Infectious Disease Modeling with GLEAMviz

Before you set up an infectious disease model using GLEAMviz, be familiar with the GLEAMviz interfaces, including the Simulation Builder, the Simulation Manager, and the Visualization interface (or Dashboard). A user-friendly guide, *Using GLEAMviz*, for each of these interfaces is included in the Pandem Data materials.

You may want to print the guide to the interfaces and this *Infectious Disease Modeling with GLEAMviz* directions for building a simulation and have them ready for reference as you work through building an infectious disease model. Sometimes, a small omission on the Settings page or a missed transition rate will cause an error and your simulation will not run. Both sets of directions will help you through your initial building of a simulation. (If you are working in teams and have access to multiple computers, you may want to open the instruction guides on one computer and build your simulation on another. You will not have to print these lengthy instructions and you can still have the instructions handy as you work through the simulation software.)

At first, building an infectious disease model with the GLEAMviz program may seem a bit daunting. Working with the interfaces is one thing; understanding how the compartments of the infectious disease are built for the model is another.

It may help you to think of how an infectious disease, like the flu, moves through your school population. There are groups of students who can be identified. The **Susceptible** group of students is basically all the students in the school unless they have received the flu vaccine. (The vaccinated population can be added into a model, but you probably won't deal with that group when you build your first sim.) Another group may be **Exposed**; the Susceptible people will move into an Exposed group at a certain rate when they are exposed to the flu virus and they move to **Infected** when they come down with flu symptoms. Lastly, they move to the **Recovered** group.

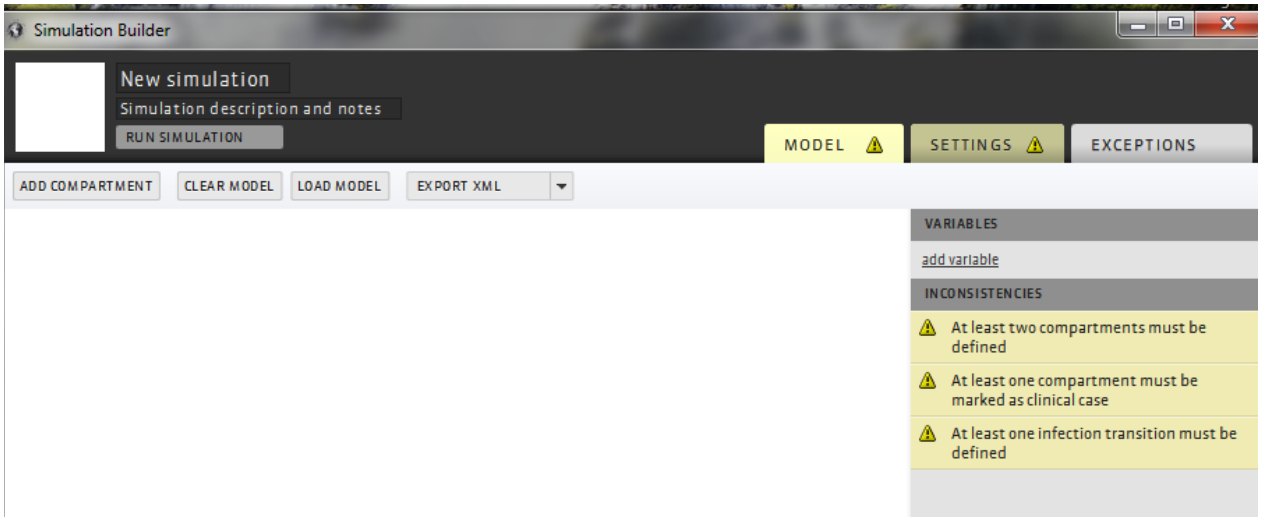
The rates at which each group moves to another are defined by the disease. What is the incubation period? What is the recovery rate? How fast do people get sick? Building the model may not be as difficult as you may originally think when you take this everyday approach and know something about the infectious disease you are modeling.

Read the examples listed below to help you set up an infectious disease model and submit the model to the GLEAMviz server for visualization. Think about how each group moves into another defined group as the disease travels through the population.

Epidemiologists use models to predict how extensive an outbreak might be, how it might spread, and what intervention strategies could be used to shorten the outbreak or reduce illness and deaths. Schools have been closed for a short time during severe flu outbreaks in some communities to lessen the number of people getting sick. Recommendations to curtail social events where exposed people may spread the disease and infect others are often based on predictions made by epidemic modeling. Travel advisories are issued to warn people to avoid areas having a disease outbreak.

Use the following directions and keep this approach in mind as you set up an infectious disease simulation that spreads through your school. The instructions are also in the guide to *Using GLEAMviz* with more detailed arrows pointing to specific icons or buttons you use to perform tasks. These instructions help you focus on the compartmental process. Referring to both will help you build your infectious disease model and run your simulation.

1) On the GLEAMviz simulator interface, click “New Simulation”.

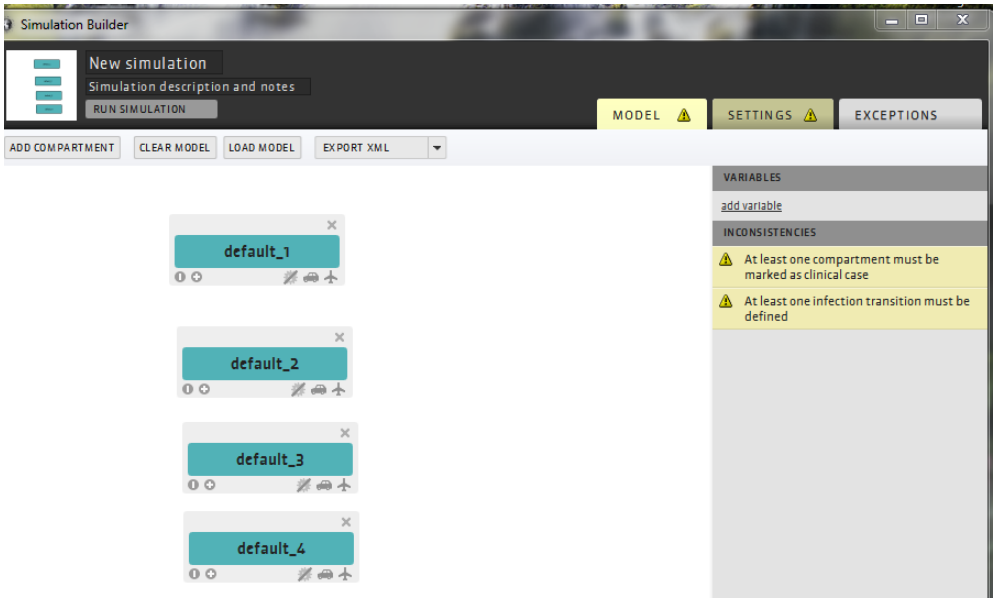


The Simulation Builder interface appears. You can access all the tools you need to run your simulation from this page.

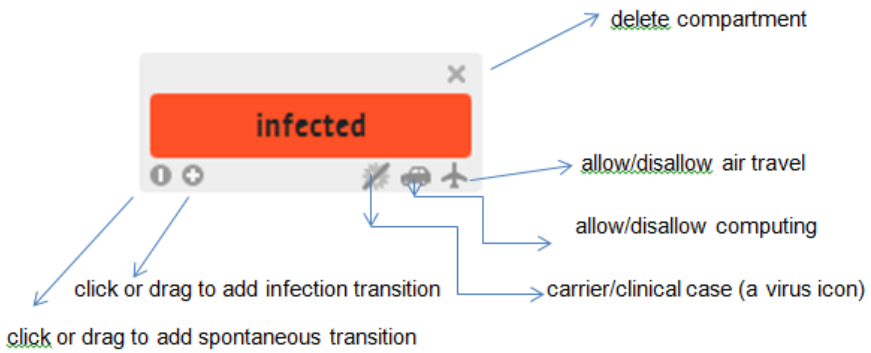
2) Click “Add Compartment” to get started. Think about what groups you want in your model. It may be best to start out with a simple SEIR (Susceptible-Exposed-Infected-Recovered) model and add more details and compartments to later models you build and run.

The compartments represent groups of people within the infectious disease population that you identify using the Settings page.

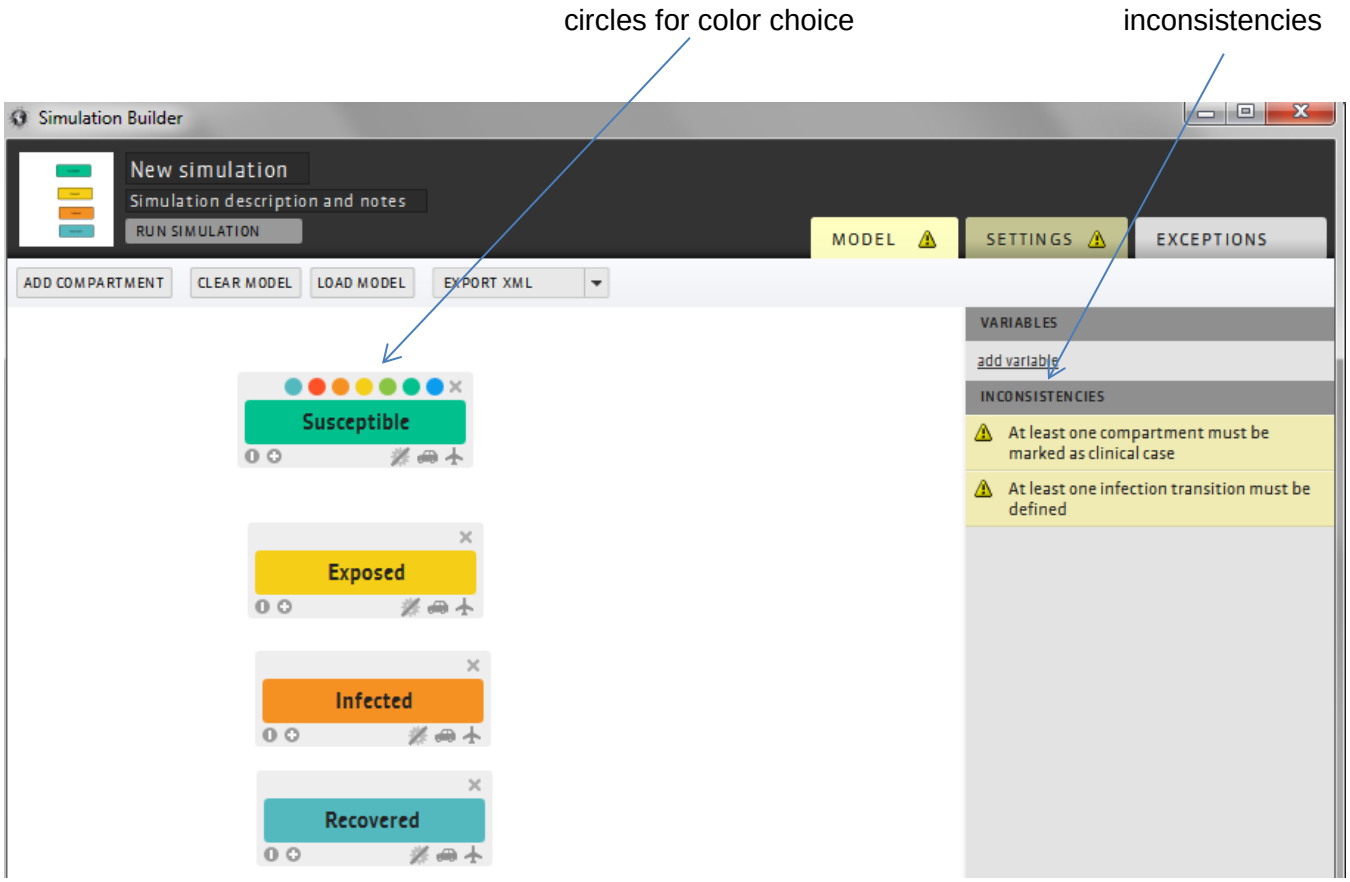
For this example disease model, click on “Add Compartment” until you have 4 compartments in the canvas area of the Simulation Builder. You can move the compartments around by clicking and dragging the top of each compartment.



Key to compartment icons/functions:



Label each compartment and choose colors to represent each one. An example is given below, but you can choose other compartments to run a different model.



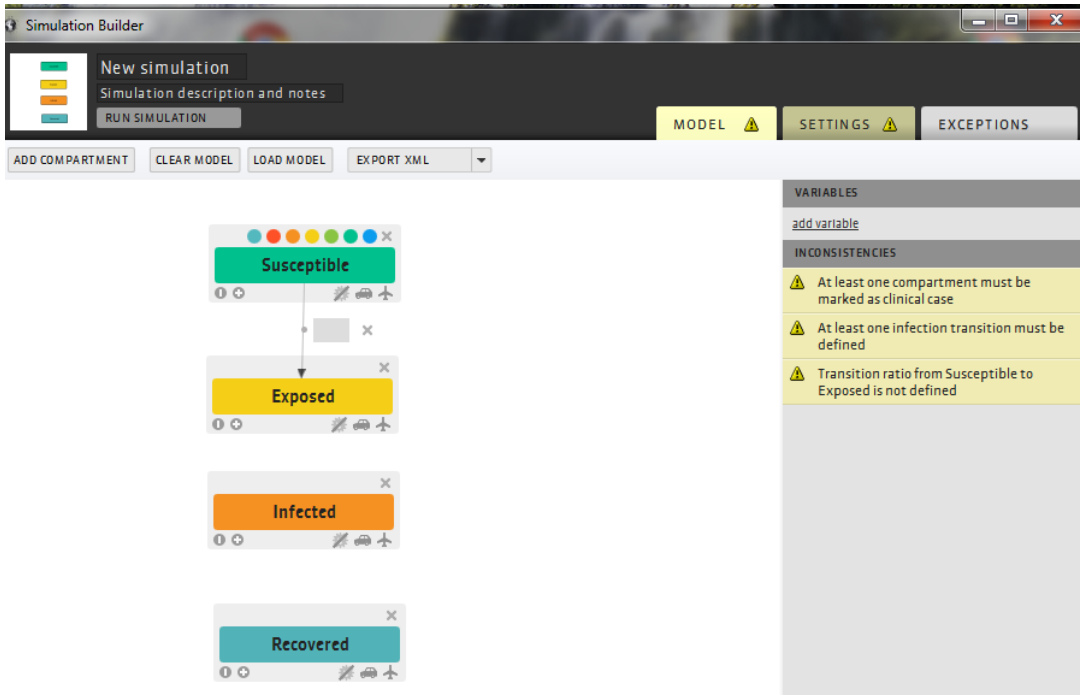
Note that inconsistencies appear automatically.

Now that you have identified the compartments you want your outbreak to model, you need to fill in the details about how you want the outbreak to progress given the characteristics of the virus that is circulating in the population.

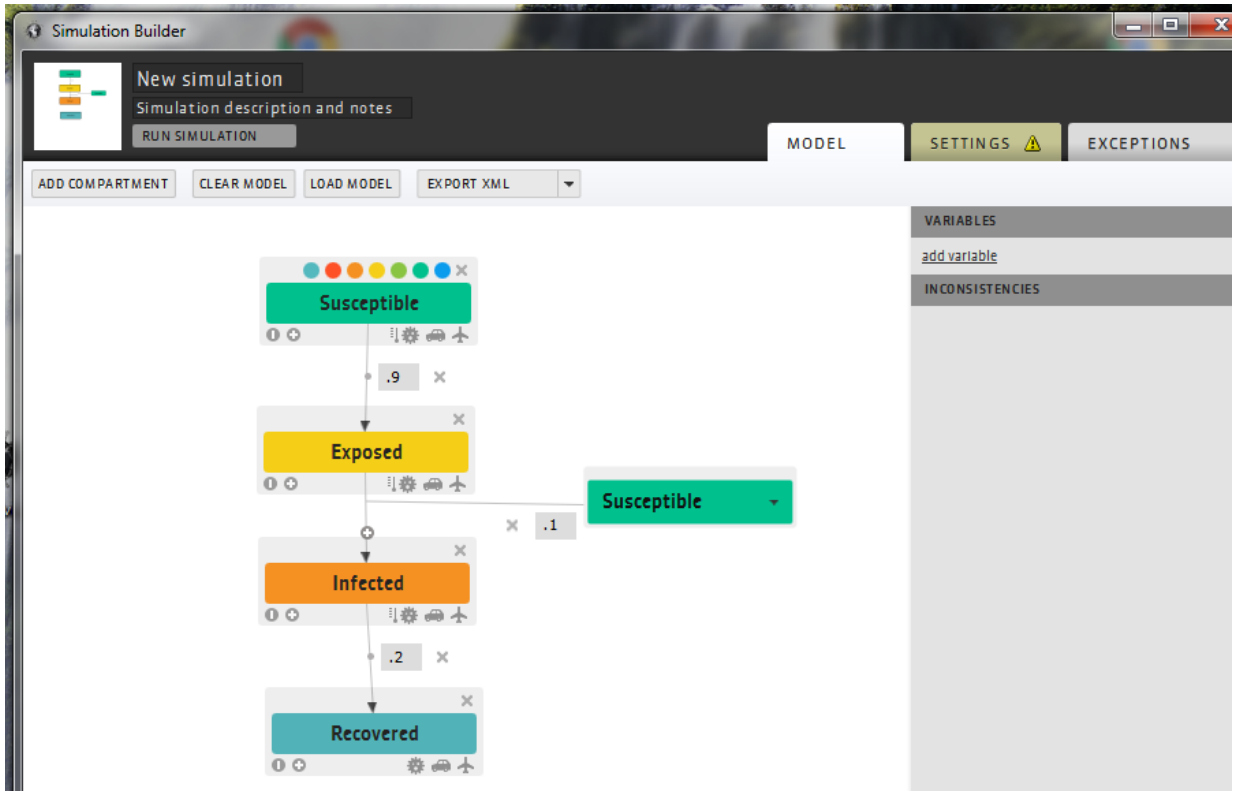
Use the icons for each compartment to select transition methods, to activate the clinical cases (compartments having the virus), and rates for movements from compartment to compartment. (Remember from the *Using Gleamviz* Epidemic Modeling instructions that transitions are simply how (either spontaneous or infectious) the virus moves to a compartment or group.) In this example, the transition from the Susceptible compartment to the Exposed compartment was spontaneous).

The boxes that appear when you drag a transition to connect compartments are where you add rates for movements. These rates are determined for specific diseases by complex mathematical formulas. You and your students can try different rates for your viruses.

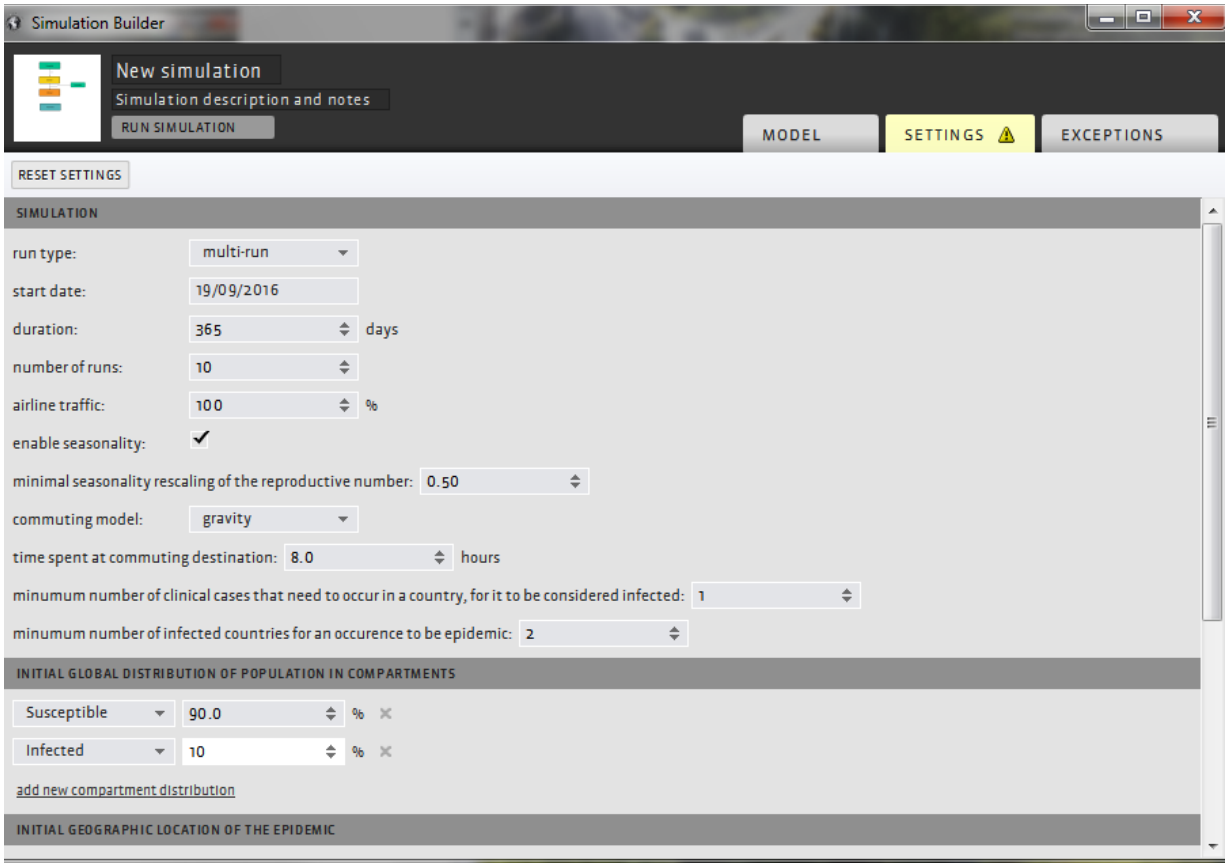
In this screen, the transition from Susceptible to Exposed has been selected (the – icon dragged to the Exposed compartment) and a new inconsistency has appeared because the rate or ratio has not been defined.



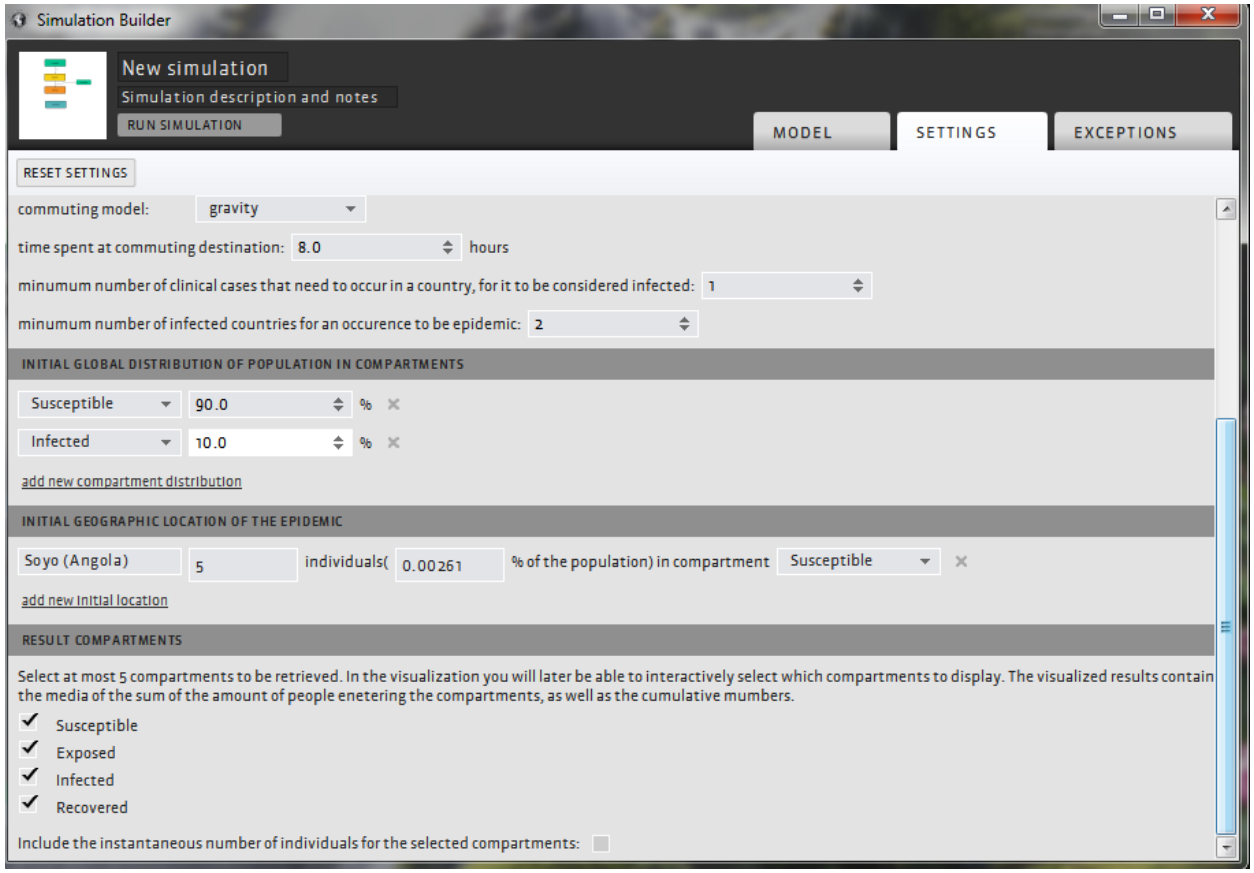
In this screenshot, each compartment has been defined and connected for outbreak spread and the virus status for each compartment has been activated. Note that all inconsistencies have been solved. The settings tab is highlighted and has an alert (!) because the settings have not been selected.



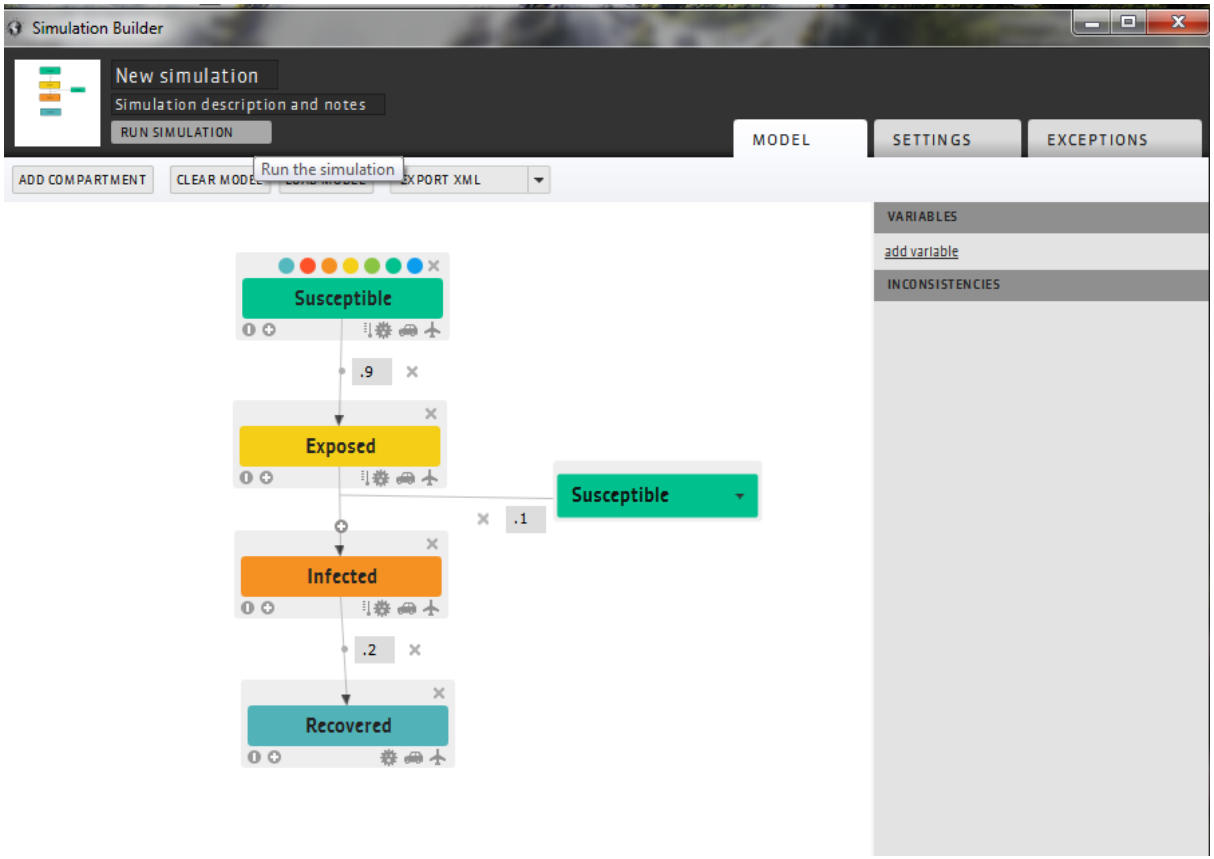
Click on the Settings tab and choose the settings for each description of the outbreak. Scroll to finish the settings page. See *Using GLEAMviz Epidemic Modeling* if you have questions about what each descriptor means. The first section of choices made for this outbreak are shown. A second screen follows.



Note that the highlighting for the Setting tab disappears when the Settings are complete.



Click on the Model tab to go back to the model interface. You now see that the RUN SIMULATION button is available. Click to send the sim to the GLEAMviz server.



The Gleamviz server will run your model and results will show in the Gleamviz Dashboard.