

Interpreting HIV Diagnostic Histories into Infection Time Estimates: Analytical Framework and Online Tool

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Abstract

Background It is frequently of epidemiological and/or clinical interest to estimate the date of HIV infection or time-since-infection of individuals. Yet, for over 15 years, the only widely-referenced infection dating algorithm that utilises diagnostic testing data to estimate time-since-infection has been the 'Fiebig staging' system. This defines a number of stages of early HIV infection through various standard combinations of contemporaneous discordant diagnostic results, using tests of different sensitivity.

Objective To develop a new, more nuanced infection dating algorithm, we generalised the Fiebig approach to accommodate positive and negative diagnostic results generated on the same or different dates, and arbitrary current or future tests – as long as the test sensitivity is known. For this purpose, test sensitivity is conceptualised as the probability that a specimen will produce a positive result, expressed as a function of time since infection. This can be summarised as a median 'diagnostic delay' parameter, together with a measure of inter-subject variability.

Methods The present work outlines the analytical framework for infection date estimation using subject-level diagnostic testing histories, and data on test sensitivity. We introduce a publicly-available online HIV infection dating tool that implements this estimation method, bringing together 1) curatorship of HIV test performance data, and 2) infection date estimation functionality, to calculate plausible intervals within which infection likely became detectable for each individual. The midpoints of these intervals are interpreted as infection time 'point estimates' and referred to as Estimated Dates of Detectable Infection (EDDIs).

Results In many settings, including most research studies, detailed diagnostic testing data are routinely recorded, and can provide reasonably precise estimates of the timing of HIV infection. We present a simple logic to the interpretation of 'diagnostic testing histories' into 'infection time estimates', either as a point estimate (EDDI) or an interval (earliest plausible to latest plausible dates of detectable infection), along with a publicly-accessible online tool that supports wide application of this logic.

Conclusions This tool, available at <https://tools.incidence-estimation.org/idt/>, is readily updatable as test technology evolves, given the simple architecture of the system and its nature as an open source project.

Manuscript Access

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Figures

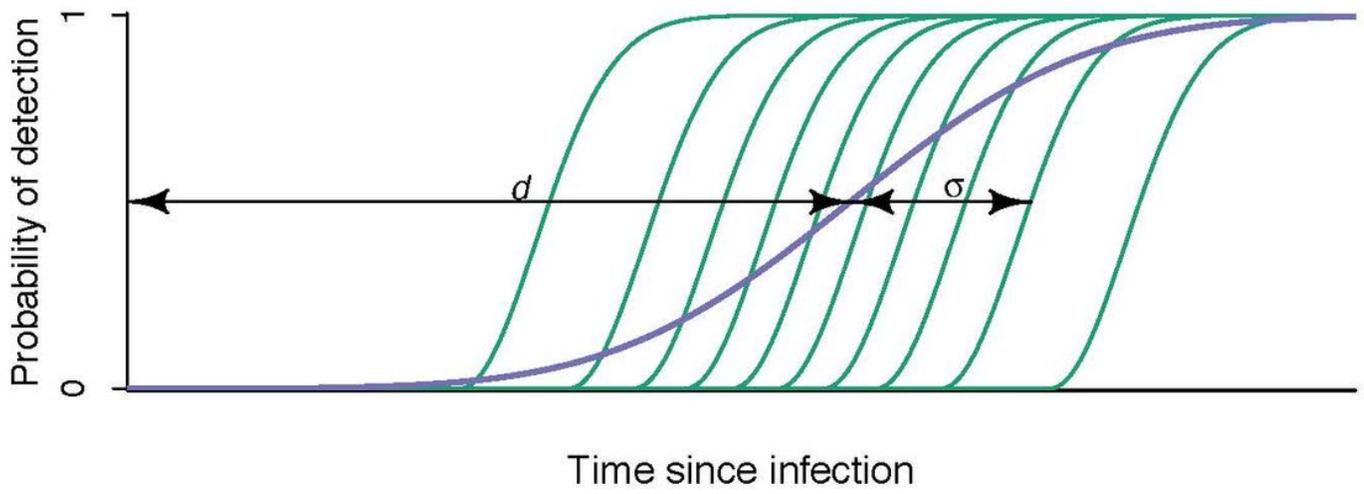


Figure 1

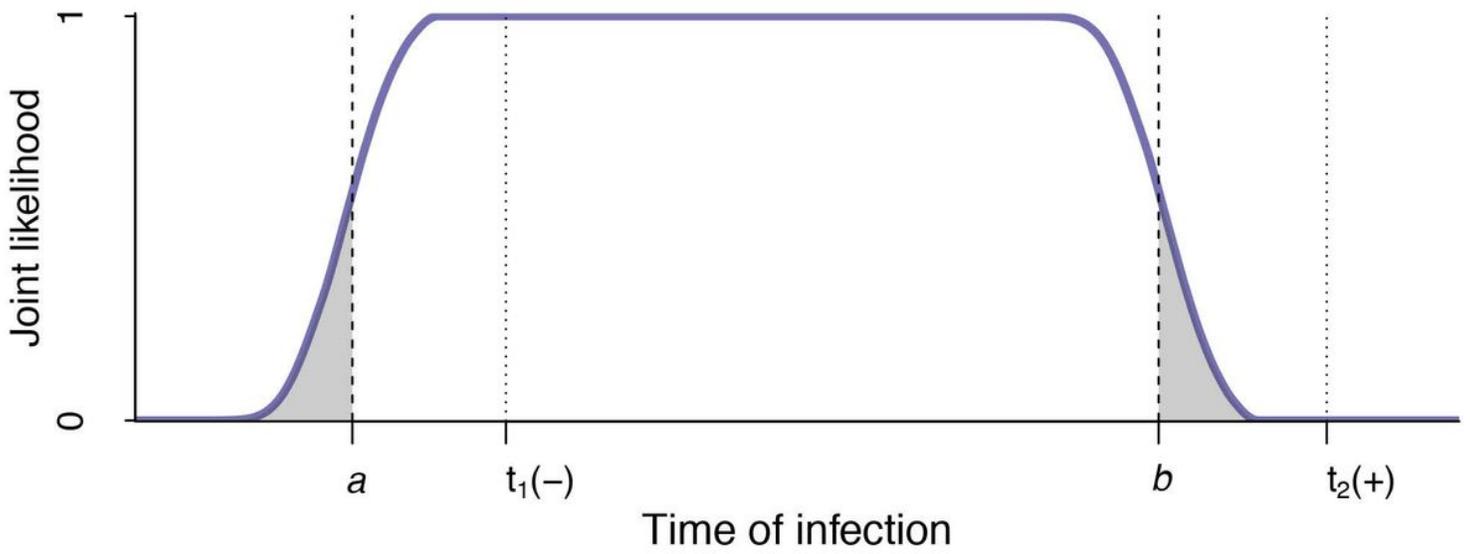


Figure 2

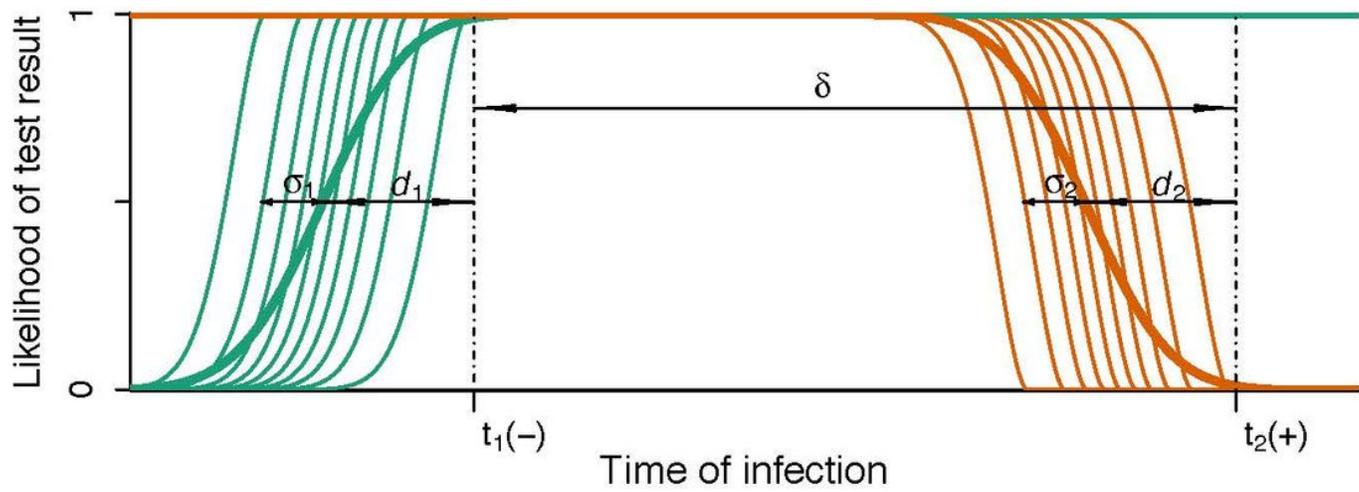


Figure 3

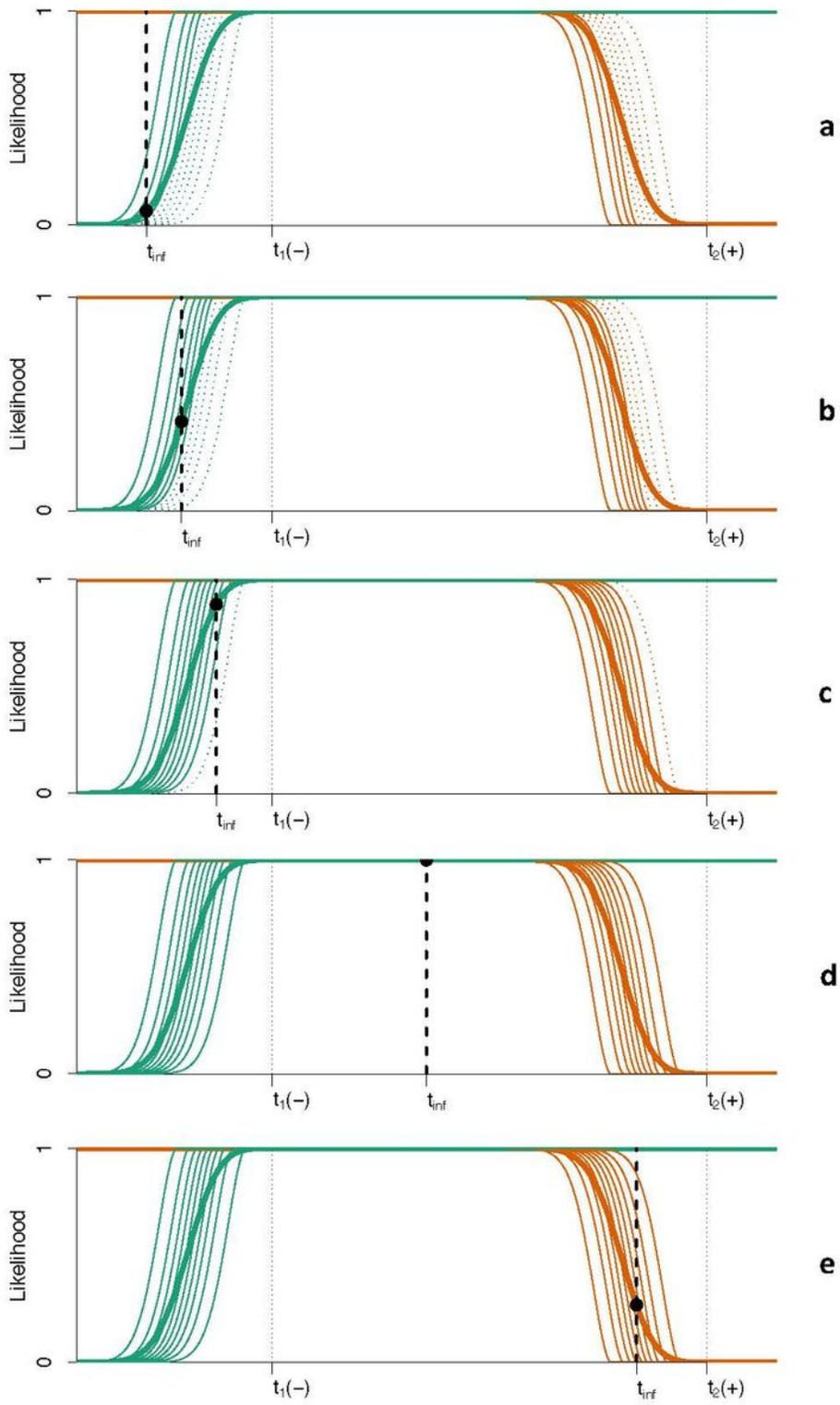


Figure 4

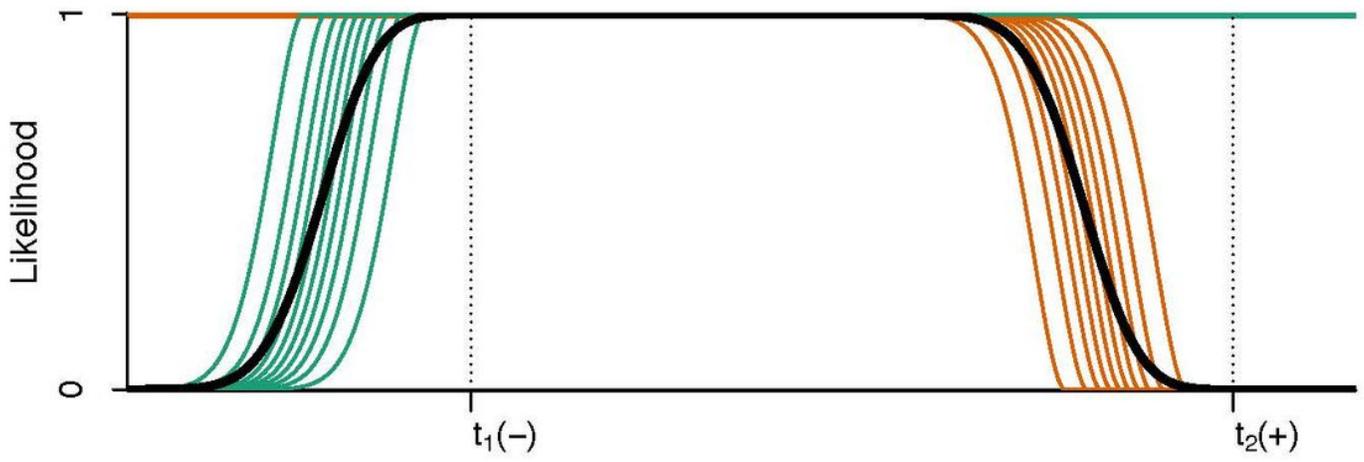


Figure 5

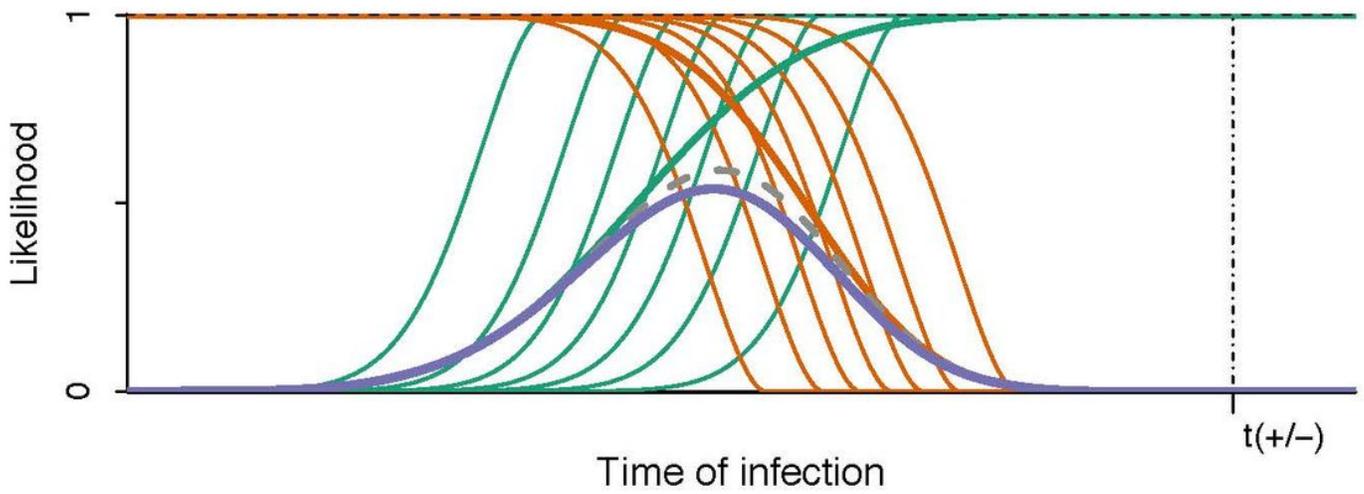


Figure 6

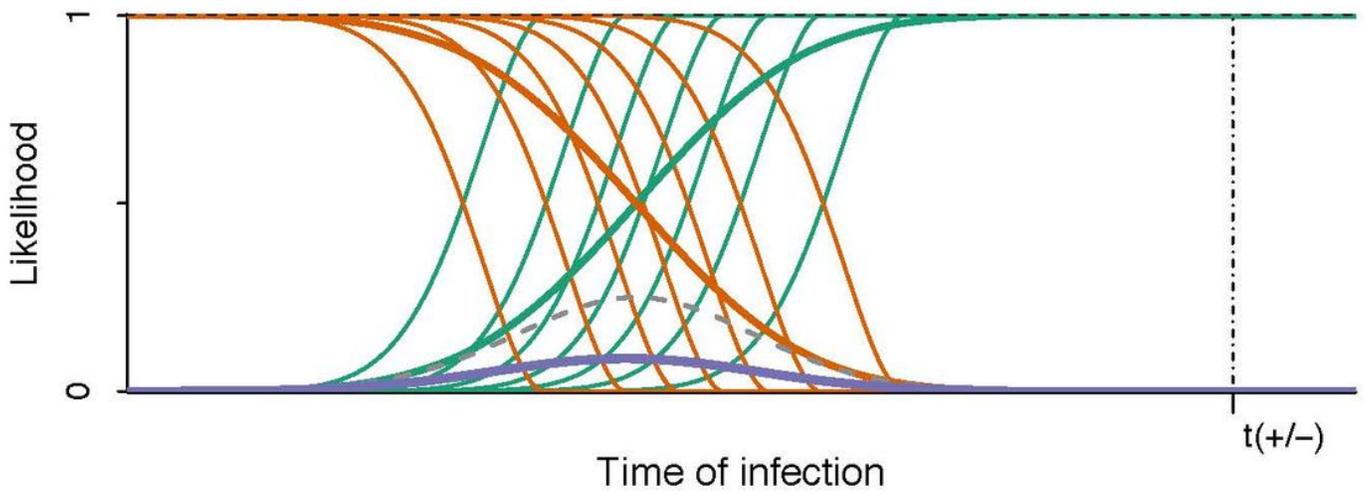


Figure 7

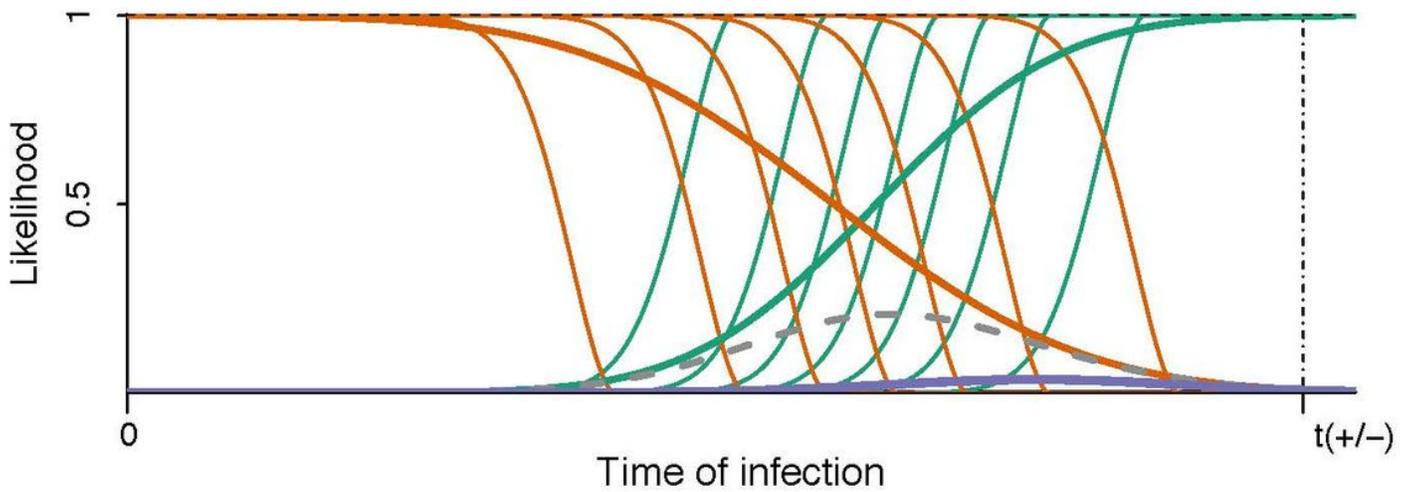


Figure 8

Supplementary Files

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- [supplement1.csv](#)
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