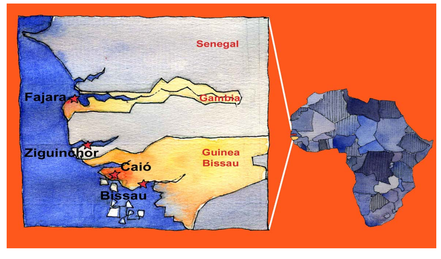
Predicting the Extinction of HIV-2 in Guinea-Bissau

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BACKGROUND

HIV-2 is less virulent than HIV-1 but can cause AIDS indistinguishable from AIDS caused by HIV-1. Guinea-Bissau is believed to be the nucleus of the HIV-2 epidemic and the prevalence was >20% in the 1980s in elderly in Caio, a rural area. In 1990-2007, HIV-2 prevalence halved and in 2007 infection amongst young adults in the region was very low (<1% in 15-34 year olds). However, HIV-2 prevalence was still 12% amongst individuals aged ≥45, due in part to increased susceptibility of women to HIV-2 with increasing age. This suggests that HIV-2 may persist as an infection of the elderly. Through a model we aimed to answer the following questions: will HIV-2 in Caio go extinct and if so, when would this happen, or will it persist as an infection among elderly?



METHODS

A deterministic transmission model was developed and fit to the age-stratified incidence and prevalence data from the HIV-2 epidemic in Caio, as measured in 3 serosurveys in 1990, 1997 and 2007.
In the model the population is segregated into 3 states: Susceptible, Infected and Removed (SIR model). A stochastic version of the model was also formulated by allowing death and infection to be governed by probabilistic methods and this version was used with 1000 simulations to make future predictions of HIV-2 prevalence and incidence.

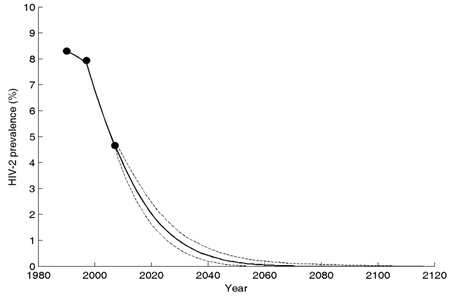


FIGURE 1. The prevalence of HIV-2 infection amongst individuals aged over 15 years.

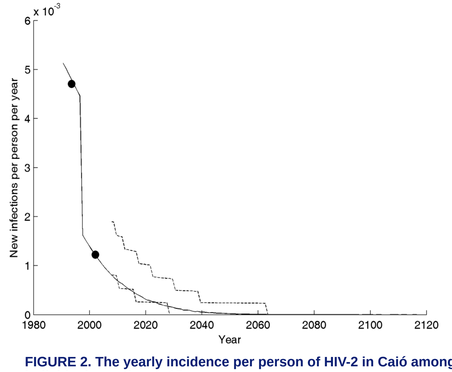


FIGURE 2. The yearly incidence per person of HIV-2 in Caió amongst individuals aged over 15 years.

For both figures, the data are represented by solid circles, the model by the black line. Between 1990 and 2007 the deterministic result is shown. Beyond 2007 the median (solid line) and 95% confidence intervals (dashed lines) of 1000 stochastic simulations are shown.

RESULTS

Our model predicts that HIV-2 infections (including dual HIV-1/2 infections) will continue to decline in prevalence and become extinct in Caió this century. HIV-2 prevalence is expected to fall below 0.1% by 2053 (95% CI: 2043-2074) (Figure 1). New infections are predicted to cease around 2047 (2029-2083) (Figure 2). Extinction is expected to occur around 2071 (2054-2106).

Sensitivity analysis reveals that plausible changes to HIV-2-related death rates, to the degree of age-segregation in partnerships and to how susceptibility changes with age (with the model refitted to the data in each case) reduces the fit of the model to data and changes the predicted median time to extinction by 15 years at most.

A better fit of the model to the age-stratified incidence data can be achieved by applying the reduction in contact rate in 1997 only to younger cohorts. It predicts that new infections would cease sooner (2024; 2019-2026) and prevalence would decline more rapidly. Prevalence would drop below 0.1% by 2047 (2040-2056), and complete extinction would occur around 2061 (2049-2080).

A third sensitivity analysis assumes a doubling of the HIV-1 prevalence. This scenario would bring forward the extinction of HIV-2 by appr. 4 years (2067; 2050-2102). Prevalence would fall below 0.1% by 2050 (2040-2069) and new infections would cease by 2045 (2029-2080).

CONCLUSIONS

Based on our model, it is predicted that HIV-2 infection will continue to decline rapidly in Caió such that new infections will cease and prevalence will reach low levels. HIV-2 will go extinct in Caió during the second half of this century. HIV-2 epidemics in other parts of the world have behaved in a very similar way thus far, making global extinction of HIV-2 a possibility. As low plasma viral loads play a key role in the restricted transmission and therefore decline of HIV-2, we highlight the relevance of our results to the potential control of the HIV-1 epidemic via universal treatment.

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