# Mother-Child HIV Impact Model

An agent-based model was build to explore the effects of a mother's HIV status on her children. The model was build with modgen (http://www.statcan.gc.ca/microsimulation/modgen/modgen-eng.htm). There are two types of actors in the model, Mothers and Children. A mother can die from the uninfected state or become infected and then transition through the different stages of the disease process. She can also die at any of the different stages of the disease. Furthermore, the mother can give birth from any of the different disease states (including the uninfected state).

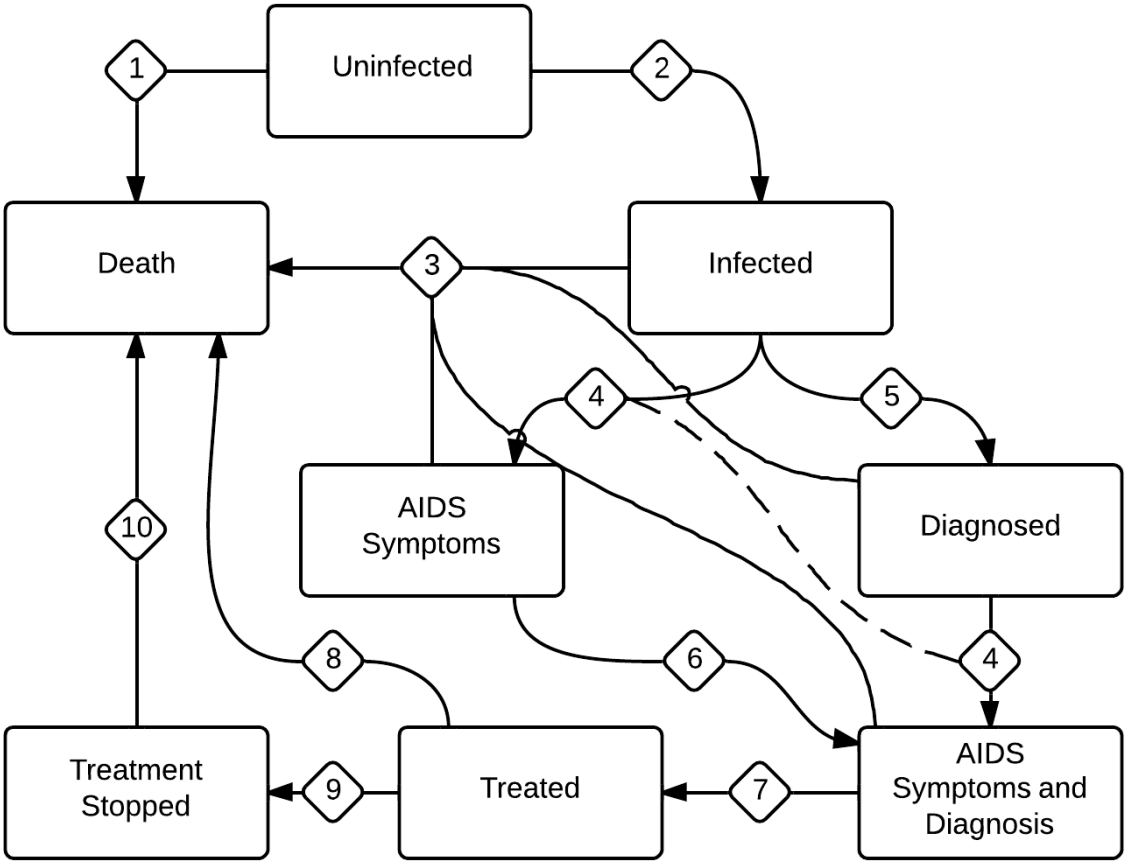
A child is linked to the mother that gave birth to it in the model. This allows the child to access the mother's disease status at any time. Using this information about the mother, the outcomes of the child is modelled. Two different outcomes can be modelled: The child's schooling outcome, or the child's risk behaviours. The following exposure and experience rates of the children are affected by the disease state of the mother: School Dropout probability, probability of experiencing abuse, probability of becoming depressed, probability of early sexual debut and probability of being a consistent condom user.

The model simulates the actors in continuous times by scheduling competing events for the actors. For example, upon initiation of a mother a time of infection and a time of death from the healthy state is scheduled. If the mother becomes infected before dying, then the mother transitions into the infected state. Since death from the infected state is governed by different equations than death from the healthy state, the death of the mother is then rescheduled together with competing events namely becoming diagnosed or symptomatic. More details of the exact state transitions each actor can experience is described in the following sections.

Consider writing about the following:

- Reporting of the model
- Data sources
- How to access more detailed documentation
- The fact that the actors does not interact with each other, does not make any decisions, … (list all the typical ABM behaviours that are not considered in this model)

# The mother model




## Transitions

All transitions can be modified by specifying a multiplier. For example HealthyMortalityMotherMultiplier affects the mortality rate from the healthy state. Setting the value to a smaller value will decrease the event rate and increasing the number will increase the event rate.

### Transition 1

Module: MotherMortality

Name: Death of uninfected mothers

Data source: ASSA Model

Factors influencing transition:

- Age
- Model Time
- Gender

Transition Type: Table of annual probabilities of dying. These probabilities come from the ASSA model and is used to construct a survival curve for the mothers from which the death events are scheduled.

### Transition 2

Module: MotherInfection

Name: HIV infection

Data source: ASSA Model

Factors influencing transition:
- Age
- Model Time
- Gender

Transition Type: Table of annual probabilities of becoming infected

### Transition 3

Module: MotherMortality

Name: Death of HIV infected mothers

Data source: Van Der Paal article

Factors influencing transition:
- Age (Van der paal age category)

Transition Type: Weibull shaped survival curve for time since infection with the scale affected by the age at infection.

### Transition 4

Module: MotherSymptoms

Name: Development of symptoms of HIV infected mothers

Data source: Van Der Paal article

Factors Influencing transition:

- Age (Van der paal age category)
- **Time to death from infected (optional)**

Transition Type: Weibull shaped survival curve (of not becoming symptomatic) for time since infection with the scale affected by the age at infection. The random draw used for this scheduling can be correlated with the draw for death from the infected stage. (controlled with a parameter)

### Transition 5

Module: MotherDiagnosis

Name: Diagnosis of asymptomatic infected mothers

Data source: None

There are two different types of transitions that can be used to schedule diagnosis of asymptomatic infected mothers. It can be based on an exponential survival curve or it can be based on a fixed input percentage. The fixed input percentage with uniformly assign event times so that the input percentage occurs before the mother dies or becomes symptomatic.

### Transition 6

Module: MotherDiagnosis

Name: Diagnosis of symptomatic mothers

Data source: None

There are two different types of transitions that can be used to schedule diagnosis of asymptomatic infected mothers. It can be based on an exponential survival curve or it can be based on a fixed input percentage. The fixed input percentage with uniformly assign event times so that the input percentage occurs before the mother dies or becomes symptomatic.

### Transition 7

Module: MotherTreatment

Name: Starting treatment of diagnosed eligible (symptomatic) mothers

Data source: None (ASSA Model data incompatible)

There are two different types of transitions that can be used to schedule treatment of eligible mothers (symptomatic and diagnosed). It can be based on an weibull survival curve or it can be based on a fixed input percentage. The fixed input percentage will cause a proportion of mothers

equal to the input percentage to become treated immediately (with a microscopic delay) after becoming eligible.

### Transition 8

Module: MotherMortality

Name: Death of treated mothers

Data source: ASSA Model

Transition Type: Constant annual probability of death - there are some issues with this transition.

### Transition 9

Module: MotherStop

Name: Treatment cessation

Data source: ASSA Model

Transition Type: Constant annual probability of stopping - there are some issues with this transition.

### Transition 10

Module: MotherMortality

Name: Death after treatment cessation

Data source: ASSA Model

Factors influencing transition:

- Age (ASSA model age categories)

Transition Type: Weibull shaped survival curve for time since infection with the scale affected by the age at infection.

## Fertility

Module: MotherFertility

Name: Mother Fertility

Data source: ASSA Model (for the base rates) and arbitrarily chosen values (for the factors affecting the fertility)

Factors influencing the transition:

- Age (base rates)
- SES Status (multipliers)
- Disease Status (multipliers)
- Parity (multipliers)

Transition Type:  Table of annual probabilities of giving birth. These probabilities come from the ASSA model and is used to construct a survival curve (of not giving birth) for the mothers from which the birth events are scheduled. Upon giving birth, a mother is assigned the status of ‘infertile’ for the period of 1 year, after which she can again give birth using the same table of annual probabilities.

## The Child Model