Sweden surpasses the UNAIDS 95-95-95 Target: Estimating HIV-1 incidence between 2003-2022

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SUMMARY

Sweden reached the UNAIDS 90-90-90 target in 2015. With possible effects from the influx of people living with HIV-1 (PLHIV) from abroad, the rollout of PrEP, the impact of the SARS-CoV-2 epidemic, and the recent refugee migration from Ukraine, it is unclear how the HIV-1 epidemiological situation may have changed in more recent years.

Using a new biomarker-based incidence model, we found that the yearly incidence decreased after 2014. Similarly, the undiagnosed fraction of PLHIV has decreased since 2006 by almost 2-fold.

By 2022, 96% of all PLHIV in Sweden have been diagnosed, of which 99% have received treatment, and 98% are on successful treatment

For people infected in Sweden, the average time from infection to diagnosis was between 1-2 years for MSM and 1-3 years for heterosexuals. While about 80% of recent incidences come from exogenous sources, they make up about 50% of the current number of infected persons in Sweden and contribute to about 40% of currently undiagnosed cases. Sweden reached all of the UNAIDS 95-95-95 targets by 2018 (Fig 1).

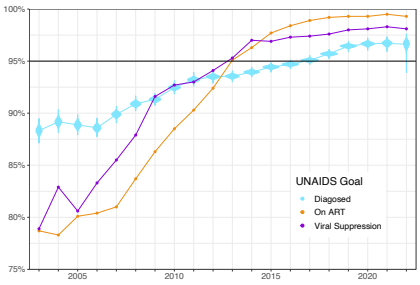

Figure 1. Sweden reached all UNAIDS 95-95-95 targets in 2018. PLHIV on ART and successful viral suppression reached their targets in 2013, and the fraction diagnosed of all PLHIV was reached in 2018.

A NEW BIOMARKER INCIDENCE MODEL

To estimate the fraction of diagnosed PLHIV out of all PLHIV (diagnosed as well as undiagnosed), we developed a new biomarker-informed incidence estimator. Our estimator used time-continuous biomarker trends to estimate the time since infection at time of biomarker testing (TI) described by a posterior probability distribution of possible infection times, thus moving the incidence of diagnosed PLHIV probabilistically back in time to when the person acquired the infection (Fig 2).

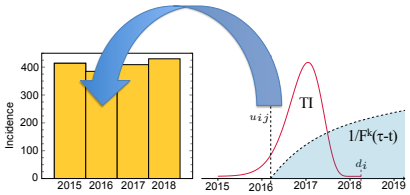

Figure 2. To estimate the incidence, we move each diagnosed PLHIV [d_i] to when they were infected [TI], sample with replacement [u_{ij}] and estimate the number of undiagnosed PLHIV [$1/F^k(\tau-t)$].

For each diagnosed PLHIV we select a random TI from the person's TI distribution, and we estimate the probability of a person infected at that selected time (t) to be diagnosed at the end of the study (τ) as $1/F^k(\tau-t)$. This probabilistic draw was repeated 100,000 times to properly estimating the total uncertainty in the final incidence estimates.

We used data from InfCareHIV in Sweden. These data included the biomarkers HIV *pol* sequence polymorphism count and CD4 cell counts, first positive and last negative test dates, sampling dates, migration arrival dates, removal dates, treatment dates, and demographic information form >13,000 PLHIV collected 1979-2023.

THE INCIDENCE IN SWEDEN HAS DECREASED SINCE 2014

During 2003-2009 the overall incidence increased, then fluctuated until 2014 when the overall trend started to decrease (Fig 3). Until 2021, heterosexual infections (endogenous and exogenous together) dominated the overall incidence at 38-59%.

The largest reduction in any transmission category since 2018 was observed in exogeneous heterosexual infections, reducing the number of new cases from 133 [123-143] to 65 [56-76] (2-fold) in 2021. In 2022, however, this category increased to 139 [122-166] new cases (2-fold), probably due to lifting of travel restrictions that were in place during the first years of the COVID-19 pandemic.

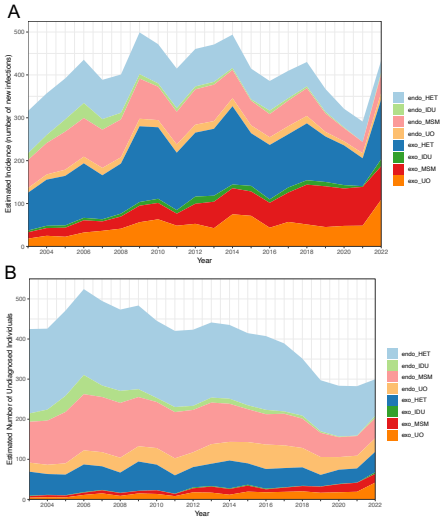

Figure 3. (A) Incidence trends among transmission categories in Sweden 2003-2023. (B) The estimated number of undiagnosed PLHIV. "endo" refers to infections believed to have occurred in Sweden, and "exo" refers to infections brought to Sweden by migration.

To prioritize prevention resources, it is important to estimate the number of undiagnosed PLHIV in different transmission categories (Fig 3). From 2003 until 2022, the endogenous heterosexual category decreased from 49.6% [46.3-53.0%] to 30.4% [21.3-41.7%] of all undiagnosed PLHIV. Similarly, endogenous MSM infections deceased from 23.9% [21.5-26.4%] to 16.8% [10.8-23.8%]. Thus, it appears that current prevention efforts work well in these transmission categories, suggesting that further reductions can occur with prolonged efforts.

For endogenous infections, diagnoses in all transmission modes were decreasing while the mean TI was 1-2 years for MSM and 1-3 years for heterosexuals (Fig 4).

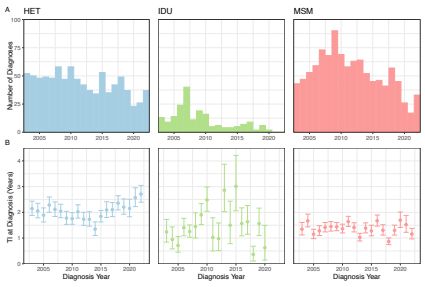

Figure 4. (A) Number of endogenous diagnoses per year by transmission mode. (B) Mean TI at diagnosis with 95% credible interval.

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