretroviral treatment, and preexposure prophylaxis has led to remarkable progress. Nevertheless, further shrinking the reservoir of undiagnosed infections and maximizing the proportion of successfully treated persons living with HIV is still likely to further improve control of the epidemic.

Clinical trial This is not a clinical trial.

Keywords HIV, AIDS, French Guiana, Diagnostic delay, Incidence, Modelling

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Introduction

French Guiana, a French overseas territory in South America, has the highest incidence and prevalence of HIV among all French territories [1]. Indeed, for over 3 decades the prevalence has been above 1%. For decades HIV has also represented a major cause of premature death in the population [2]. Intense testing effort were implemented with about 2 times more tests per capita than in mainland France, these testing efforts also concerned the most remote areas [3]. Furthermore, the diversification of testing included free HIV-testing clinics, free tests at the health centers, special events with emphasis on testing, rapid testing by NGOs from 2010 onwards, mobile testing trucks starting in 2012, a specific nurse for HIV testing at the emergency ward in Cayenne, free tests at private laboratories. Yet despite these efforts, year after year, a substantial proportion of new diagnoses invariably presented at the advanced HIV stage [4]. Furthermore, despite prevention efforts within the HIV cohort, disclosure of one's status to sexual partners was inconsistent and transmission continued, notably when antiretrovirals were only indicated for those below a certain CD4 threshold. In 2016 the HIV continuum of care cascade in French Guiana was 85% of persons with HIV aware of their infection, 74.8% of the latter on antiretroviral treatment, and 91% of those on treatment with virologic suppression. However, antiretroviral treatment indications evolved, and an increasing proportion of patients have been treated; since 2017, most patients receive antiretroviral treatment, irrespective of their CD4 count, in French Guiana and neighboring countries [5]. Despite the disruption of outpatient care by the COVID-19 pandemic, clinicians witnessed a clear decline in new patients, AIDS diagnoses, and deaths [2]. In this context, we aimed to model the epidemic and to study the evolution of the estimates of the intervals between HIV-infection and HIV diagnosis in French Guiana.

Methods

Study design

The study was descriptive and comparative. Anonymous data from the DAT'AIDS HIV cohort was aggregated into yearly statistics between 2000 and 2023. Comparisons of these statistics were made between nationalities and genders were made.

Setting

As in all regions of France, the HIV programme in French Guiana compiles programmatic data on HIV hospital cohorts. Epidemiological, biological and therapeutic data are collected by trained clinical research assistants in the eNADIS/DAT'AIDS system. French Guiana being a French territory, patients have the same rights as in mainland France, more specifically they benefit from health insurance covering for paraclinical explorations, consultations, hospitalizations and treatments. Foreign nationals benefit from residence permits for health reasons. In practice, different insurance regimens, including for undocumented migrants, ensure treatment and paraclinical explorations are free. Treatment guidelines are the same as in mainland France. They are issued and regularly updated by the Conseil National du Sida et des hépatites virales and by the Agence Nationale de Recherche sur le SIDA et les Hépatites, et les maladies infectieuses émergentes. Test and treat is the recommendation and the treatment options are the same as in mainland France.

Participants

Participants were all adults followed in the hospital outpatient cohort of persons with HIV in French Guiana between 2000 and 2023.

Variables

For the present study date of diagnosis, date of death, AIDS stage at diagnosis, CD4 counts at diagnosis, gender, and country of origin were studied.

Data sources

The cohort data originates from computerized medical records filled by physicians, completed and verified by clinical research assistants who undertake quality control of the database with source paper medical records. Biological variables –here CD4 counts— are checked using laboratory printouts, and the laboratory regularly undergoes rigourous quality controls.

Estimation of the interval between date of infection and diagnosis

We used the method developed in the UK by Rice and colleagues [6]. We estimated year of infection using the rate of CD4 decline (which is influenced by age and ethnicity) between the CD4 count at diagnosis and the estimation of the CD4 count at the time of HIV infection. CD4 cell count at HIV sero-conversion and square root of CD4 cell decline used modelling of the CD4 decline in a cohort of HIV-infected persons, fitting random effect (slope and intercept) multilevel linear regression models. Because most migrants in French Guiana have African ancestry we used median CD4 counts, interquartile ranges, and the slope of CD4 (square root) decline calculated for black populations (median 487(IQR = 377–619)), and 0.2 + 0.02*age, respectively. For patients from northern Brazil, we used median CD4 counts, interquartile ranges, and CD4 slope (square root) for other ethnicities (median 538(IQR = 403–701)), 0.55 + 0.02*age. The interval between seroconversion and diagnosis was computed using the following formula [square root(CD4

at seroconversion)-square root(CD4 at HIV diagnosis)]/slope of CD4 decline [7]. Analyses use Stata 16 software (Stata corporation, College Station, Texas, USA).

ECDC HIV modelling platform

The French Guiana epidemic was modelled using the HIV modelling platform version 3.0.2 [8]. To function we uploaded csv files with the annual number of new HIV infections, the number of new AIDS cases, and the number of new HIV infections presenting with AIDS. In addition 4 files with patient numbers with different CD4 strata were also uploaded to the HIV platform tool: the first file included annual number of HIV diagnoses with CD4 ≥ 500 cells/mm3 and no concurrent AIDS diagnosis; the second one included the annual number of HIV diagnoses with CD4 350–499 cells/mm3 and no concurrent AIDS diagnosis; the third one included annual number of HIV diagnoses with CD4 200–349 cells/mm3 and no concurrent AIDS diagnosis; The last file included the annual number of HIV diagnoses with CD4 < 200 cells/mm3 and no concurrent AIDS diagnosis. Modelling included 100 bootstrap replications. This allowed to obtain the number of diagnosed and undiagnosed patients, the incidence rate, the proportion of undiagnosed patients, and the time to diagnosis, all with confidence intervals [9].

Ethics and regulatory aspects

The anonymized data is part of the DAT'AIDS cohort which in turn feeds the French Hospital Database on HIV. The Dat'AIDS cohort has been approved by the Commission Nationale Informatique et Libertés (CNIL 2001/762876). The research performed in accordance with relevant guidelines and regulations. All subjects in the cohort gave written informed consent.

Results

General results

Overall 3628 records from adults with initial CD4 counts were available. The proportion of males and females was equivalent (50.25% males vs. 49.75% females). The median age among males was 44 years (IQR = 35–56) and 41 years (IQR = 32–51) among females. The number of new patients dropped sharply after 2017 (Fig. 1).

CD4 counts at the time of diagnosis

In 2000–2005, 26.81% of newly diagnosed patients had CD4 counts < 200 per mm^3, in 2006–2011, 26.81% of newly diagnosed patients had CD4 counts < 200 per mm^3, in 2012–2018, 33.37% of newly diagnosed patients had CD4 counts < 200 per mm^3, and in 2019–2023 15.62% of newly diagnosed patients had CD4 counts < 200 per mm^3. Figure 2 shows that CD4 counts at the time of diagnosis rose in the past decade (Kruskal-Wallis $P < 0.001$).

Evolution of the interval between HIV infection and diagnosis

Figure 3 shows the slow decline of the estimated interval between HIV infection and diagnosis (Spearman's Rho=-0.09, $P < 0.0001$). Overall, the delay between infection

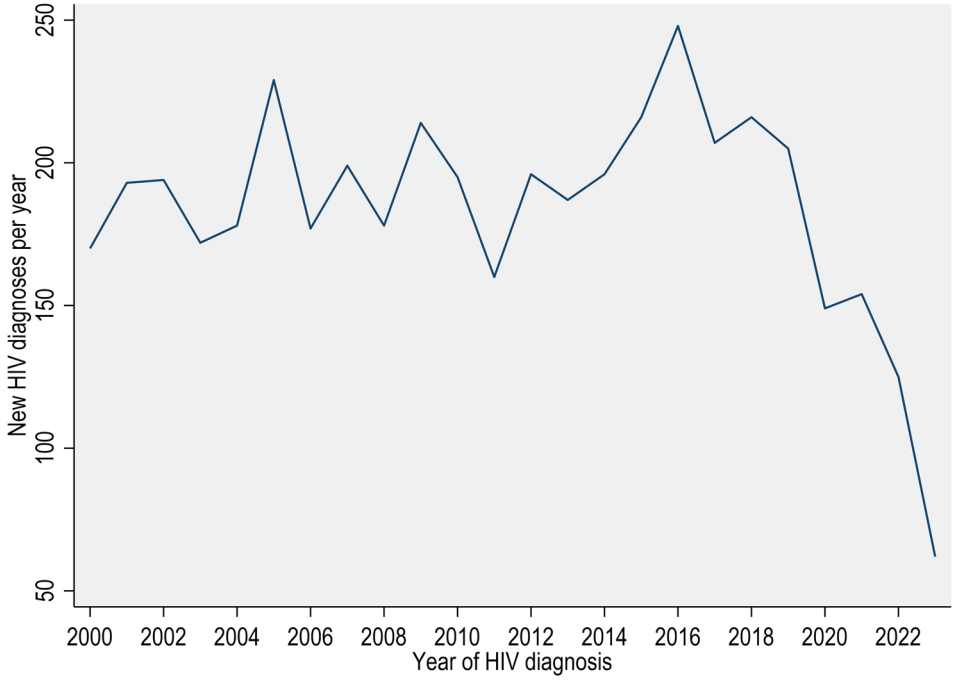


Fig. 1 Yearly number of new HIV patients in the French Guiana hospital cohort

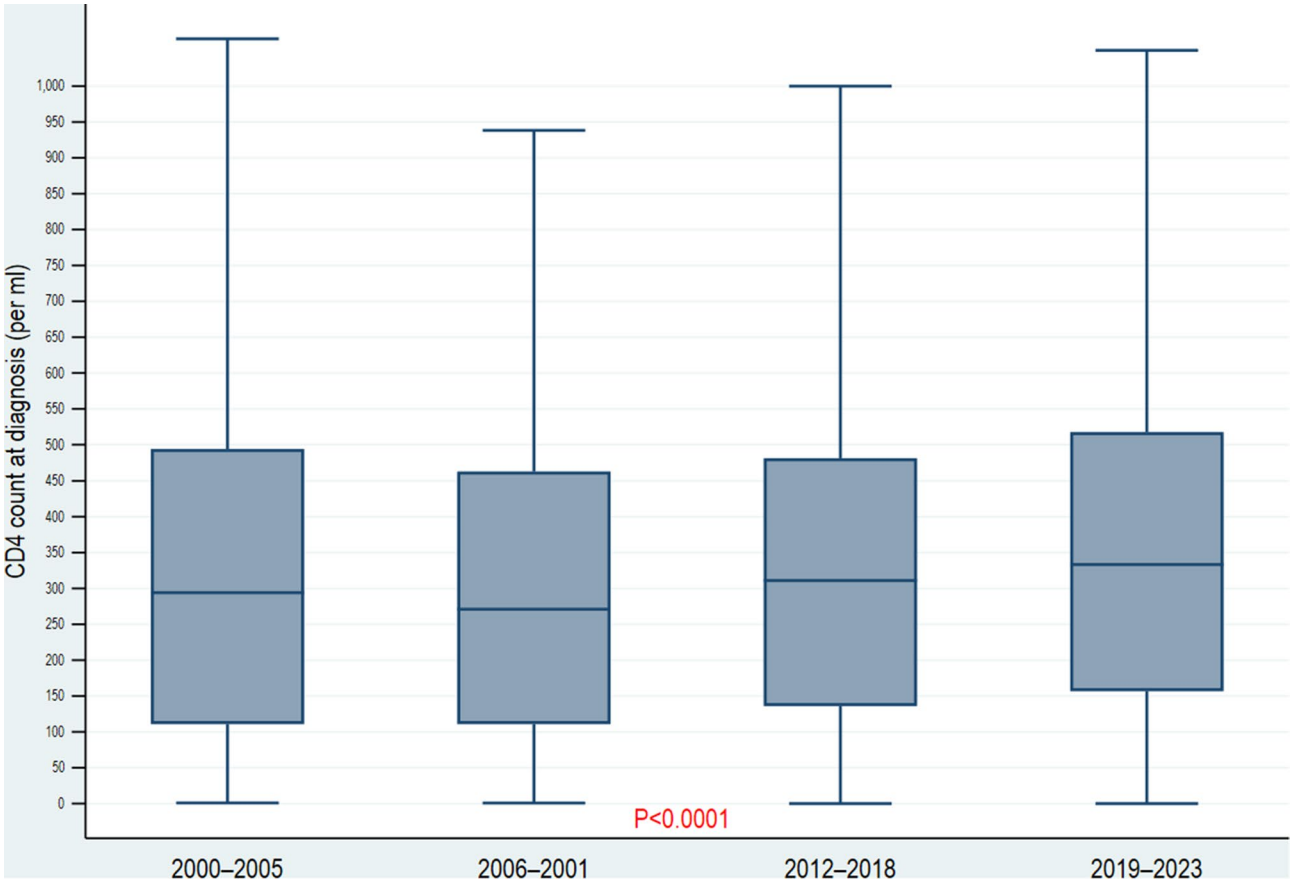


Fig. 2 CD4 count at HIV diagnosis for different periods in French Guiana

and diagnosis was about 2 years longer for males than for females (Fig. 3) but both had declining trends Spearman's rho=-0.09, $P<0.001$ and Spearman's rho=-0.08, $P<0.001$, respectively.

Figure 4 breaks down the analysis for the 4 main population groups. We show that the diagnostic delays were longest among persons from neighboring countries, and that the diagnostic delay even seemed to increase among Brazilian and Surinamese nationals. For French (including French Guiana) or Haitians the interval between infection and diagnosis approached 3 years, and the trend seemed to decline. The decline was significant for Haitians Spearman's Rho=-0.19, $P<0.001$, but not significant for French (Spearman's Rho=-0.04, $P=0.2$); by contrast the interval between infection and diagnosis was longer and seemed to increase for Surinamese and for Brazilians (Fig. 4). The increase was significant for both –Spearman's Rho = 0.14, $P<0.001$ for Suriname, and Spearman's Rho = 0.2, $P<0.001$.

Mortality

Figure 5 shows the gradual decline in the number of deaths in the Hospital HIV cohort. After the 1990's, from around 40 deaths per year there was a first drop in the number of deaths followed by oscillations around 30 deaths per year for a decade until a rapid drop from 2017 onwards.

ECDC HIV modelling platform results

The ECDC modelling platform estimations shown in Fig. 6 shows that, although the number of persons with HIV increased, there was a gradual shrinkage of the reservoir of undiagnosed infections.

Figure 7 shows the evolution of the proportion of infections that were undiagnosed. There was a rapid decline until 2000, from then on to 2018 the pace of decline was slower, with a recent dip in 2019–2023. In 2023 the proportion of undiagnosed was 5%.

Figure 8 shows the estimated average diagnostic delay using the ECDC modelling platform, suggesting a continuous decline over time, between 3 and 4 years in the past decade.

Figure 9 shows a decline of incidence but with a "camel back" aspect suggesting a surge in new patients in the past decade.



Fig. 3 Estimated interval between HIV infection and diagnosis in French Guiana, overall and by sex

Discussion

Here we show that the estimates of HIV diagnostic delays using 2 different methods (Figs. 3 and 9) have gradually declined. There was however an apparent brief transient rebound in 2020–2021 using the CD4 erosion method (Fig. 3) coinciding with health system disruptions due to the COVID-19 pandemic. We also show that the diagnostic delays were longest among persons from neighboring countries, and that the diagnostic delay even seemed to increase among Brazilian and Surinamese nationals (Fig. 4). Overall, the epidemic model also suggested that the proportion of undiagnosed infections has been gradually shrinking. We believe the main factor behind this has been the increase of the proportion of persons with HIV on effective antiretrovirals. Preexposure prophylaxis among vulnerable groups may also have contributed to this virtuous cycle. As effective antiretroviral therapy revolutionized the prognosis of the disease and its transmission dynamics, a major strategic goal of the local HIV program has long been the reduction of the number of undiagnosed infections—a major source of HIV transmission. Estimates vary between contexts: while some studies put transmission by persons unaware of their infection at 54% to 70% [10], others estimate it at 34% [11]. In French Guiana, the cascade of care was estimated at 95%x92%x94%, for an estimated total of 4,000 diagnosed and undiagnosed persons with HIV, this suggests that 732 (200 + 304+228) persons, 532 of whom are aware of their infection were not virologically controlled in 2023. Hence, this suggests that further controlling the epidemic requires both to sustain the intense testing efforts and to maximize the proportion of persons on effective antiretroviral treatment. Perhaps outreach interventions could further maximize virological control. While it was recommended to treat all patients, it is still not clear why 8% of hospital cohorts were not receiving ARVs. In October 2025 however, the proportion of the hospital cohort not on treatment declined to 2%.

The HIV epidemic curve shows that incidence has markedly slowed down. Small gains in diagnostic delays may have contributed to this, but it is also very likely that treatment as prevention has weighed heavily on the reduction of transmission. Furthermore, in 2015, most patients were prescribed ARVs, and preexposure prophylaxis started being scaled-up in persons from high risk groups in French Guiana, mostly migrant sex workers. The synchronous surge in primary and secondary prevention hence has presumably had a major impact on the

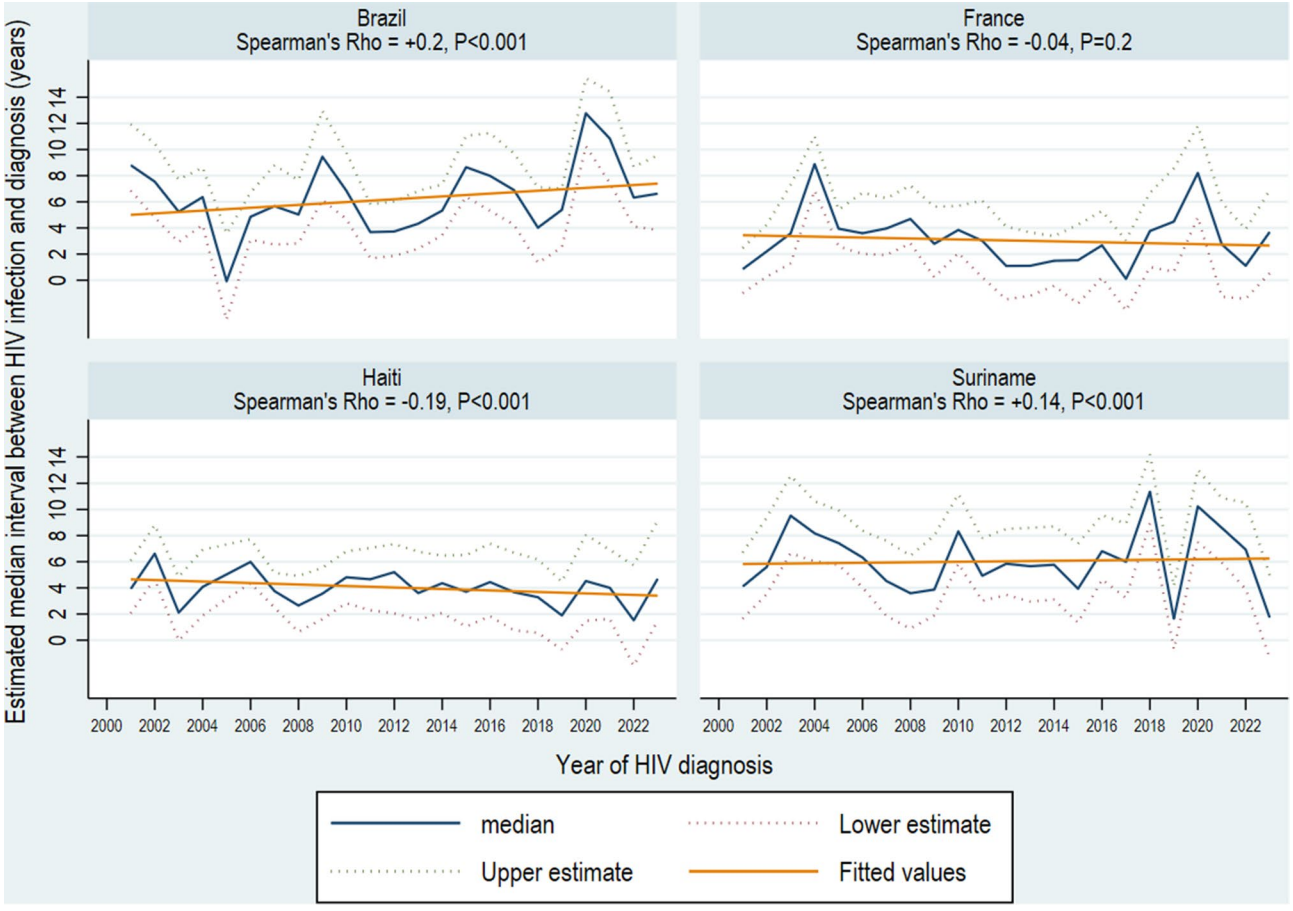


Fig. 4 Estimated interval between HIV infection and diagnosis for 4 countries of origin in French Guiana

epidemic. Finally, in neighboring Suriname only a fraction of the HIV cohort were on antiretrovirals until the 2016 WHO guidelines expanded treatment indications [12]. This led to a high community viral load in Suriname until the new guidelines were implemented, which had an impact notably in western French Guiana where a large proportion of patients come from Suriname. However, in 2025 UNAIDS estimated that only 49% [44–55] of persons with HIV were on ARVs, suggesting that transmission is still potentially high [13]. The camel back aspect of incidence curve (Fig. 9) seems intriguing but may simply reflect the massive immigration wave from Haiti following the 2010 earthquake peaking in 2015 [14, 15]. This emphasizes that despite tremendous progress, spillover effects of socioeconomic and political crises in Latin America and the Caribbean could further impact the profile of the HIV epidemic in French Guiana.

The present study has limitations that should be kept in mind when interpreting the results. First, over time in a territory with frequent health personnel turnover, there may have been variations in data entry that were incompletely mitigated by the research technicians controlling the quality of the data. Many of the annual estimates show considerable oscillations from year to year because of the small population size which amplifies random variations. However, given the time span statistical trends become apparent. Modelling the epidemic in a context of complex migratory flows may lead to uncertainty in the estimates produced, which may, in some cases, be influenced by imported cases rather than local dynamics. The COVID-19 pandemic created major disruptions in HIV testing and patient follow-up in 2020 and part of 2021. These disruptions may also have led to changes in patient behavior leading to interruption of hospital outpatient follow-up and inciting them to turn to private practitioners, who do not collect any data. Finally, although there are convincing reasons to relate the generalization of antiretroviral therapy to most persons living with HIV and prep to the decline in incidence, correlation is no definitive proof.

In conclusion, we show a decreasing trend of diagnostic delays, incidence, deaths, and the proportion of undiagnosed patients. We also show that the number of new infections has sharply declined since 2016–2017, which corresponds to the expansion of treatment indications to all persons living with HIV and the scaling-up

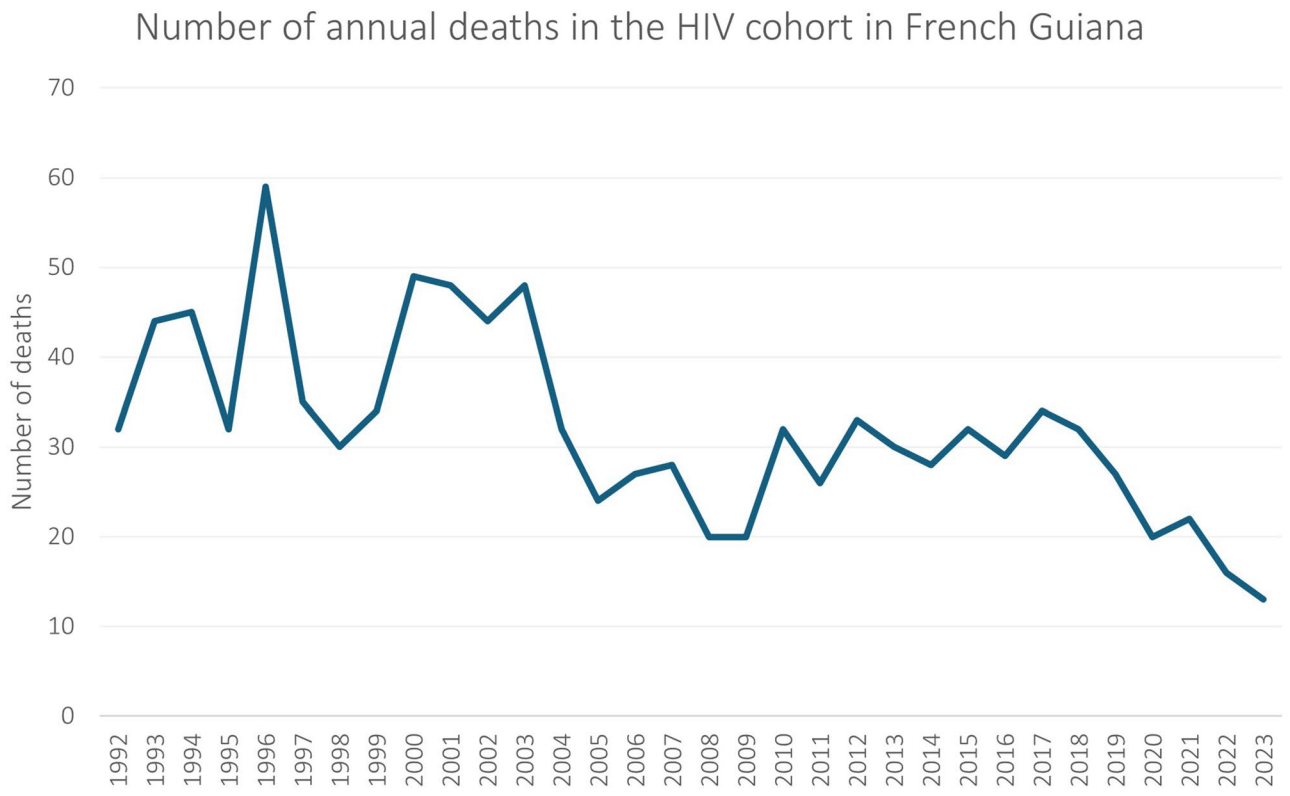


Fig. 5 Number of annual deaths in the HIV cohort in French Guiana

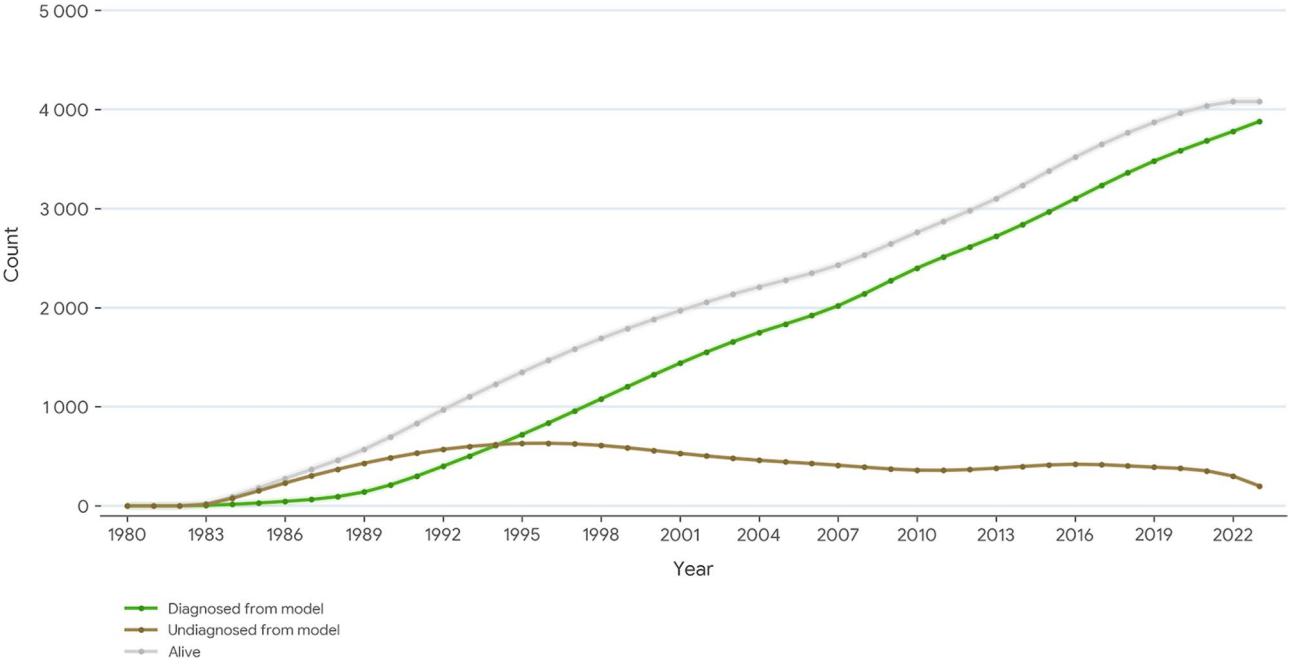


Fig. 6 Estimated number of diagnosed and undiagnosed HIV infections in French Guiana (ECDC modelling platform, incidence method). The y axis represents the count or the number of persons with HIV in French Guiana. The grey curve represents the total (aware and unaware) the green curve represents those having been diagnosed, and the brown curve represents those who are unaware of their infection

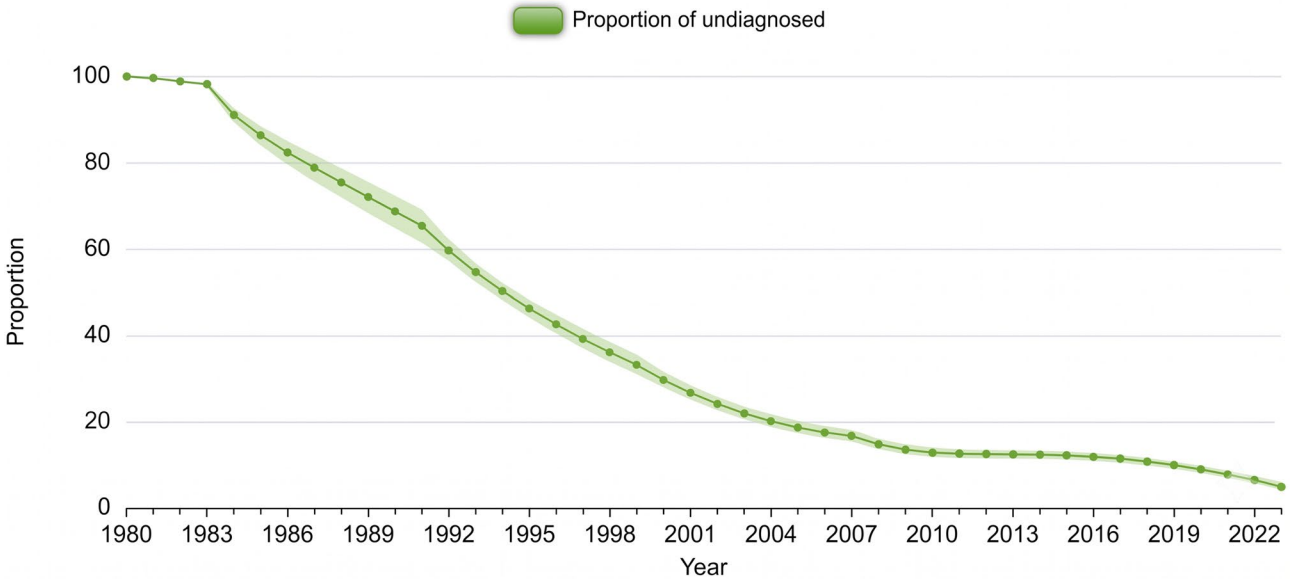


Fig. 7 Estimated percentage of undiagnosed HIV infections in French Guiana (ECDC modelling platform, incidence method). The y axis represents the proportion of persons who are unaware of their infection at different time periods in the history of the epidemic. In 1980, apart from AIDS cases, before HIV testing, most were unaware they were infected with HIV. Over time the proportion aware of their diagnosis has gradually increased, with a plateau between 2010 and 2017

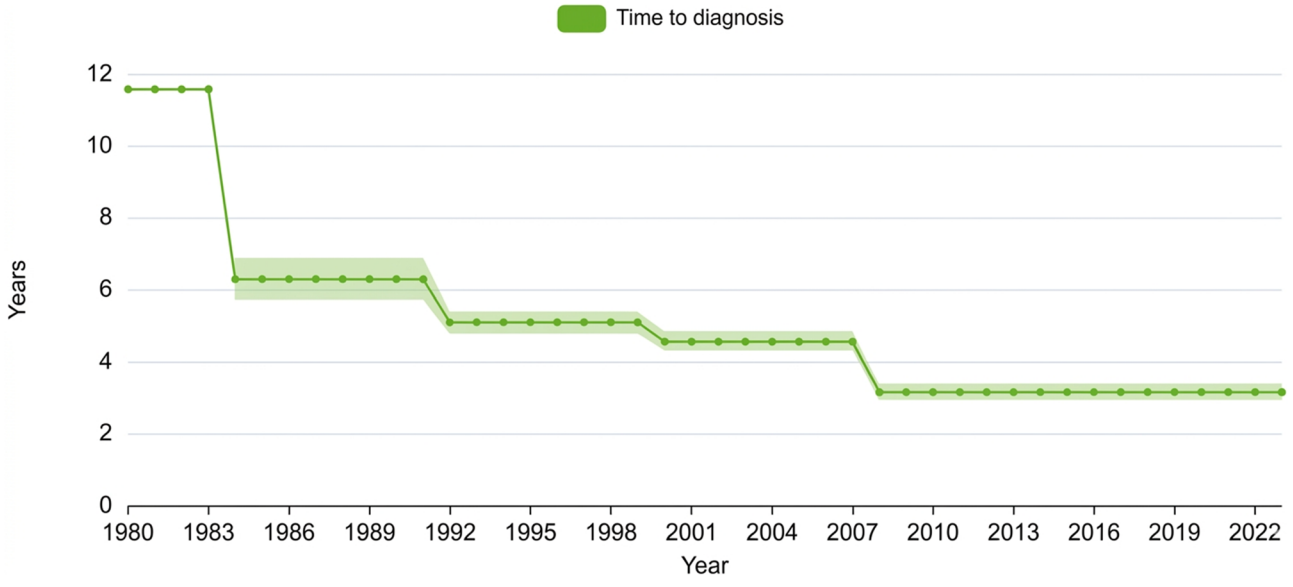


Fig. 8 Estimated diagnostic delay for HIV infections in French Guiana (ECDC modelling platform incidence method). The y axis shows the estimation by the ECDC HIV modelling platform of the diagnostic delay between infection and diagnosis for different years

of preexposure prophylaxis. Besides the continuation of testing efforts, there may still be room for progress in increasing the proportion of diagnosed persons on effective antiretroviral therapy.

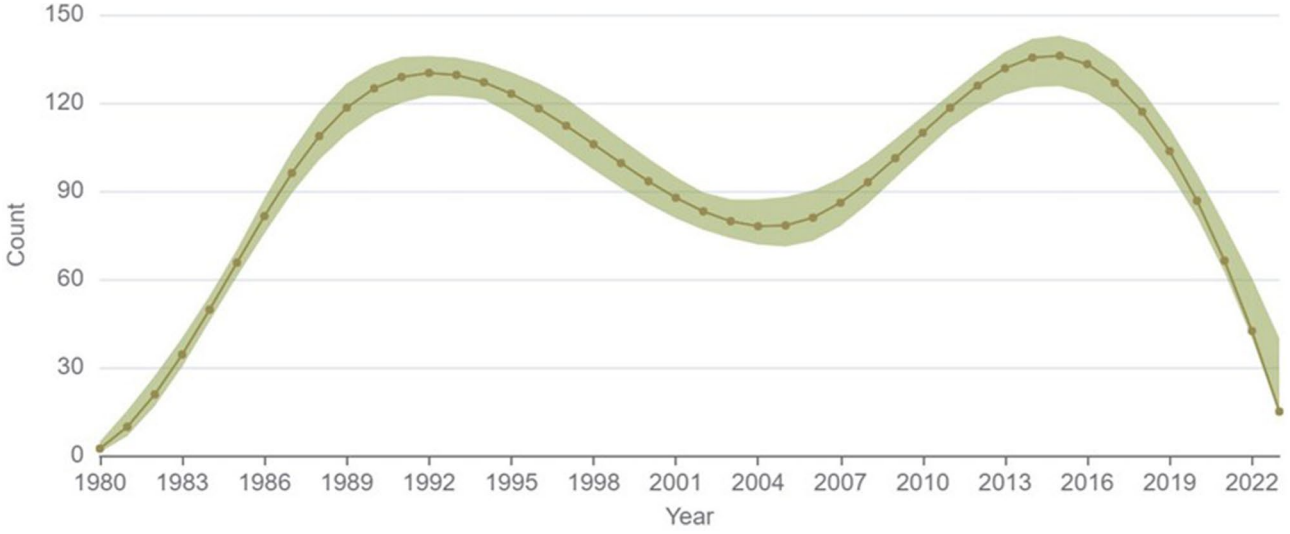


Fig. 9 Estimations of the evolutions of HIV incidence (HIV modelling platform, incidence method). The y axis represents the count of the incident number of persons acquiring HIV in French Guiana each year and the confidence interval

Abbreviations

AIDS	Acquired Immunodeficiency Syndrome
ARVs	Antiretroviral drugs
CD4	Cluster of Differentiation 4 (T lymphocytes)
CHC	Centre Hospitalier de Cayenne
CHOG	Centre Hospitalier de l'Ouest Guyanais
CNIL	Commission Nationale de l'Informatique et des Libertés
COREVIH	Comité de Coordination de la Lutte contre le VIH
COVID	19–Coronavirus Disease 2019
DAT'AIDS	Database for the Hospital HIV Cohort (France)
ECDC	European Centre for Disease Prevention and Control
eNADIS	Electronic NADIS system
HIV	Human Immunodeficiency Virus
IQR	Interquartile Range
NGO	Non–Governmental Organization
PLWH	People Living With HIV
PrEP	Pre–exposure prophylaxis
WHO	World Health Organization

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Author contributions
PA: Investigation, Writing – review & editing AA: Investigation, Writing – review & editing. AL: Investigation, Writing – review & editing. CM: Investigation, Writing – review & editing. CD: Data curation, Writing – review & editing. FV: Writing – review & editing. FD: Investigation, Writing – review & editing. HC: Investigation, Writing – review & editing. LE: Investigation, Writing – review & editing. MN: Conceptualization, Formal Analysis, Validation, Writing – original draft, Writing – review & editing. MeG: Investigation, Writing – review & editing. PIT: Investigation, Writing – review & editing. Philippe Abboud: Investigation, Writing – review & editing. PC: Writing – review & editing. SR: Data curation, Writing – review & editing. TV: Investigation, Writing – review & editing.

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Data availability
The data is not immediately available to the public. It may be shared upon reasonable request at [corevih@ch-cayene.fr](mailto: corevih@ch-cayene.fr) after approval by the French regulatory authority the commission nationale informatique et libertés (3 Place de Fontenoy - TSA 80715 - 75334 PARIS CEDEX 07).

Declarations

Ethics approval and consent to participate
The anonymized data is part of the DAT'AIDS cohort which in turn feeds the French Hospital Database on HIV. As required by French law, the Dat'AIDS cohort has been approved by the Commission Nationale Informatique et Libertés (CNIL 2001/762876) and complies with the European General Regulations for Personal Data. It does not require IRB approval. During the first consultation, after information all subjects in the cohort gave written consent for inclusion of their data in the cohort and for publication of research from the anonymized data. This form is kept in the patient records.

Consent for publication
Not applicable.

Accordance
The research performed in accordance with relevant guidelines and regulations and did not include experiments or human samples.

Competing interests
The authors declare no competing interests.

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