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V.16

**All right reserved to Simpact team**

Simpact White User Guide

User guide

08

**Fall**

Simpact White

An individual-based simulation software for HIV modelling

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# 1. Overview

Simpact is a simulation tool to develop, run and analyse event-driven, individual-based models in a continuous time framework. Individuals in the model population are socially and biologically connected to each other through sexual relationships and parent-child relationships. HIV can be transmitted in this network either by heterosexual intercourse or perinatally from mother to child. Possible events include pregnancy, birth, AIDS-related and non-AIDS-related death, relationship formation and relationship dissolution, HIV testing, medical male circumcision, attending antenatal care (ANC), initiating and discontinuing antiretroviral therapy (ART), and behavioural intervention that increases condom use or reduces HIV-related risky behaviours across the population. [1]

Simpact White is the foundational member of Simpact software family. It is developed with MatLab 2012b [2] by an inter-institutional team. Information about Simpact software tools and relevant research projects can be found in [1] and our website (<http://www.simpact.org>). Source code of Simpact White is regularly updated on GitHub (<https://github.com/yfmeng/SimpactWhite>).

# 2. Software Architecture

Simpact White consists of two types of elements, individuals and events. A hazard function is defined for each event and the time until events happening to an individual is calculated using the hazard functions. A scheduler function (/lib/modelHIV.m) decides the sequence and time intervals of possible events. The statuses of individuals are updated after an event is fired, then the expected times of remained events are recalculated accordingly.

Simpact White provides 20 events up to date (Section 5). New events can be added using a template code file (/lib/events/eventTemplate.m). Individuals in simulated population are heterogenized by 21 personal variables (Section 4.3).

# 

# 3. Working with Simpact White

## 3.1. Software prerequisition and default simulation

The current version of Simpact White is developed with MatLab 2012b. Minor adaptions might be required for running with older versions ([contact me for help](mailto:fei.d.meng@gmail.com?subject=Simpact%20White%20consultation)). Installation downloads and system requirements of MatLab can be found on the official website <http://www.mathworks.nl/>.

When MatLab is installed, save the entire Simpact White folder under your MatLab paths or add the folder of Simpact White to your MatLab paths. Then simulations can be run with the MatLab console. The output of simulation is a MatLab data structure.

Example 1. Run Simpact White with default configuration.

% Method I.

% Directly run with default configuration

SDS = spRun;

% Method II.

% Create an initial data structure

SDS = modelHIV(‘new’);

% Run with default configuration using the data structure

SDS = spRun(‘start’, SDS);

## 3.2. Configuration

The Simpact Data Strucure (SDS) contains substructures of global variables, individual variables, and event configurations. Once an initial data structure is created by using Method II in Example 1, configurations and parameters can be directly assigned as following:

Example 2. Configuration

% Create an initial data structure

SDS = modelHIV(‘new’);

% Configuration.

% Global variables: SDS.{variable name} = value;

SDS.number\_of\_males = 1000;

% Individual variables: SDS.{gender}.{variable name} = value;

SDS.males.born = zeros(1, 1000);

SDS.males.born(20) = -1;

% Event configuration: SDS.{event name}.{variable name} = value;

SDS.formation.baseline = log(0.1);

% Run the simulation

SDS = spRun(‘start’, SDS);

## 3.3. Exporting outputs

The output SDS can be either saved as data structure in .mat format or exported to .csv files by using exportCSV.m function. In the latter case, 4 .csv files will be created, containing information on individuals, sexual relationships, HIV tests and ARV treatment respectively.

Example 3. Save Simpact Data Structure

% Method I. Save MatLab data structure

filen\_ame = ‘SDS\_0001\_baseline\_scenario.mat’;

save file\_name SDS;

% Method II. Export data structure into comma separated files

path = ‘/SimpactWhite/output/’

index = 1;

file\_identifier = ‘baseline\_scenario’;

exportCSV(SDS, path, index, file\_identifier);

# 

# 4. Population and Individuals

## 4.1. Population variables

|  |  |  |
| --- | --- | --- |
| Name | Comment | Type |
| number\_of\_communities |  | Integer |
| number\_of\_males | limitation of number of males | Integer |
| number\_of\_females | limitation of number of females | Integer |
| initial\_number\_of\_males |  | Integer |
| initial\_number\_of\_females |  | Integer |
| percentage\_of\_MSM |  | Float |

## 4.2. Simulation variables

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Comment | Default | Type |
| age\_file | a .csv file containing initial age distribution | ‘none’ | String |
| start\_date |  |  | Date |
| end\_date |  |  | Date |
| iteration\_limit |  |  | Integer |
| model\_function |  | ‘modelHIV’ | String |

## 4.3. Individual variables

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Comment | Default | Type |
| (gender).father | ID of father | 0 | Integer |
| (gender).mother | ID of mother | 0 | Integer |
| (gender).born | Time of birth | NaN | Float |
| (gender).deceased | Time of death | NaN | Float |
| (gender).HIV\_source | ID of HIV source | 0 | Integer |
| (gender).HIV\_positive | Time of HIV infection | NaN | Float |
| (gender).AIDS\_death | Death due to AIDS | 0 | Logical |
| (gender).HIV\_test | Time of HIV test | NaN | Float |
| (gender).ARV\_start | Time of ARV initiation | NaN | Float |
| (gender).ARV\_stop | Time of ARV dropout | NaN | Float |
| (gender).community | Community | 0 | Integer |
| (gender).partnering | Sexuality level, 0~1 | Random | Float |
| (gender).ARV\_eligible | Time at becoming ARV eligible | NaN | Float |
| (gender).CD4Infection | CD4 count at infection | NaN | Float |
| (gender).CD4ARV | CD4 count at ARV initiation | NaN | Float |
| (gender).CD4Death | CD4 count at death | NaN | Float |
| (gender).CD4\_500 | Time of CD4 count reaching 500 | NaN | Float |
| (gender).CD4\_350 | Time of CD4 count reaching 350 | NaN | Float |
| (gender).CD4\_200 | Time of CD4 count reaching 200 | NaN | Float |
| males.MSM | Having sex with men | Random | Logical |
| males.circumcision | Time of circumcision | NaN | Float |
| females.sex\_worker | Being a female sex worker | Random | Logical |

# 5. Events

## 5.1. eventBirth

ANC

Circumcision

MTCT

Mortality

Conception

Birth

Debut

Boy

Hazard function



## 5.2. eventDebut

Formation MSM

Formation

Debut

Birth

MSM

Female

FSW

Hazard function



## 5.3. eventFormation

Sero-

discordant

Conception

MTCT

HIV transmission

Dissolution

Formation

Debut

Pregnant female

Female

Hazard function



## 5.4. eventDissolution

Sero-

discordant

Conception

HIV transmission

Formation

Dissolution

Hazard function



## 5.5. eventFormationMSM

## 5.6. eventDissolutionMSM

## 5.7. eventTransmission

MTCT

HIV introduction

AIDS mortality

HIV transmission

HIV test

Sero-

discordant

Formation

Pregnant female or

Breastfeeding female

Hazard function



## 5.8. eventTransmissionMSM

## 5.9. eventConception

## 5.10. eventANC

## 5.11. eventTest

## 5.12. eventARV

## 5.13. eventARVstop

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## 5.15. eventBehaviourChange

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