Modelling the Course of an HIV Infection: Insights from Ecology and Evolution

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Abstract

The Human Immunodeficiency Virus (HIV) is one of the most threatening viral agents. The disease progresses more or less symptom-free for 5 to 10 years. During this asymptomatic phase, the virus slowly destroys the immune system until the onset of AIDS when opportunistic infections can overcome immune defenses. We still have an unclear idea of the role of virus evolution in the progression to AIDS. Mathematical models have played a decisive role in estimating important parameters (e.g., virion clearance rate or life-span of infected cells). However, most models only account for the acute and asymptomatic latency phase and cannot explain the progression to AIDS. Models that account for the whole course of the infection rely on different hypotheses to explain the progression to AIDS. Among the few models capturing all three phases of an HIV infection, we distinguish between those that mainly rely on population dynamics and those that involve virus evolution. Overall, the role of virus evolution remains largely open. We know that the virus evolves but is this a driving factor,an indicator, or something completely independent from the disease's progression. However, the modeling quest to capture the dynamics of an HIV infection has improved our understanding of the progression to AIDS but, more generally, it has also led to the insight that population dynamics and evolutionary processes can be necessary to explain the course of an infection.

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