Modeling using Discrete Event Simulation:

Discrete event simulation is a form of computer based modeling that provides an intuitive and flexible approach to representing complex systems. Our model simulates the dynamics of main, and casual sexual partnerships, with behavioral model parameters estimated form sexual network data.

Structural development:

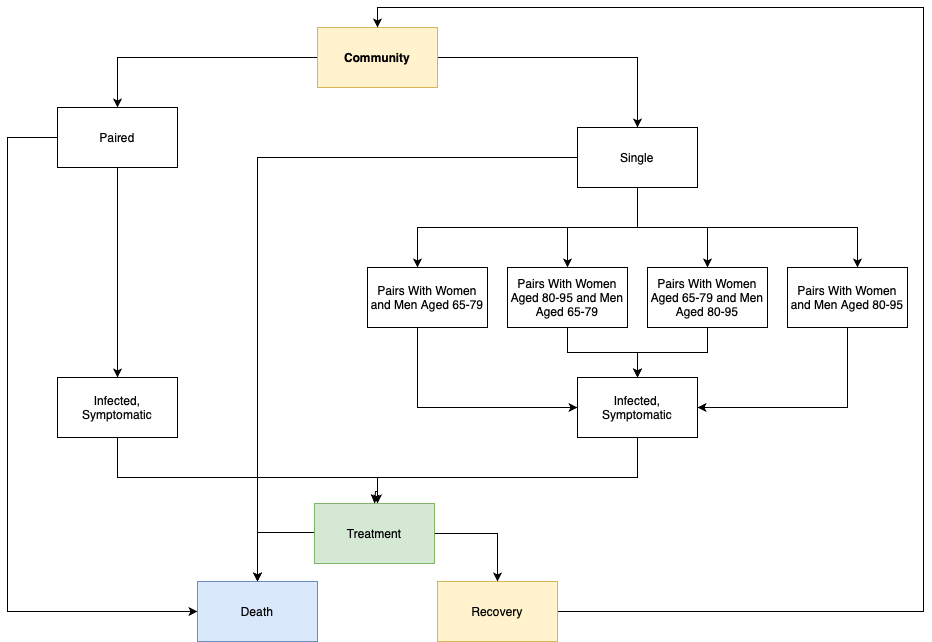
The core concepts of DES are entities, attributes, events, resources, queues, and time. In disease modeling studies, the network model will generally consist of a set of individuals connected by contacts, where it is assumed that the contacts are such that if a transmission event could take place. The use of the most important feature is how well individuals are connected. In pair-formation models developed by Dietz and Hadeler[3] , Waldstätter[4], and Kretzschmar and Dietz[5] ,the pair-formation framework allow modeling of differential infection risk among persons who are single or paired, and it has been widely used in a number of other mathematical models of sexually transmitted infections[6-9].

The model include compartments that stratify the population by age, sex, partnership status, sexual risk behavior, and infection status. Transmission of sexual disease in the model occurs via unprotected sex in heterosexual partnerships[Fig1].

Predictors of partnership formation varies by partnership type,risk level,, age mixing, and status-unknown partnership. In our model, there are 2 partnership statuses that are mutually exclusive. Entity can be part of the unpaired(“single”)population or paired(“married”), unpaired population can have casual partners at age-specific rates. Casual partners represent short term relationships, and they are modeled as instantaneous partnerships. Behavioral parameters were informed by the National Survey of Family Growth[1]. Parameters and their prior distributions[2] are shown in Table 1.

|  |  |  |
| --- | --- | --- |
| Table 1. Description of parameters governing testing, natural recovery and transmission probability | | |
| Parameter / Variable | Description | Distribution |
| Population size | Population size for each age group | Uniformly distributed |
| Time step | Time step implemented in the model | A day |
| High risk | Fraction of the population defined as high risk | 10% (Assumption\*) |
| Low risk | Fraction of the population defined as low risk | 90% (Assumption\*) |
| Testing symptomatic individuals | | |
| Women | Testing of symptomatic women | 1/(52\*(0.079+0.072\*Beta(4,4))) |
| Men | Testing of symptomatic men | 1/(52\*(0.079+0.072\*Beta(4,4))) |
| Casual partners | | |
| High risk(HR) | Single, 65-79 HR | Beta(3,60) |
|  | Single, 80-95 HR | Beta(3,400) |
| Low risk(LR) | Single, 65-79 LR | Beta(1,160) |
|  | Single, 80-95 LR | Beta(1,160) |
| Among paired | | |
| High risk(HR) | Single, 65-79 HR | Beta(10,70) |
| Low risk(LR) | Single, 80-95 LR | Beta(10,100) |
| Treatment success(efficiency of antibiotics) |  | Beta(190,8) |
| Natural recovery | | |
| Women |  | 1/(52\*(1.13+0.5\*Beta(4,4.969))) |
| Men |  | 1/(52\*(1.13+0.5\*Beta(4,4.969))) |
| Transmission probability | Per act probability | Beta(5.5, 50) |
| \*we chose to fix the fraction of the population defined as high risk at constant 10%, but accommodate uncertainty in levels of risk behavior by varying the partner change rates by relationship states and age, in each of the risk groups. Defining a set proportion of the population to belong to a risk group and varying partner change rates is a modeling convention | | |
|
|
|

Fig1:



Literature Survey:

Propagation of Sexually transmitted diseases (STD) is modeled mainly based on the option of the social network that describes the contact between individuals. Perhaps the initial form of these models was STDSIM, created in the late 1990s and utilized in numerous HIV modeling studies [10]. The network models have become increasingly difficult with the use of information from the populaces under examination. One such model [11] depicts a collection of work around demonstrating the HIV pandemic in Vancouver, which incorporates a system model of infusing drug clients and female sex laborers, with the point of evaluating the viability of various control methodologies. To model STDs, a network model is generated with an analogy of vertices representing persons and edges representing contacts.A transmission event can happen in cases of connected edges, thus making the probability distribution of the number of edges of each node a very salient feature. Each of the edges can have various weights which directly relate to the type of interactions between the individuals. For instance, the netwrok can be modeled in three levels of interactions that determine heterosexual contact:0, no contact; 1, spousal partnership; 2, non-spousal partnership[12].

Although, this can be very difficult in cases with large datasets as developing models with social networks would need a large number of people to have expertise on the different fields involved like statistics, computer science, ethnography, medicine among others. An alternative model can be built by considering mainly a few concise statistics regarding the extensive data[13]. These contact networks make way for analysing the break of disease transmissions between persons by the use of condoms and other precautionary measures. This helps understand the impact of superspreaders as well. There are other models of STDs that are based on System Dynamics and other concepts. These are mainly aimed for making decisions on how to allocate resources to reduce STDs in a targeted testing program[14].

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