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## Revision History

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<th>Description</th>
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<th>Prepared By</th>
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<td>01/06/2013</td>
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3 General Information

3.1 Introduction
SIBEL is a web based application developed for experiment designs and analysis for epidemiological disease studies based on realistic social network simulations. It is currently run and used by Biocomplexity Institute of Virginia Tech.

This user manual presents the features and capabilities of the revamped version of the old tool with a fresh look and feel of all its existing functionalities along with few advance features like cards preview and slider graphs. Users will be able to access it over internet using the web address/URL of the server where it is deployed like any other website. The tool is now operational with few known issues.

Data and results accessible using the tool are from previously conducted studies and analyses, or are generated on-line as required, using the high performance computing (HPC) capabilities. Datasets generated by the tool are retained and cataloged automatically on the IDAC system.

3.2 Goal
SIBEL is designed to support running numerous simulations of experiments that generate distributions of outcomes to gain an appreciation of the time-varying state (the dynamics) of an epidemiological event. The tool specifically supports exploration of the variability of outcomes in this highly stochastic process. The outcome of experiments is used in analysis reports which are a kind of distribution of numerous replicates of an experiment and is generally viewable in the form of plotted graphs. The SIBEL tool is intended primarily to facilitate both the planning and course of action analysis activities of analyst. The tool may also be useful in the training of military/medical personnel/NGO/Rescue Operation team – impressing the importance of accurate and timely reporting; it may also be useful in training and coordinating activities with civilian authorities and medical personnel/infrastructure and other required teams.

3.3 Audience
This web based tool can be used by:
- Public Health System Officials
- Government Authorities involved in Policy decision making
- Scientists and Researchers
- Clinicians and Epidemiologists
- Surveillance Department Officials.
- Students

Attempt is to support anybody with little or no knowledge of backend algorithms or computing resources to set-up and run experiments on HPC cluster through this easy to use web UI interface to achieve their goals, studies and be usable for emergency crSIBEL planning at any time.

3.4 Pre-requisites
Effective use of the SIBEL tool requires some prior knowledge of experimental design, with particular emphasis on factorial experiments, as taught in typical introductory undergraduate statistics classes. More complex studies and experimental designs can be built up from
simple designs, but a basic grasp of analyses of variance and the underlying assumptions of such analyses are fundamental. The values for parameters to be entered into examples described in this document are not intended to be taken as recommendations for study design defaults.

3.5 References

- Reference materials used in this document

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Description</th>
<th>URL/Location</th>
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<tr>
<td>1</td>
<td>Installation Guide</td>
<td><a href="https://collaboration.vbi.vt.edu/display/ndsslsyncollab/BI+Documentation">https://collaboration.vbi.vt.edu/display/ndsslsyncollab/BI+Documentation</a></td>
</tr>
</tbody>
</table>

3.6 Acronyms and Abbreviations

- List of all Acronyms/Abbreviations:

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Acronyms/Abbreviations</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SIBEL</td>
<td>Synthetic Information Based Epidemiological Laboratory</td>
</tr>
<tr>
<td>2</td>
<td>CNIMS</td>
<td>Comprehensive National Incident Management System</td>
</tr>
<tr>
<td>3</td>
<td>IDAC</td>
<td>It is a Didactic cluster.</td>
</tr>
</tbody>
</table>

3.7 Navigating the Manual

*User Manual Navigating Tips*

Contents succeeding with this icon are added only for Information sake.

4 System Summary

*Hardware:* The SIBEL tool is available as a web-enable service hosted on a 76 node Linux cluster of 1GHz class processors called Aredhel, located on the Virginia Tech Blacksburg campus. This cluster is used for research, and for test and evaluation. The operational data repository and the system used to execute simulations and analyses is a 112-node cluster of 2.2 GHz class processors located in a secure facility at Kirtland Air Force Base, NM.

*Software:* The user interface is implemented in JavaScript with the help of frameworks like Backbone.js and JQuery. Components communicate via a Simfrastructure blackboard construct implemented (in this case) using a Jini/JavaSpace approach.

5 Feature Summary

SIBEL application provides the users with an interactive easy to use and self-sufficient graphical user interface to design their own specifications/models for experiments simulate
them and generate analysis reports for further actions. Below is a quick reference to all the available features:

<table>
<thead>
<tr>
<th>Section #</th>
<th>Feature Name: List of Functionalities</th>
</tr>
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<tbody>
<tr>
<td></td>
<td><strong>Experiments:</strong></td>
</tr>
<tr>
<td></td>
<td>• Create Experiment</td>
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<tr>
<td></td>
<td>• View own and other users Experiment Details</td>
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<tr>
<td></td>
<td>• Specify Input Parameters to Experiment using preview cards for: Details, Region, Disease Models, Initial Conditions and Interventions</td>
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<td></td>
<td>• Duplicate any experiments in</td>
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<tr>
<td></td>
<td>• Run Experiments.</td>
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<tr>
<td></td>
<td>• Experiments created can be run only once.</td>
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<td></td>
<td>• Delete New/Failed Experiments.</td>
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<td></td>
<td>• Archive/Restore Experiments.</td>
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<tr>
<td></td>
<td>• Show Cells: Allows to View Cells, the output of experiments and their total count</td>
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<tr>
<td></td>
<td>• Interventions specification possible for:</td>
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<td></td>
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<td>o Social Distance</td>
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<td>o Close work</td>
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<td></td>
<td>o Pharmaceutical Treatment</td>
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<td>o Pharmaceutical Prophylaxis</td>
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<tr>
<td></td>
<td>o Generic Intervention</td>
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<tr>
<td></td>
<td>o Dynamic Sequestration</td>
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<tr>
<td></td>
<td>• Multiple or a Combination of interventions can be added onto an experiment.</td>
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<tr>
<th>Initial conditions</th>
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<tr>
<td>• Filter Initial conditions for self and other users.</td>
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<td>• Create New/Edit Initial Conditions.</td>
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<td>Options to specify :</td>
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<td>o Everyday</td>
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<td>o Daily Seed</td>
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<tr>
<td>• Duplicate Initial conditions.</td>
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<tr>
<td>• Delete Initial conditions created by owner.</td>
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<tr>
<td>• Delete Initial conditions not used in experiments run.</td>
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<tr>
<td>• Archive/Restore Initial conditions.</td>
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<table>
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<tr>
<th>Disease Model:</th>
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<tbody>
<tr>
<td>• View Disease models in system.</td>
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<tr>
<td>• Filter self-created / created by other owners.</td>
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<tr>
<td>• Create New/Edit Disease Models.</td>
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<tr>
<td>Parameters Available :</td>
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<td>o Transmissibility</td>
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</tbody>
</table>
6 Browser Compatibility

Following browsers are compatible and supported by SIBEL v2.3:

1. Safari v5
2. Firefox v17
3. Google Chrome v23.0.1
4. Application also runs on: iPAD v5.1
7 Workflow Overview

High level workflow operation with the SIBEL tool revolves around the User goal. User may want to Create Experiment, Run Experiment, Analyze Results and Generate movies.

7.1 Workflow Actions
To achieve the above goal user will have to perform following actions using the tool:

Create New Experiment: New experiment can be created as a New Experiment or by duplicating any existing experiment. Enter Name and details for the experiment, and specify characteristics of the experiment like the number of simulated days, number of replicates, the geographic region, a particular disease transmission model, selection and specification of interventions, such as vaccination of a subpopulation, efficacy of the vaccination, etc and save it. Once the new experiment has been created it will be included in the list of experiments. If required user can also edit the created experiment by selecting it at a later stage to establish numerous conditions of the experiment, including number of replications, and interventions, etc.

Figure 1: Workflow overview
**Run an experiment:** After the experiment has been created and edited; execute the experiment by selecting it from the Experiment List Grid and clicking **START**. The status of the experiment – whether New, Starting, Queued, Running, Completed, or failed – is represented below the Experiment Name.

*Figure 2: Workflow overview*

**Set-up Analysis:** When the experiment is completed, run generates data that are stored together and identified as the Results of the experiment – available through the Analysis page. By clicking the Analyses menu at the top brings up the Analysis List Grid. **Create a New or Duplicate an existing Analysis** and edit it to change details and include the cells of the experiment completed in previous step. Save all the changes. The New Analysis will be listed in the Grid.
View Analysis Results: When the Analysis is finalized analyst may gain access to the results and start to integrate results to achieve the goals of the study. The analysis results are shown in View details section of the analysis.

7.2 Workflow Execution Process

The very act of creating a new experiment involves a process which essentially establishes a configuration file used to manage the execution of a series of jobs on a distributed HPC cluster. The values established at this stage, and collected into the configuration file, are communicated by the SIBEL tool user interface to a server called Aredhel, a small Linux cluster located in Blacksburg, VA. This server manages the interface to the databases that hold the synthetic population data and the results of studies on those data.

Running the experiment comprises execution of a series of jobs on a second, larger cluster called IDAC, located in a secure facility at Kirtland, AFB, NM. Execution of the experiment entails transfer of parameters and data between the Aredhel cluster and the IDAC cluster. The simulation is set up and run automatically, and repeatedly, in accordance with the specifications for the experiment. A simple experiment may be completed in a short time, whereas a complex experiment may run for several hours on the IDAC cluster.
In SIBEL there are mechanistic algorithms that are designed to generate series of numbers between some limits with a distribution that is indistinguishable from random on the margins called as Experiment Replicates. Random number generators begin with a seed number, and calculate iteratively to produce the series of “random” numbers. Such generators will produce identical (and therefore non-random) sequences when they start with the same seed number. SIBEL uses an algorithm from the following URL: http://sprng.cs.fsu.edu/

In the SIBEL tool/environment, each experiment represents the calculated interaction among perhaps millions of nodes mediated through numerous complex networks which might themselves be time-varying. Research has shown that the time-course of these interactions can vary greatly with initial conditions, Disease Models used to run the the Experiment. Each run generates data that are stored together and identified as the cells that are Results of the experiment – available through Analysis page.

Once an Experiment is run the data generated as part of it is used to generate Analyses reports. Analyses are needed to generate configuration files for input to the R0 statistical analysis package for visualization in graphical format. The data collected by a CNIMS (Comprehensive National Incident Management System) simulation run can be extremely voluminous – Terabytes may be collected on a single run. The analyses available through the CNIMS SIBEL tool are designed to support various kinds of analytical studies and therefore-planning in the event of an Epidemic.

8 Using SIBEL
This section provides a detailed description of all system features. The interface comprises numerous buttons and data entry fields which are explained in detail in this section, for reference. For ease of reading, these descriptions are organized by display of menus, beginning with the Experiments page. Data shown in the examples/figures in this Manual are reasonable, and will result in interpretable output data from simulation runs, graphical analysis and visualization tools. However, these values should be viewed as tutorial in nature, and are not intended to be recommended as default settings, or suggested values for policy-making or operational decision-making purposes.

8.1 Access to SIBEL
Access the SIBEL URL using any of the supported browsers. User is first displayed the Login Page shown in Figure 2.

8.1.1 Request Account
Experienced Users who already have an account, may login into application with their login credentials. New users require creating an account to login.

Following are steps to create an account:
On Clicking the **Request account** link on Login page user navigates to the Request Account page which is used for new user account creation.

**Figure 4: Request Account**

The following information has to be provided on the Request Account form for creating a new account:

- **Username**: Enter the username for login, in Username field. It should be greater than 3 characters.
- **Full Name**: Enter Full name, which will appear with the Welcome note.
- **New Password**: Enter the Password which appear as encrypted. Password has to be 8 or more characters.
- **Repeat Password**: Enter same string as it is in New Password field which will also appear as encrypted.
- **Email Address**: Provide valid email address.

**Description**

Account created for Tom Anderson

**Terms of Use**

This system is for authorized users only. Users accessing this system consent to the monitoring, recording and/or disclosure of all activities while using this system. Usage of this system is subject to the terms of the Virginia Tech Acceptable User Guidelines.

I agree with terms of use
• **Description**: User can provide the description for account creation e.g. purpose etc.
• **Cancel**: Cancel button navigates the user back to the Login page without account creation.
• **Request Account**: On clicking the Request Account Button User navigates back to the Login Page with account created as ‘TestUser1’.

### 8.1.2 Login
User can now login to SIBEL with the newly created account.

![Login to SIBEL](image)

The Login page as illustrated in Figure-2 has following fields:
- User Name: Enter valid username
- Password: Enter Valid Password
- Login Button: Click Login Button to Login to the tool
- Request Account Link: Used by new users to create an account.

### 8.1.3 First Landing Page
The landing page lists all the menus in the following order:
- Experiments
- Analysis
- Initial Conditions
- Disease Models
- Triggers
- Regimens
- About

The Experiments landing page is selected by default and presented to the user as illustrated in Figure 5.

### 8.1.4 Logout
A Logout Link is available next to the Welcome note.
User can click on the Logout button to exit SIBEL from anywhere in the tool. The login page is presented again when user exits.

8.2 Common Features

The following listed functions are available across all menus on its respective landing pages/inner pages for Experiments, Analyses, Initial Conditions, Disease Models, Triggers and Movies. They have the same usage across the tool.

8.2.1 My/All /Archived Filter

All the menus except “About” on SIBEL tool have My/All/Archived Filters above the Lists for Experiments, Analysis, Initial Conditions, Disease Models, Triggers and Regimens. It is used to toggle between MY List which displays the list of objects created/owned by the current logged in user, ALL List which displays the list of all available objects to the user i.e objects of all users both active and archived and Archive List which displays the list of Archived objects owned by current logged in user. A filter
specified by the user remains in effect for the session. Hence, each time the user returns to any of the menu, the information listed will be displayed per the most recent filter specified during this session.

8.2.2 List Navigation

Figure 8
Navigation buttons are available on each menu to view the available list for Experiments, Analysis, Initial Conditions, Disease Models, Triggers and Movies if there are too many list items. By default user can view 8 items per list at a time. User can also navigate through the next, previous, last and first page navigation buttons as desired.

8.2.3 Back

Figure 9
On Experiments and Analysis detailed view/ while creating entries user can select the Back button to return to the home/previous pages

8.2.4 Cancel

Figure 10
Cancel button is available while editing existing or adding new experiments, analyses, initial conditions, diseases models, triggers and movies to reset to original values if any changes are done. Cancel will also return to the previous page without saving any changes if at all made depending on which page the user is editing.

8.2.5 Value Slider

Figure 11

% Value Refers to a single set point value between 0% and 100% reflecting the percentage of individuals in the experiment’s selected subpopulations. The slider can be used to drag between the values. Specification of this value will define a single cell. %value slider is presented to user while specifying Compliance Efficacy, Delay for an Intervention, Diagnostic Rate and %Infectious while defining/editing Triggers.
8.2.6 Sweep

Sweep is a short-hand way of specifying several experimental cells that vary by one parameter. Interventions, Initial Conditions, Disease Model and triggers for an experiment as may be specified by a sweep.

Sweep can be specified either as **Linear sweep** or **Customized sweep**.

1) **Linear Sweep:**
Linear sweep is specified as a range of values with Initial value, Final value and increment value.

- **Initial Value** – Starting value for sweep process to generate a range of cells.
- **Final Value** – Ending value for the parameter to be set during a sweep. The final cell generated by the sweep will not exceed this Final Value. The final cell generated in the sweep will be set at the Final Value, regardless of the increment size.
- **Increment** – Size of the change in percentage of population to be used during sweep generation of cells. This increment will be added to each cell value to create the next subsequent cell.

If a sweep is specified, the CNIMS system will generate a set of experimental cells that begin at the Initial value, and represent each level of the parameter above the Initial value incremented up to and including the Final value. For example, if the analyst were to sweep Infectious from 30% to 70% in increments of 10%, the cells generated would represent percentages from 30, 40, 50, 60, 70.

2) **Customized sweep:**
Customized sweep is defined as arbitrary comma separated values. It generates cells with each of the specified sweep value. For example if the analyst were to sweep % Infectious as 15,38,90 ,the cells generated would represent percentage of 15 %, 38 % and 90 %. Specify the values in the edit box and click on Go. A graphical display of the specified values is shown.
8.2.7 Archive/Restore
Archive restore feature would enable a user to remove objects which are not required by the user from My view. This way user can declutter the My list view for any object. User can archive any object owned by the user. To archive an object, user has to select the object and click on ‘Archive’ action for the object. Once an object is archived, it is moved from My list to the Archived list. User can restore or duplicate an object from archived list. Restore action moves the object to My list of the user. Duplicate action duplicates the object and duplicated object is available in My and All list.

8.2.8 Help Tips
Help Tips are available for most of the fields on SIBEL forms. User can click the Help icon to get a brief description of the field.

Experiments
Experiments are a means to define and specify an Epidemic event along with all the required parameters and use it to simulate the event. The parameters will mainly include the number of replicates, duration, region affected, conditions when the event occurred, effect of the pathogens, the trigger which caused the event, intervention strategy-type and its application on the sub-populations of the selected region. Once all the required parameters are defined the experiment is run to be further used for creating analysis and reports.

Using this menu analyst can view, define, manage and run experiments which are further supplied for Analysis. Below sections explains each operation in more detail.

8.2.9 View Experiments
When user logs into SIBEL or on clicking the experiments menu from anywhere in the tool, the Experiments Grid and short cards preview is presented on the Experiments Landing Page as illustrated in Figure 4.
8.2.9.1 Summary of Experiments List

- List of Experiments is sorted on the basis of time stamp. The first experiment is selected by default when user logs in. Whereas on returning from any other menu the last selected experiment in the session is highlighted. User can use MY/ALL filters to navigate between own and other user’s experiments.
- Search Experiment text box allows user to search by its ID, Name, Owner, Status. User shall enter first 3 characters only if the name is not known.
- Name of Experiment
- Owner is shown under each Experiment.
- Time stamp is shown under each experiment entry which indicates the time stamp at which the experiment is last updated. The last updated time stamp is shown for experiments with status as Complete/Failed/Paused.
- For experiments with status as Submitted/Posted/Running, time at which the experiment run started is displayed.
- For experiments with status as Complete, duration to complete the experiment run is shown in minutes.
- Action Links against each Experiment:
  - **Start**
    - For Runnable experiment the link will be enabled and in other state it will be disabled
    - For already running experiment the link will be disabled
    - For Experiments in completed state the “Start” link will be disabled
For Experiments of other users the “Start” link will be always disabled

**Duplicate**
- The link is enabled for all experiments so that user can duplicate experiment anytime.

**Delete**
- Delete link is enabled for Experiment in New/runnable state
- When experiment is running or in completed state this link get disabled.
- It is also disabled for experiments of other users.
- Pagination at the bottom allows user to navigate 10 experiment list at a time next/previous, back/forward and on specific page.

**Archive**
- Archive link is available for all experiments in My List of a user.
- To archive an experiment click on more options and select Archive option.
- User can move back the experiments from Archived list to My list using Restore option available for all experiments listed in archived list.

**View Cells**
- Clicking View Cells causes the system to read the parameters selected for independent variables in the experiment - The combination of intervention specifications and the parameter to be swept – and generates the required cells.
- These cells comprise the specification of the conditions for the experiment to be run and the Conditions have been generated considering combinations of all the sweep and non – sweep values.

**Manually Set Up Experiment**
- This feature would allow an expert user to manually edit the experiment files created at the backend.
- Once the files are updated by the user, he can select to submit the job on cluster. The job would now run as per the user updated configuration files.
- This would help an expert user to update an experiment for parameters which can not be currently controlled by user interface.

### 8.2.9.2 Cards Preview

#### Short Card Preview

For any experiment in the list the right side frame of the Experiments Landing Page display a short preview of the Experiment characteristics (see Figure 4) which are categorized as below.

- **Details**: preview of replicates, simulated days, total cells and model values of the experiment
- **Region**: Geographic region selected for the Experiment
- **Disease Model**: preview of the selected Disease Model of the experiment along with its Incubation period and Infectious period probability bar graphs
- **Initial Conditions**: preview of the selected initial condition of the experiment along with the infected people details for On Day, EveryDay or DailySeed.
- **Interventions**: preview of the selected interventions for the Experiment.

#### Fully defined Experiment

On selecting any experiment with all cards edited and saved the short preview display will have all the cards populated as shown in Figure 4.
**Partially defined Experiment**
An experiment if defined partially for eg only Details specified then the short preview displays only the Details card populated and all other cards - Region, Disease Model, Initial Conditions and Interventions will be empty with ‘+’ sign indicating user to add information to them. See Figure, 5 below.

![Figure 14: Short Card Preview with only Experiment Details](image-url)

**Detailed Card Preview**
A larger preview of the Experiment card definition is available on clicking anywhere on the short preview on Experiments page.

**Incomplete Experiment**
A newly created experiment will have only the Details card preview for the first time. Other cards can be added anytime as desired from this preview by clicking on the corresponding card, as illustrated in Figure 6.
Experiment Progress bar
A Progress bar is displayed on the top right corner to indicate the experiment definition state and run state.

1. Experiment state in the progress changes from Incomplete, Runnable to Runnable only when Details, Region, Initial Condition and Disease Model are defined.
2. The progress bar colour code turns from Red to Yellow to Green in the order of its readiness for simulation.

Completely Defined Experiment
For a completely defined experiment all cards will be defined/selected in the detailed preview. On the right side top corner the Progress Bar will indicate “Runnable” state in green color code as displayed below:
8.2.10 Define Experiment
For setting up a new experiment user has to click on New Experiment Button available on the Experiments Landing Page. See Figure 8.

A new experiment is created and user is first presented with the Experiment Details page.

8.2.10.1 Experiment Details
Experiments Details shown in Figure 9 has fields for entering detailed specifications for the new experiment.
Details page shows below fields:

**Name**
A unique name to identify the Experiment. A system generated name is pre-populated. User can retain the default name or provide own Name. It is a mandatory field.

**Description**
An optional text field to describe or provide additional information for the experiment.

**Status**
Provides the state of the experiment run. For new experiment it will be pre-populated as **New** which is un-editable.

**Owner**
Refers to the name of the user who created the experiment. It is a pre-populated field. For new experiment it will be pre-populated with logged in username which is un-editable.

**Model**
In this drop-down list, you can select the appropriate simulation engine type. To facilitate simple experimental designs, click *Epifast*, and to facilitate complex experimental designs, click *EpiSimdemics*
**Replicates**
The number of times the experiment will be run. Default value is 25. Each run will use a different random number seed defined by the Initial Conditions Daily Seed. In SIBEL, each replicated experimental run is identical to all others for the parameters of the experiment – Initial Conditions, Disease Models, etc – but varies in terms of the random number seed used to establish the initial condition.

**Total Cells**
Total number of cells in this particular Experiment. It is dependent on the Intervention and Triggers values. For Experiments without Interventions the Total cell count is always 1. Currently the maximum allowed cell limit for an experiment is 64, in case the cell count for an experiment exceeds 64 user would not be allowed to run the experiment, user would have to reduce the cell count.

**Simulated Days**
Duration of the simulation period. Default value is 200.
Once all the fields are populated, click **Save** to store the details entries. User is then navigated to Detailed Cards Preview for the New Experiment. See, Figure 8

**8.2.10.2 Region**
This refers to the geographical region which is affected by the Epidemic. Click on add new on the Region card of Detailed Preview and select a region. See Figure 10
The region page allows the below controls:

**Search region**
Allows to search for a specific region by entering first few characters or entire name of the region.

**List**
It is a list of all the available regions.

**Map**
The enlarged view of the selected region is depicted on map. This allows the user to view all the nearby regions that are likely to be infected. The region can be zoomed in or out as desired.

**Select Region**
Select a region from the list or search for one for eg: *Montgomery*. The new region will be highlighted on the map. **Save** the region and return back to the New Experiment Detailed Cards Preview. The saved region shows up on the Region card as in Figure 12.
8.2.10.3 Disease Model

In general Disease Models represent how the pathogens affect a person. To attach a Disease Model to the experiment user has to click the add [+\(\)] button on the Disease Model Card from the new experiments detailed cards preview page.
Figure 22: Disease Model card
Figure 23: Disease Model Selection for Experiment

**View**
The Disease Model Landing page opens for viewing by filters, selecting, adding new, editing, duplicating, and deleting existing Disease Models.

**Select and Save**
For defining a Disease Model select an existing Disease Model from the View Disease Model Landing Page which is suitable for the experiment and has Details, incubation period and infectious period correctly filled in eg: **AL_25 Moderate Flu** and save the entry as illustrated in Figure 14 above. The detailed cards preview is displayed highlighting the selected Disease Model name as **AL_25 Moderate flu** on the Disease Models card with a short graphical representation of the Incubation period and infectious period probabilities across Infected Days.
New or Duplicate
Alternatively, users can either create a new Disease Model or Duplicate any existing Disease Model.

8.2.10.4 Initial Conditions

Initial conditions are a way to define the onset conditions of an epidemic. To attach a Initial Condition to the experiment user has to click the on the Initial Conditions Card on the new experiments detailed cards preview page.

View
The Initial Conditions Landing page opens for viewing by filters, selecting, adding new, editing, duplicating, and deleting existing list.

Select and Save
Select an existing Initial Condition from the Initial Conditions Landing page which is suitable for the experiment and has Details and Conditions populated eg: InitCholera and save the entry as illustrated in Figure 16.
The detailed cards preview is displayed highlighting the selected InitialCondition 5aday on the corresponding card.
New or Duplicate
Alternately users can either Create New or Duplicate existing Initial Conditions of own or other users from the view page then save and return to the cards preview.

8.2.10.5 Interventions

The Interventions are a means to study effect of different strategies like treatments on population, distancing measures on controlling pathogen and or disease spread in population. Simulations are performed on realistic socio-technical networks of synthetic US population where every individual is a node and edge represents activity between nodes. Application of Interventions over these complex directed graphs of population results into removal of edges and contact amongst nodes. Simulation continues on Resultant contact structure of the population.

R estimates can vary significantly and are estimated to further to decide the most effective intervention strategy for the disease situation.

SIBEL tool is capable of introducing high variability and analyzing complex scenarios on human interaction networks to gain evidence for proposed hypothesis and effectively plan and prepare for emergency crSIBEL. The tool allows enabling 8 different types of intervention.

One can choose to define a single intervention or multiple interventions. The interventions available are:

- Vaccinate
- Social Distance
- Close Work
- Close School
- Pharmaceutical Treatment
- Pharmaceutical Prophylaxis
- Generic Intervention
- Dynamic Sequestration

Parameters configurable to enable interventions provided in SIBEL are as follows:

**Name**
User should give intervention a name of choice by entering the name in the name field.

**Sub-population**
Interaction of demographics with the dynamics of disease propagation and the impact of disease on socio-technical systems is possible by specification of subpopulations of a region. Subpopulations comprise a type and a category. Refer [Appendix A](#) for entire list.
For eg: *Age* – Subpopulation is based on age type and the categories include preschool, school-age, adult, seniors, etc.

**Trigger**
After the onset of an epidemic event, interventions may be triggered by conditions that emerge during the event. For example, the decision to intervene by Closing Work could not realistically be made prior to the onset of the event.
The set of conditions to initiate the onset of an intervention are called a Trigger.
Specification of triggers is possible for each individual intervention chosen for study.

**Compliance**
Compliance refers to the probability that an individual might be selected for inoculation. In other words, a compliance rate of 90% means that 10% of the individuals will not be inoculated. Compliance

**Efficacy**
It refers to the probability of transmission of the disease after having been inoculated. 100% effective on X% Population is considered in current version of SIBEL.

**Following is how user would be able to work on Interventions support in SIBEL:**

**View**
To view the Enabled Interventions Page Click on the Define Interventions card on Detailed Card Preview is shown in Figure 18.
**Enabled Intervention Display**

- **Name of the Experiment**
- **Summary** - It lists all the interventions enabled along with the sub-populations selected in separate cards for each of the defined intervention. If multiple interventions are defined, the summary will group and display total of all defined interventions.

- When no interventions are defined, the Summary displays a message “No enabled Interventions”
- Following Interventions are displayed as separate menus:
  - Vaccinate
  - Social Distance
  - Close Work
  - Close School
  - Pharmaceutical Treatment
Define Interventions
To define an Interventions select the specific Interventions Menu. For eg click on Vaccinate Intervention menu and click on Create New+

**Vaccinate**
Vaccinate represents immunizing a selected set of population. It is possible to specify a percentage of the population that complies with this intervention (i.e., the percentage who are vaccinated), a trigger for when the vaccination is applied during the course of the pandemic, and the efficacy of the vaccination.

To add a new Vaccinate intervention click on Create New+ button on the Vaccinate Intervention Page. A vaccinate intervention form opens with textbox for name and separate cards to specify detail of sub-population, compliance, trigger and efficacy.
Sub-population
To support simulation and analysis pre-defined subpopulations in the selected geographic region for the experiment is included for selection for vaccinate intervention plan.

Type: The population of a region is logically grouped according to age, working group, infection prone group etc. All the available sub-population Type in the example Region-Montgomery will be listed and available for selection.

To create an intervention as vaccination, select vaccination from the intervention menu. Click on Create New. Enter an intervention name. Click on Create New. Enter an intervention name. Select a subpopulation Type.

Categories: The population groups are further classified as categories with specific range/conditions. Example for Age as the Type the Categories available are Pre-school, School-Age, Adults, Seniors along with the % of sub-population. Select all the categories for Type Age as illustrated in figure above for the intervention vaccination.
Select percentage of the selected sub population categories by using the slider. The selected sub population percentage would be displayed below the slider. The categories can be de-selected by again clicking on it.

**Compliance**
User can set compliance by specifying %Value OR using Sweep.

**%Value**
Define compliance as a single set point value at 100% using the slider bar. It reflects 100% of individuals in the experiment’s selected subpopulations that should comply with the intervention. Specification of this value will define a single cell for the experiment.

![Figure 31: Intervention Compliance %Value](image)

OR
Sweep
Set Sweep as a range of values as below:

- Initial Value=20, This is the starting value for sweep process to generate cell
- Final Value=50, Final value for the sweep cells will not exceed this value
- Increment by 10, This increment will be added to each cell value to create the next subsequent cell.

Figure 32: Intervention Compliance Sweep

Trigger
It is essentially the condition to trigger the intervention. While defining intervention for the first time one can select the available Triggers for On Day or % Infectious list. Alternatively, user can click on New button to define a new trigger.
On Day
Lists Triggers created by all users that defines the onset of trigger on specific days as % Value or as sweep values. Select On Day 15 as the Trigger. It displays the Name and Value of the Trigger.

OR

% Infectious
Selecting % Infectious, Lists Triggers defined by all users for % of infectious individuals in specified subpopulation.
Figure 34: Intervention Trigger %Infection

It can be %Value or Sweep Value. For Eg. Select Trigger-Cholera which has a sweep value. It displays:

Name: Name of the Trigger

Sub-population: Selected sub-population eg: pre-school, school-age

%Infectious: Displays the swept values. For eg if initial value is set as 0, final 10 and increment by 2, then only the values are represent as 0.0%, 2.0% etc.

Delay: It is the trigger delay specified in days after beginning of the experiment. It can be a single value or a Swepted value. For eg in Trigger-Cholera the delay is set for 31 days after which the Trigger will be applied.

New Trigger
On clicking New Trigger, a New Trigger form page is presented to enter the details.
Figure 35: New Trigger
Enter only the name as Ebola Trigger 1 and click on save as shown in above figure. User is then navigated to Vaccine Interventions page.

**Efficacy**
It is the %population on which the intervention is 100% effective. User can define efficacy by two methods:

- **%Value**
  Allows setting a specific % of population.

- **Sweep**
  Allows setting a range of values.
Figure 37: Efficacy of Vaccine Value
**Rate of Administration**

This parameter would specify number of doses of intervention to be delivered each day to a fraction of subpopulation, following the trigger event. Sub population would be divided into groups based on the user specified rate.

Intervention would be applied to each group on consecutive days for the entire duration of intervention specified after the specified trigger.

Intervention rate would be set to unlimited by default for all interventions. In case user selects the rate of administration as unlimited, entire subpopulation would be treated as a single group and intervention would be applied on a single day as specified by the trigger.

Example: Vaccinate school age kids at rate of 3K/day, if there are 30K school age kids in population and the trigger fires on day 10, then there would be 10 vaccinate interventions one each for days 10-20 with a specific 3K of the 30K school kids, and the specified compliance rate would be applied each day.

After defining **Sub-population, Compliance, Trigger Efficacy** and rate of administration clicking on **Save** button on the Vaccine Interventions page will store it with all the set parameters and display the summary page which lists the newly defined **Vaccine Intervention**.
Multiple Intervention
The new SIBEL allows user to create multiple interventions of same type with new set of parameters and attach to the experiment.
For example, To create a second Vaccine Intervention, navigate to the Vaccinate Intervention and Click on Create New button and set new values for all the intervention parameters as displayed below:
On Clicking save the Summary page lists the newly created Vaccine2 Intervention with the sub-population applied. Alternately select the already defined intervention from the drop down list and click **Duplicate** to create a copy of the intervention and then change values of all the parameters. On clicking save button will return user to the Intervention Summary page which lists all the Vaccine interventions created and applied for the experiment.
Similarly user can create multiple interventions for Generic Intervention, Vaccine, Social Distance, Close Work, Close School, Pharmaceutical Treatment, Pharmaceutical Prophylaxis and Dynamic Sequestration and attach it to the experiment. The Summary lists all the interventions created for the experiment:
Social Distance
Represents limiting non-essential activities in an individual’s daily schedule to reduce the probability of disease transmission. Non-essential activities are those that occur at locations in the model other than home, work, and school. The edges in a social network graph that represent these non-essential activities are probabilistically removed based on the compliance rate.

Duration
The time/duration in days for which an intervention would be applied during the experiment run. This is available for only social distance interventions such as social distance, close work, close school, dynamic sequestration and generic interventions. Duration can be specified as a value or sweep. The controls - sweep, value, initial, final, and increment settings function in the same way as specified for other interventions. For regimen based interventions such as pharmaceutical prophylaxis and pharmaceutical treatment, regimen duration would be used as the duration of the intervention. Duration for vaccination would be the number of simulation days for the experiment.

Close Work
Intervention Close Work represents the closure of work places and the elimination of work activities to reduce disease transmission. All edges in the social network graph that represent work contacts are
probabilistically removed based on the compliance rate.

**Close School**

Intervention Close School represents closure of schools and the elimination of school activities to reduce disease transmission. All edges in the social network graph that represent school contacts (including college) are probabilistically removed based on the compliance rate.
Pharmaceutical Treatment

Intervention Pharmaceutical Treatment represents Antiviral drugs that can diminish the infection to a level sufficient for the natural immunological responses of a body to defeat it.
Diagnostic Rate
Proportion of the infectious individuals who get diagnosed, and thus are treated. This is for treatment purposes only. For individuals who are diagnosed, the treatment starts on the first day of infectiousness and ends once the regimen is completed. The remaining controls - Sweep, Value, Initial, Final, and Increment settings function in the same way as specified for Intervention: Vaccination. However, units are calculated in percentage of the selected subpopulations for diagnosis.

Regimen
A prescribed course of medical treatment for the restoration of normal health of an individual. Regimen allows user to set the Available Doses/Unlimited Doses. Constraint on the total number of doses for both treatment and prophylaxis This constraint could be
related to stock available or limitations with respect to age, gender, genetic profile of the population. It gives details of the below fields:

- **Name** – Name of the Regiment. Eg: Tamiflu Treatment
- **Duration** – Number of days for which medication is prescribed. If used as prophylaxis, individual is considered as protected for this duration.
- **Units per Day** – Number of pills individual consumes per day
- **Infection Efficacy** – Reduction in the probability of infection
- **Transmission Efficacy** – Reduction in the probability of transmission

**Pharmaceutical Prophylaxis**
Pharmaceutical Prophylaxis is application of medication that specifically fights a viral infection. Pharmaceutical Prophylaxis for sequestered subpopulations can have unintended consequences by masking the symptoms of some infected individuals, and allowing their introduction into small sequestered groups. The result can be a greater infection rate within the protected subpopulation.

![Figure 47: Pharmaceutical Prophylaxis](image)
**Generic Intervention**

This will allow a customized intervention to be applied. A generic intervention would allow risk of infection through each activity type to be scaled independently. The five activity types are home, work, school, shop and other. The edges in the network graph that represent contacts due to the five activity types are scaled as per the user provided value for the factor. Similar to social distance intervention, sub population, compliance, trigger, duration and rate of administration can be set for generic intervention.

**Figure 48: Generic Intervention**

**Scaling Factor**

It is a vector of floats that sets the scaling factor for each of the five activity types, both in the "in" and "out" edges of the individual affected by the intervention. Infectivity multiplier would represent the in edges of the network graph due to the five activity types of the individual affected by the intervention. Susceptibility multiplier would represent the out edges of the network graph due to the five activity types of the individual affected by the intervention.
**Dynamic Sequestration**
This implies isolating healthy individuals from susceptible population to attempt to protect them from infection. This involves sequestering specified sub-population randomly in specific group sizes on a particular day specified, followed by simulating disease spread.

**Group Size:**
The number of individuals in a sequestered group. Group size can be defined as a value or a sweep. The controls - Sweep, Value, Initial, Final, and Increment settings function in the same way as specified for Intervention: Vaccination

**Manage Interventions**

**Edit**
Interventions can be edited as per the experiment requirement only for experiments in the New state i.e. experiments not started yet. Different Intervention components e.g. Subpopulation, compliance, Trigger, Delay, Efficacy, Regimen and Diagnostic rate can be edited separately for all the interventions attached to the experiment. To edit an intervention go to intervention details page, edit the parameters that needs to be modified and click on Save button. User can discard the modifications by clicking on Cancel button.
Duplicate
To duplicate an Intervention click on the Duplicate button visible on the Intervention page and Save. Duplicate Intervention gets populated with the details of duplicated Intervention. System appends the incremented number to the duplicate Intervention e.g. Inter2 will be the duplicate of Inter 1.

Delete
Interventions can be deleted by selecting the interventions from corresponding drop down and by clicking the delete button at the bottom. Intervention once deleted cannot be recovered.

View Cells
Clicking View Cells causes the system to read the parameters selected for independent variables in the experiment - The combination of intervention specifications and the parameter to be swept – and generates the required cells. These cells comprise the specification of the conditions for the experiment to be run and the Conditions have been generated considering combinations of all the sweep and non – sweep values. Things would be more clear with the below mentioned example.
Consider an Experiment **Cholera** with Intervention parameters for sub-population, Compliance, Trigger and Efficacy sweep settings as shown below:

There would be 4 (2 Compliance & 2 Efficacy) different combinations for which Vaccine intervention will be triggered on 20th day.

See the figure below.
Here compliance defined in intervention with linear sweep value as 30,40 and efficacy with linear sweep value of 10,20. This results in formation of four different cells with combination (2 values of efficacy and 2 values of compliance).

The user provided intervention name (Vaccinate-Adults) is shown in the cell information block of each cell of an experiment. The unique differentiating factor amongst the cells of an experiment along with the value of parameter should be shown in the cell information block of each cell of an experiment. For example in this case the only differentiating factors between the cells of the experiment are the values for compliance and efficacy. So the cell information block shows the unique differing value of the two for all the cells. Clicking on View More link in the cell information block displays all the parameters defined for the intervention. The pop-up displays the complete intervention details for the created cell.

The cells should display the name of the cluster on which the cell job was executed.
**Business Rules for Interventions**
- Intervention of Experiments in state other than New cannot be edited/duplicated/deleted
- Intervention of Experiments owner by other users can only be viewed.

### 8.2.11 Manage Experiment

#### 8.2.11.1 Edit preview with detailed step by step screenshots
Experiment can be edited by selecting the experiment from the list on Experiments Landing Page. The detailed card preview page is seen which lets the user to select different cards for adding or editing information.

![Edit Detail card preview 1](image)
As desired add/update fields for the Experiment by clicking on the respective cards.

- **Details**: Click on the Details card to view the experiment details. Edit the Experiment Name, description, Model, Replicates and Simulated days as required and click save to apply the changes. Figure as needed. Save the edited form and view the applied changes from the detailed cards preview.
• **Region**: Click on the Regions card and select a new region. Click Save to apply the changes.

• **Disease Model**: Existing attached disease Model can be edited only in two situations:
  - Disease model should not be owned by others.
  - Disease Model should not attach to any other experiment.

• **Initial Conditions**: Existing initial conditions can be edited only in two situations:
  - Disease model should not be owned by others.
  - Disease Model should not be attach to any other experiment.

• **Interventions**: All the Interventions attached to the experiment can be revisited by selecting the Interventions card and the corresponding Intervention menu and then edit the required parameters like- Sub-population, Compliance, Trigger, Efficacy, Diagnostic Rate etc. The updated changes can be saved and applied on the Experiment

• **Duplicate**: Selecting an experiment and clicking the Duplicate Link on the Experiments page will add a new experiment to the list. This new experiment will be created with a a new Name, but all other features will be identical to the experiment selected for duplication. This new experiment will be owned by the currently logged in User.

8.2.11.2 Delete Experiment
• Experiment can be deleted by clicking the delete button. Once deleted cannot be recovered.
• User cannot delete Experiments in any state other than new or failed.
• User cannot delete Experiments owned by other users.

8.2.11.3 Run Experiment

To Run an Experiment, select it from the list and click START link.

---

**Figure 57: Experiment Status**

Experiment Status: The status of the Experiment changes in the following order:

- **New** – just created, not yet executed experiment.
- **Running** – currently executing on the IDAC cluster.
- **Completed** – simulations completed, and data ready for analysis on the DAC cluster.
- **Failed** – If experiment not completed then Failed status is shown which means achieved normal termination.
- **Restart** - User would be able to restart failed experiments using a restart link.

The Experiment status can be seen changing in the Progress bar in detailed card preview.

**View Error Log**

User would be able to see a View Errors link for experiments with Failed status. On clicking on the link, user would be navigated to Cells page. For all cells with failed status, a view error link would be displayed next to the cell name. On clicking on the view error link, error log would be displayed. The error log would give details of the failure of cell execution.
Manual Editing of experiments
This feature would allow an expert user to manually edit the experiment files created at the backend. Once the files are updated by the user, he can select to submit the job on cluster. The job would now run as per the user updated configuration files. This would help an expert user to update an experiment for parameters which can not be currently controlled by user interface.

Figure 58: SetUp Experiment

An expert user would be able to set up an experiment, using the SetUp button from More Actions list next to each experiment. Once user selects an experiment for set up, application would pause the experiment run. All the experiment files would get created on backend. User can manually edit the created files and resume the experiment run using Resume button from More Actions list.

Experiment folders on the cluster
- On the cluster, a job for an experiment is executed and the cell data is stored in specific folder as follows:
  /home/isisdemo/archive/sibel/<sibell instance>/Experiments/<cell id>/cell/<cell id>
E.g. For experiments run on SIBEL-DEV, cells should get created at:
  /home/isisdemo/archive/sibel/SIBEL-DEV/Experiments/<cell id>/cell/<cell id>
- This folder would contain 3 folders - input, output and run
- Input folder would contain files:
  - Incubation period distribution
  - Infectious period distribution
- Output folder would contain file:
• Run folder would contain files:
  o Cell.properties
  o Configuration
  o Qsub
  o Qlog
  o Diagnosis
  o Intervention
  o DailySeed
  o Log files

**Thaw Experiment**
The status of completed experiments for which the last modified date is equal or more than 60 days would be shown as FROZEN. User would be able to THAW an experiment using THAW link next to the experiment. Once the Thawing is complete, user would be able to view the analysis using the VIEW ANALYSIS link next to the experiment. The status of experiment would be updated to COMPLETE.

**View Analysis**
Once an epifast job for all cells of an experiment is complete, cell summary jobs for each cell of an experiment is executed. Once cell summary of all cells is complete, user should be able to view a View analysis link next to each completed experiment.

A view analysis link is shown next to each experiment with status as Complete. Click on View analysis should display the interactive analysis plot for the experiment. The analysis name should be shown as Analysis for experiment <experiment_id>.

**Download Analysis**
Analysis data can be downloaded by clicking on the Download button on the analysis page. The analysis data would be downloaded as a background process. Once the downloaded analysis data is available, a download link should be available in the More actions list for the selected experiment.

The downloaded link should be available to all registered users of the application in My and All listing page of the experiments.
Download Data:
After analysis, on Experiment listing page, on click of Download in More Actions, a zip would be downloaded. This zip would be named as Experiment_<experiment id>.zip and would contain

- Individual Excel files for each cell in the experiment. They would be named as <cell-id>.xlsx and would contain sheets for:
  - Replicates,
  - SubPop Infection Data
  - Standard Plot Data.
- The zip would also contain an Excel for Cell metadata which would contain sheets for:
  - Experiment Details
  - Mean Infection Data

8.2.11.4 Business Rules
- Edit/Delete/Cancel/Archive/Restore actions cannot be performed for the Experiments of other Users.
- Edit/delete/duplicate actions cannot be performed for the Experiments with status Submitted, Queued, Running, Completed.
- Archive option can be performed for the experiments in My list only.
- View Analysis link would not be available for an experiment in FROZEN status.
- Owner of the experiment would be able to DUPLICATE, VIEW CELLS, ARCHIVE, REVIVE an experiment in FROZEN status from My listing page of experiments.
8.3 Initial Conditions

Initial Conditions allows user to specify number of infected individuals in a population to mark the concerned disease onset.

Mixed Population of Infected and susceptible individuals is setup to start with the simulation experiments of disease progression. Random selection of individuals as per configuration occurs at specified time during each iteration which implies each iteration need not set up same individuals as infected. Choice of Initial conditions is based on known facts of the disease under consideration. The experiment outcome and hence the analysis would significantly differ as per the set conditions and hence gains significant importance.

SIBEL provides three ways as follows, to define initial seed trying to mimic real world scenarios:

- **Day 0**: Specify Number of people infected on day 0. This marks infected count at the beginning of the Infectious disease period
- **Every day**: Specify Number of people infected per day. This defines infected count per day as disease progresses.
- **Daily Seed**: Specify Number of people infected on specific observed days. This represents infected count reported on particular days of infectious period.

8.3.1 View Initial Conditions

Initial Conditions Landing Page lists all the existing available initial conditions created by the logged in user under My list and that of all other users in the system under All list.

![Initial Conditions Landing Page](image)
8.3.1.1 Description of Landing Page

- List of Initial Conditions in the system is displayed in alphabetical order. The first Initial Conditions is selected as default when user clicks the Initial Condition Menu.
- User can use MY/ALL filters to navigate between own and other user’s Initial Condition.
- Name of Initial Conditions is displayed in the list.
- Logged in Username is shown in non-editable Owner Name field.
- Modified on indicates the time stamp at which the initial condition was created or modified.
- Action Buttons for Initial Condition:
  - +New Initial Condition on the top right corner
  - Duplicate
  - Delete
  - Save
  - Cancel
  - Archive

8.3.2 Define Initial Conditions

For Setting up a new Initial Condition User has to click the + New Initial Condition button and a blank Detail screen is presented.

![Image of Initial Conditions]

Figure 61: New Initial Condition

8.3.2.1 Details

Name
To provide the unique name to an Initial Condition.

Modified on
Indicates the time stamp at which the initial condition was created or modified. Owner
8.3.2.2 Conditions

Click on Conditions tab for defining the infected people in one of three ways: **On Day 0** – User can specify infected number on Day 0 in textbox provided under OnDay0 tab. E.g. 50 infected on day 0.
**Everyday** – To specify the specific number of persons infected per day. E.g. 5 infected on each day.

![Initial Conditions](image)

**Daily Seed** - The Daily seed tab is provided to configure the individuals infected on specific days. Here, user sets the Duration (in days) for an experiment. This timeline is displayed on graph shown below.
For Entering Infected People
- Click on Digit on Days axis to enter the number of Infected People on that particular day.
- Enter the Infected People on Day 3 as 5 and Press Go.

To increase the Infected People using drag feature
- Put the cursor on the Green bar visible for the day 3.
- Press the left click.
- Drag the bar in straight horizontal direction as per the number of infected people.

8.3.2.3 Sub population:
- User can either select a default sub population groups or upload a set of PIDs to define a sub population.
- Select a sub population type from the available list of sub population such as age, influenza risk, critical worker and All.
- Each sub population type has sub-categories for e.g. Age has sub types as Pre-school, school-age, adult and seniors.
- Select from any of the sub categories from the list populated below on selection of parent type.

**Upload PIDs**
This allows user to upload a set of person identifiers to define a sub population. The defined sub population would be used only for initial seeds applied to an experiment. This feature would be available to all users.

![Image of Initial Conditions](image)

**Figure 65: Upload PIDs**

- Select a region for which the experiment simulation is to be run from the list of region
Click on browse, navigate to the location on the machine where person identifier file is present.

The person identifier file should contain a list of comma separated person identifiers.

Once the file is uploaded the file name would display the name of the uploaded person identifier file.
8.3.2.4  **Business Rules**
- The PID file should be greater than zero KB in size.
- The PID file should be either a .txt or .csv file.
- The PID file should contain comma separated PID values.

8.3.3  **Manage Initial Conditions**

8.3.3.1  **Edit**

Existing Initial Conditions, owned by user but not attached to any experiment. Fields that can be edited are **Name, Description and different types of seeding type i.e. On Day, Every day and Daily Seed.**

![Figure 68: Edit Initial Condition](image)

8.3.3.2  **Duplicate**

Initial Condition can be duplicated from any of the existing Initial Condition on clicking the button Duplicate. Duplicate Initial condition gets populated with the details of duplicated Initial Condition. SIBEL appends the ‘Copy’ in the end of duplicate Initial condition; user can edit the duplicate Initial Condition and save it.
8.3.3.3 Delete

Initial Conditions, owned by the user and not attached to any of the experiment, can be deleted. After deletion the Initial condition will not be available to any registered user.

8.3.3.4 Archive

Initial conditions owned by the user can be archived from My list only. An archived initial condition should be available in archive listing of the initial condition.

8.3.3.5 Business Rules

- Value more than 100 and less than 0 cannot be allowed to save in Numbers of Infected and Duration of Timeline fields.
- Numbers of Infected and Duration of Timeline should be provided in whole numbers only.
- Edit/Delete/cancel/archive actions cannot be performed on the Initial Conditions of other Users.
- Edit/Delete/cancel actions cannot be performed on the Initial Conditions, owned by user and attached to any experiment.
- Archive action can be performed on the initial conditions owned by user from My list only. Archive can be performed for initial condition attached to an experiment.

8.4 Disease Model

Disease models are often calibrated after literature review and observed real case data available. These denote how pathogen affects a person and helps trace its propagation through a population. This defines effects of the pathogen on its host as a series of transitions among finite states (Susceptible, Infected, and Recovered).
They follow SIR(Susceptible, Infected, and Recovered) propagation rates and thus help to compare the results with expectations from classical epidemiological models when data is available.

For running simulations, Any Infectious Disease such as : Influenza, Hepatitis, Gastritis could be defined with limited parameters specification through SIBEL.

Current SIBEL version helps configuring following:

**Transmissibility**
Transmissibility is a function of contact duration and contact frequency calibrated to yield specific attack rate in population.
Disease severity differs for different strains causing disease and is marked by increase in Transmissibility values. Also temporal variations in transmissibility require definition of different disease model for same disease under study.
Generally biologically improbable values are those specified above 0.0001

**Incubation Period Probability**
The time period between exposure to the infectious agent and detection of the first signs or symptoms in an individual in population is defined as the **incubation period**.
The period may be as short as minutes to as long as thirty years depending upon the nature of the exposed pathogen.
Incubation period is specific for every disease.
The Incubation Period probability are defined per day as probability that a person from a population becomes exposed and harbors the latent contagious pathogen

**Infectious Period Probability**
The time period during which infected are able to transmit infection to any susceptible host or vector they come in contact is defined as the **infectious period**.
Both Symptomatic and asymptomatic individuals could be the possible source of infection dissemination in the population.
In SIBEL, Infectious Period Probabilities are defined for each day of infectious period.
This is probability that infected from a population are capable of transmitting infection to any other susceptible when in contact.

**Symptoms**
This contains the following:
- Symptomatic Proportion
- Asymptomatic Reduction

**8.4.1 View Disease Models**
Disease Models Landing Page lists all the existing available Disease Models created by the logged in user under My list and that of all other users in the system under All list.
8.4.1.1 Description of Landing Page

- List of Disease Models in the system is displayed in alphabetical order. The first Disease Models is selected by default when user clicks the Disease Models Menu. User can use MY/ALL filters to navigate between own and other user’s Disease Models.
- Name of Disease Models is displayed in the list.
- Logged in Username is shown in non-editable Owner Name field.
- Modified on indicates the time stamp at which the disease model was created or modified.
- Action Links against each Disease Model:
  - +New Disease Models
  - Duplicate
  - Delete
  - Save
  - Cancel
  - Archive

8.4.2 Define Disease Models

On clicking New Disease Model on the landing page a new form is presented to enter the details, then the incubation period, infectious period and symptomatic proportion:
8.4.2.1 Details

This page can be used to define general details. The fields available on the Details form are:

**Name**
A unique name to identify the Disease Model. A system generated name is pre-populated. User can retain the default name or provide own Name. It is a mandatory field.

**Description**
An optional text field to describe or provide additional information for a Disease Model.

**Owner**
Refers to the name of the user who created the Disease Model. It is a pre-populated non-editable field.

**Transmissibility**
It is a mandatory field calibrated as per the nature of causative disease agent.

**Modified On**
Indicates the time stamp at which the disease model is created or modified.

8.4.2.2 Incubation Period

- Set the duration for an experiment along with the probability of infection at the particular day during that duration.
- Incubation Period has been provided with the graph with drag feature for probability.
- **Remaining probability** which can be entered for others days is visible also graphically as well as in text.

**Timeline Duration**
This field is mainly used to define Time period for trend analysis of Incubation Period for a particular Disease Model would be observed on sample Users. User can group the % of individual’s as per the incubation period within the defined duration of timeline.

**Probability Values**
Pop up for probability can be used by user to provide the % age of infected people, having same incubation period. Sum Total Probability for a sample of users for fixed timeline duration cannot be more than 1.

**8.4.2.3 Infectious Period**

Same as Incubation period set the Duration of Timeline and probability on specific days for the Disease Model.
**Timeline Duration**
This field is mainly used to define Time period for trend analysis of Incubation Period for a particular Disease Model would be observed on sample Users. User can group the % of individuals as per the incubation period within the defined duration of timeline.

**Probability Values**
Pop up for probability can be used by user to provide the % age of infected people, having same incubation period. Sum Total Probability for a sample of users for fixed timeline duration cannot be more than 1.
8.4.2.4 Symptoms

Symptoms would contain two fields:
- Symptomatic Proportion
- Asymptomatic Reduction

**Symptomatic Proportion**
A text box to enter value for symptomatic proportion.
The acceptable range would be between 0 to 1 with fraction acceptable up to 3 decimals.

**Asymptomatic Reduction**
This is the percent reduction in transmission probability as compared to those with symptoms.
The acceptable range would be between 0 to 1 with fraction acceptable up to 3 decimals.

**Configuration file parameters**
The configuration file at the cluster should calculate the values for Asymptomatic Probability and Asymptomatic Factor based on the values entered for Symptomatic Proportion and Asymptomatic Reduction respectively.

Asymptomatic Probability = 1 – Symptomatic Proportion
Asymptomatic Factor = 1 – Asymptomatic Reduction
8.4.3 Manage Disease Models

8.4.3.1 Edit

Existing Disease Models, owned by user but not attach with any experiment, can be edited. Fields that can be edited are Name, Description, Transmissibility, Timeline duration, Probability for Incubation Period and Infectious Period, Symptomatic Proportion and Asymptomatic Reduction.

8.4.3.2 Duplicate

Disease Model can be duplicated from any of the existing Disease Model on clicking the button duplicate. Duplicate Disease Model gets populated with the details of duplicated disease model. SIBEL appends the ‘Copy’ in the end of duplicate Disease Model; if user wants it can be changed.
8.4.3.3 Delete

Disease Models, owned by user and not attached to any of the experiment, can be deleted.
8.4.3.4 Archive
Disease Models owned by the user can be archived from My list only. An archived disease model should be available in archive listing of the disease model.

8.4.3.5 Business Rules

- Value more than 100 and less than 0 cannot be allowed to save in Duration of Timeline fields
- Duration of Timeline should be provided in whole numbers only.
- Edit/Delete/cancel/archive actions cannot be performed on the Disease Models of other Users.
- Edit/Delete/cancel actions cannot be performed on the Disease Model, owned by user and attached to any experiment.
- Archive action can be performed by owner of the disease model from My list only. Archive can be performed for disease model attached to an experiment.

8.5 Analysis
Simulation Experiments designed and run in SIBEL, generate voluminous data. Results of each experiment contain data as cells. Each Cell is a distribution outcome of the specified replicates of parameters configured in experiments. Cells from same or different experiments can be then aggregated to perform analysis. Visualization provided in form of a wide range of graphs helps in better analysis and decisions. User may require to perform Analysis for a wide range of objectives or hypothesis for which experiments may be designed.

Analysis may be conducted for:
- Increasing Situational Awareness regarding various emerging Infectious diseases.
- Study of new strain disease characteristics and its impact on disease spread in US populations.
- Prediction of next wave of an epidemic or pandemic planning in US populations.
- Assess and compare the consequences of proposed interventions
- Understand the differential impacts of interventions
- Supporting Decision making - Prioritizing intervention strategies applied
- Preparations and Planning vaccination strategies in case of a Pandemic – Antiviral Stock planning
- Develop targeted surveillance for efficient situation preparedness.
- Develop intuition about the complicated relationship between the epi curve and R values.

8.5.1 Analysis Categories

8.5.1.1 Epi Curves Analysis
This method helps visualizing the progression of a disease over time in the population considered. In SIBEL, simulations are run on individuals with time parameter fixed to a day. The Epicurves generated are plots of infected cases per day during entire simulation trajectory. From such Epicurves, Analyst can basically investigate on:

- Modes of Transmission
- Cases first exposed
- Exposure duration
- Nature of epidemics: point /propogated
- Primary cases or Secondary cases
- Secondary attack rates
• Incubation period and Infectious period
• Case-fatality ratio indicating how fatal is the infectious disease

8.5.1.2 Standard Plots
8.5.1.3 Enhanced Analysis Capabilities:

Current SIBEL version integrates following features supported in previous versions of Didactic:

SIBEL 1.2 Updates:
Enhanced analysis specifically related to the computation of estimates of R:

• Wallinga likelihood Estimations of daily R values from the simulated transmission tree(s), disaggregated by demographics or geographics e.g. the average number of children infected by a single infectious child.
• Comparisons of summary features of the daily R curve, e.g. maximum slope, slope near R =1
• Statistical analysis of the influence of input parameters on these summary features

SIBEL provides capability to:
1. Compare daily R values i.e. Estimated_R, calculated using Wallinga estimate on transmission trees and Actual_R calculated as an instantaneous derivatives of number of new infections each day from simulation data on epicurves
2. Analyst can use Wallinga estimates to infer generation times or generation times used in simulation could help in deriving Estimated R for studying the disease characteristics.
3. Assessing likely outcomes of disease progressions with applied interventions over realistic networks is made possible. This help design effective strategies.

SIBEL 1.3 Updates:
1. Since epicurve observed in real world are complex and change with time, exact R or Growth rate calculation isn’t possible. Hence the need of combined analysis. In current SIBEL, Attempt is made To exactly determine relations between R(EstimatedR) and ρ(Growth rate-Actual_R) in a fully-mixed population by estimating Growth rate ρ using a 10-day regression window to filter background noise from the early phase of the epidemic.
2. The plots such as: Actual Effective R, Estimate of Effective R, Slope of Actual Effective R, Slope of Estimated Effective R are now available to view data with these estimates.

R curves can clearly show the intervention’s effect, and also show that by itself a proposed intervention may not be sufficient to stop the outbreak.
Epi curves might suggest that the intervention changes the extent of the vulnerable population (the eventual attack rate) more than might be expected on the basis of the change in R.

Limitation:
Social network structure and Disease propagation dynamics relationships are non-linear. This limits inference of disease characteristics based on Wallinga estimates.
Current SIBEL features capabilities yet help combine analysis to yield more actionable information than either by itself. This supports complex hypothesis driven testing effectively.
Following sections will help user work with features of Analysis section provided and explore capabilities themselves.

8.5.2 View Analysis
User clicks on “Analysis” on Menu on SIBEL Main UI to enter the Analysis Section to view Analyses entries. For Reference purposes, History of Analysis created or performed by users of SIBEL is stored and readily available.
A Quick view of Analysis Landing Page is as follows:
A Summarized Analysis List shows the below information:

**Name**
The Name of analysis entry

**Status of Analysis**
The analysis can be in either Draft, Downloading or Complete state.

**Time stamp**
Indicates the time stamp at which the analysis was created, modified or started.

**Owner/Userame**
User login name is displayed below the analysis name.

**+New Analysis button.**
To define new Analysis.

**Various Action Hyperlinks exist for:**
- View Details
- Interactive Plot
• Duplicate
• Delete
• Archive
• Download

Interactive plot

• The interactive plot for an analysis would be displayed on right hand side of the Analysis listing page
• The user would be able to click on the plot to navigate to Interactive Plot page for executing or downloading or filtering of the plot for analysis
• The plot on analysis listing page would be actual plot when the analysis is in Draft state
• Once the analysis is completed, the plot on analysis listing page would be a static image and not actual plot.

8.5.3 Define New Analysis

8.5.3.1 Analysis using post processing scripts

SIBEL supports adding new analysis to the system through Analysis landing page itself. On click of ‘+New Analysis’ on the Analysis Landing Page as shown below, a new Analysis is created:

Figure 79: New Analysis button
Enter the information for fields on UI shown as given below:

**Details**

**Name:**
Enter an unique name for analysis being performed for reference purposes for analyst.
Description:
Describe the goal or purpose for analysis in short. Optional.

Script:
- Select the post processing script from the dropdown.
- Alternatively the user can start typing the name of the script which would filter the list and show the matching results.
- It is optional to add post processing script to the analysis

Experiment
User can search for experiments from MY and ALL listing page of experiments using SEARCH EXPERIMENT option. Selection of an experiment in the listing updates the right hand view with the cells of the experiment.

User can select cells of the searched experiments by clicking on the check-box against the cell.

Figure 81: Select experiment for adding cells
**Define Cells To Analyze**
This section allows user to collate cells from same or across experiments to be included in Analysis. Cells from completed and frozen experiments of self or other users are enabled for selection.

*Note: Please see section 8.5.3.3 and 8.5.3.4 for details*

![Select experiment for adding cells](image)
**My Selection:**
Clicking on 'My Selection' tab on this page, lists down cell selected from same or different experiments for this analysis. These are grouped by experiment to which they belong. See below:

![Image of the interface showing selected cells]

If users wish to delete the cells selection made, user can click on delete icon adjacent to each cells. This immediately removes the deleted cell/s from selection:

*Figure 83: Cells attached to analysis – My Selection*

Click on **Preview**, to analyze the cells selected. User can view the interactive plot view of the created analysis for the selected cells.
Interactive Plot page:

User can click on ‘Finalize & Execute’ to post the analysis job on cluster. The status of the analysis would be shown on the Analysis listing page as Posted > Submitted > Running > Complete.

Once the analysis is completed, the data is downloaded in the form of a zip. The zip will contain the cell metadata, each cell data and the output of the scripts file. The user will be able to download the zip from More Actions menu from My or All list. Alternatively, the user can also download the data from Interactive Plot page > Download button.

NOTE:

- Finalize & Execute button on Interactive Plot page will be enabled only for analysis in Draft state. Once the execution of the analysis is done and the status changes to Completed, the Finalize & Execute button will be disabled on Interactive Plot page.
- The Download button on Interactive Plot page will be enabled only after the analysis is executed. If the analysis is in Draft state, the Download button on Interactive Plot page will be disabled.
Figure 85: Zip contents of analysis with script data

Figure 86: Zip contents of analysis data
In case user wants to revisit the created analysis and not execute the analysis, the analysis can be saved in Draft state. For analysis in Draft state user can make edits to the analysis. For saving an analysis in draft state user need not click on Preview button and click on Back button on the analysis page.

**Analysis folders on the cluster**

- On the cluster, a job for an analysis is executed and the cell data along with the script output is stored in specific folder as follows:
  
  `/home/isisdemo/archive/sibel/<sibel instance>/Analysis/<analysis id>`

  E.g. For experiments run on SIBEL-DEV, cells should get created at:
  
  `/home/isisdemo/archive/sibel/SIBEL-DEV/Analysis/`

- This folder would contain 3 folders - input, output and run
- Input folder would contain file:
  - Cells.json
- Output folder would contain file:
  - Analysis log
  - Files as per script output. They could be png, jpeg, pdf or txt files
- Run folder would contain files:
  - Qsub
  - Qlog

### 8.5.3.2 Analysis without using post processing scripts

On click of ‘**New Analysis**’ on the Analysis Landing Page, the create analysis page is presented to the user. Here the user can do the following:

- Enter name of analysis
- Description of analysis
- The user is allowed not to select any script and move on to select the experiment and the cells for the analysis
Once created, the user can click on Preview button to view the Interactive Plot of the created analysis for the selected cells.

Interactive Plot page:

User can click on ‘Finalize & Execute’ to start the analysis.
Once clicked on Finalize & Execute, the listing page is displayed and the status of the analysis is shown as Downloading.

After the data is downloaded, the status of analysis is updated to Complete.

An option Download is available in More Actions to download the data which would download the data in the form of a zip.

Alternatively, the user can also download the data from Interactive Plot page > Download button.

The zip would contain:

- Individual Excel files for each cell in the experiment. They would be named as `<cell-id>.xlsx` and would contain sheets for:
  - Replicates,
  - SubPop Infection Data
  - Standard Plot Data.

- Excel for Cell metadata which would contain sheets for:
  - Experiment Details
  - Mean Infection Data
NOTE:

- Finalize & Execute button on Interactive Plot page will be enabled only for analysis is Draft state. Once the execution of the analysis is done and the status changes to Completed, the Finalize & Execute button will be disabled on Interactive Plot page.
- The Download button on Interactive Plot page will be enabled only after the analysis is executed. If the analysis is in Draft state, the Download button on Interactive Plot page will be disabled.

8.5.3.3 Analysis with or without script attached and with frozen cells

On click of ‘+ New Analysis’ on the Analysis Landing Page, the create analysis page is presented to the user. Here the user can do the following:

- Enter name of analysis
- Description of analysis
- The user may or may not select any script.
- The user can see the complete and frozen experiments in the experiments list.
- He may then select the experiment and the cells for Frozen experiments.

![View of Analysis Details page – Frozen cells](image)
• Post selecting the freezed cells, the user can click on Preview button to proceed
• Here the user is presented with a dialog box with a message saying ‘All the selected cells are frozen. Please thaw the cells to proceed’ and the button for Thaw would be present on the dialog box.

![Figure 91: Dialog box when all selected cells are frozen](image)

• When the user clicks on Thaw, he is navigated to the listing page
• The status of the analysis is changed to **Thawing**
• While Thawing, the Interactive Plot on listing page is not displayed and will show a message ‘No Preview Available’
• Correspondingly, the experiment status also changes to Thawing

• Once the thawing is complete, the status of the analysis is changed to Draft
The Interactive Plot on the listing page will show the actual epicurve. Then navigate to Analysis Details page and My Selection tab will show the status of the selected cells. The user can now click on Pre-View button to proceed to Interactive Plot page.

Figure 94: Experiment state is Draft when Thawing is complete

Figure 95: Interactive plot page now shows the curves and buttons
On the Interactive plot page, the user can proceed to Finalize and Execute the analysis.
Once completed, the data would be downloaded in the form of the zip.
This data can be downloaded from either:
o. Listing page – More Actions > Download
o. Interactive Plot page – Download button
Alternatively, when on Analysis details page, the user may want to cancel the action and revisit the cells selected. For this, he can click the ‘X’ icon on right top corner. This will cancel the dialog box and the user can then add or remove the cells of choice to proceed with the analysis.

8.5.3.4 Analysis with or without script attached and with complete and frozen cells
On click of ‘+New Analysis’ on the Analysis Landing Page, the create analysis page is presented to the user. Here the user can do the following:
- Enter name of analysis
- Description of analysis
- The user may or may not select any script.
- The user can see the complete and frozen experiments in the Experiments list.
- He may then select the experiment and the cells for Complete and Frozen experiments.
Figure 96: View of Analysis Details page – Frozen cells
Figure 97: Frozen and Completed cells selected for analysis

- Post selecting the completed and frozen cells, the user can click on Preview button to proceed
- Here the user is presented with a dialog box with a message which mentions:
  - The analysis contains few frozen cells.
  - A list of frozen cell id’s will be shown up to 4 cells. If there are more than 4 cells frozen, then the message will show 4 cell id’s and ‘and more’ text to indicate more than 4 selected cells are frozen
  - The button ‘Thaw’ and ‘Remove and Proceed’
The user will click Thaw, if he wants to thaw the frozen cells and analyze them.

When the user clicks on Thaw, the analysis would behave similar to what is explained in section 8.5.3.3.

If the user wants to remove the frozen cells added to the analysis and proceed, then he would click on ‘Remove & Proceed’ button.

This would automatically remove the frozen cells added to the analysis and navigate the user to Interactive Plot page.
On the Interactive plot page, the user can proceed to Finalize and Execute the analysis.
Once completed, the data would be downloaded in the form of the zip.
This data can be downloaded from either:
- Listing page – More Actions > Download
- Interactive Plot page – Download button
Alternatively, when on Analysis details page, the user may want to cancel the action and revisit the cells selected. For this, he can click the ‘X’ icon on right top corner. This will cancel the dialog box and the user can then add or remove the cells of choice to proceed with the analysis.

8.5.4 Manage Analyses

8.5.4.1 Edit Analyses

Analysis in DRAFT state can be edited by a user. User has option to go back and edit the entries as required.
As shown above when user clicks on the View Details link next to the Analysis entry choosen to be edited, User is navigated to analysis specific page where:

- User can edit the name or description of the selected analysis.
- User can add or remove scripts
- Select an experiment from MY/ALL listing page of analysis
- User can add or delete any specific cells.
**Figure 101: Add or remove cells and/or scripts from Analysis**

- To reject the edits and return to Analysis specific page, user can make use of “Cancel” button provided on this page. This retains the original values as shown below:
- Again any cell from an experiment in dropdown can be added or removed from “My Selection” tab
Alternatively user can Cancel to reject the changes in cell selection, retain the original data and return to Analysis specific page.

- User can Analyze to view the analysis results of the edited analysis.

**Points To Note:**
1. Any Analysis only in Draft state are editable.
2. Analysis performed by other users in SIBEL are not editable.

**8.5.4.2 Duplicate Analysis**

An alternative to define and add Analysis entry is by duplicating any existing analysis in the system. To Duplicate, simply click on Duplicate in More Actions adjacent to respective analysis entry on Analysis summary listing page.
This results into Adding one more entry with “-copy” appended in the “Name” field by default as shown below:

User can edit and save the name and description details in the duplicated entry if required.
Any parameters of the Details section are editable.
Similarly user can view and edit the cells selected for analysis.
User can choose to add additional cells from recently completed experiments as well.
On Click of “Back” user is taken to the Analysis Summary page where the duplicated entry is listed.
Increase in number of “My Entries” confirm the same.

8.5.4.3 Delete Analysis
User has an option to delete the Analysis enteries which are not required.
User can click Delete in More Actions adjacent to each analysis entry to remove the entry.
The analysis entry is deleted by this action. This is no more visible in the Analysis summary list.
Also decreased number of analysis entries seen on UI confirms the same.
Points To Note:
1. User is restricted from deleting the analysis entries of other SIBEL users.

8.5.4.4 View details
- User can view Epiplots data or standard plot data of the analysis.
- Interactive plots are displayed in the results section. The visualization and data displayed can be configured using various options available in the plot configurations.

8.5.4.5 Plot Configurations
- **Infection Count**: Plot actual infection count or cumulative infection count of the selected cells for a day range.
- **Show proportion**: Plot proportionate of the actual or cumulative infection count of the selected cells for a day range.
8.5.4.6 Data Filters

- **Cells**: Plots the infection data for the cells selected from the list by the user. For each cell user can select the option to view the infection data for the replicates of the cells. User can select a set of the replicates for which the infection data should be plotted.

- **Sub Population**: User can also view the infection data for different sub population categories for each of the selected cell.

![Ebola Montgomery Analysis](image)

**Figure 106: Filtering by Cells**
Differentiating factors: Plots the infection data for the cells with the values of differentiating factors selected from the available list by the user.

For all values selected from the same filters:
For example: If user selects value as 55 for Ebola Mode compliance, two cells with the compliance value as 55 plotted on UI.
For all values selected from different filters:
For example: If user selects value as 55 from Ebola Mode compliance and 66 from Diagnostic Rate, a single cell with compliance as 55 and Diagnostic rate as 66 are plotted on UI.
8.5.4.7 Shrink Graph
User should have the provision to shrink the plotted infection graph. This is required in cases where the amount of data to be plotted is large and so the data overlays the legends of the plots. In such cases the user can shrink the graph so the legends are legible.

8.5.4.8 Hide/Unhide legend
User should be able to hide/unhide the legends of the cells/replicates plotted in the graph. Hovering over a cell legend would provide details of the intervention name and the differentiating factor values of the cells.

8.5.4.9 Download Data
User is able to download the analysis results in the form of a zip. Below sub sections mention about the details downloaded in the zip

8.5.4.10 Download data for analysis with script
- Click on Execute button on the Interactive Plot page. Once analysis data is downloaded and the analysis is marked as complete, a Download link would be available in the More actions list of the analysis for which data is downloaded.
- The link should be available to all the registered users of the application.
• The data would be downloaded in the form of a zip.
• The zip would contain:
  o Individual Excel files for each cell in the experiment. They would be named as <cell-id>.xlsx and would contain sheets for:
    ▪ Replicates,
    ▪ SubPop Infection Data
    ▪ Standard Plot Data.
  o Excel for Cell metadata which would contain sheets for:
    ▪ Experiment Details
    ▪ Mean Infection Data
  o The zip would also contain an Output folder which would contain
    ▪ Analysis.log file
    ▪ Script output files, if any
• The Cell metadata file would contain Analysis details sheet and Mean Infection data sheet
• The Excel for individual cells would contain sheets for infection data of replicates for the cell, sheet for infection data of all the sub population category for the cell and the standard plot data for replicates of the cell
• The script output files could be png, jpeg, pdf etc.

8.5.4.10.1 Download data for analysis without script
• The analysis download would be available as a background process. Click on Download button on the Interactive plot page. Once analysis data is downloaded and the analysis is marked as complete, a Download link would be available in the More actions list of the analysis for which data is downloaded.
• The link should be available to all the registered users of the application.
• The data would be downloaded in the form of a zip.
• The zip would contain an Excel for Cell metadata and one Excel for each cell participating in the analysis, i.e. An analysis with 2 cells should have 3 Excel files – 1 metadata file and 2 files for 2 cells
• The Cell metadata file would contain Analysis details sheet and Mean Infection data sheet
• The Excel for individual cells would contain sheets for infection data of replicates for the cell, sheet for infection data of all the sub population category for the cell and the standard plot data for replicates of the cell

Analysis metadata sheet: This sheet should have details such as name description and identifiers of the experiments used for the analysis. Analysis details such as analysis name, analysis description, cells used in the analysis and differentiating factor values of each cell of an analysis should also be present in the downloaded sheet.

Mean infection data: The means of the infection data of all the replicates of each cell for the experiment duration.
Eg: An analysis is run with 2 cells, cell identifier as 1, 2, for a duration of 200 days. Each cell has 25 replicates.
There should be a single sheet with mean infection data values for all the cells over the duration of experiment run.

Infection data for replicates: The infection data for all the replicates of each cell for the experiment duration. There should be separate Excel files with the replicates infection data of each cell.
Eg: An analysis is run with 2 cells, cell identifier as 1, 2, for a duration of 200 days. Each cell has 25 replicates.

There should be two separate Excel files for cell identifier 1 and cell identifier 2. The Excel should be named as Cell-<cell identifier> (Cell-1 and Cell-2).

**Mean SubpopInfection data:** The mean of the infection data for each sub population category for each cell for the experiment duration. This would be included in Excel for each cell data.

Eg: An analysis is run with 2 cells, cell identifier as 1, 2, for a duration of 200 days. Each cell has 25 replicates

There should be two separate Excel files for cell identifier 1 and cell identifier 2. The Excel would contain a sheet named as 1-SubPopInfection data with mean of the infection data for each sub population category for all the 25 replicates of cell identifier 1.

**Standard Plot data:** This sheet contains values for Actual Mean, Actual Standard Deviation, Proportion Mean, Proportion Standard Deviation for all SubPop Categories belonging to that region

### 8.5.4.11 Snapshot of the Analysis
1. User should be able to download the application view displayed at a particular point of time in the form of an image.
2. On selection of the snapshot option, user should be prompted to open the file or to browse to a location to save the file. (This would be specific to the browser used).

### 8.5.4.12 Archive Analysis
Analysis owned by the user can be archived from My list only. An archived analysis should be available in archive listing of the trigger.

### 8.5.4.13 Thaw Analysis
The status of analysis created with experiments with FROZEN status would be updated as FROZEN. User would be able to THAW an analysis using THAW link next to the analysis. Once the Thaw is complete, user would be able to view the analysis details using the VIEW DETAILS link next to the analysis. The status of analysis would be updated to Complete.

### 8.5.4.14 Business Rules
1. Owner of the analysis would be able to VIEW DETAILS, DELETE, ARCHIVE, THAW an analysis in FROZEN status from MY listing page of analysis.
2. Non Owner of the analysis would be able to THAW and VIEW DETAILS for an analysis in FROZEN status from ALL listing page of analysis.
3. Preview of analysis marked as FROZEN would not be available to a user in MY and ALL listing page of analysis.

### 8.6 Triggers
As explained in interventions triggers are the set of conditions that is obtained to initiate the onset of an intervention which may be triggered by conditions that emerge during the event are called a Trigger.
Triggers are the reusable component for interventions of any experiment. Two types of triggers are available in the models:

- **On Day**: Specification of an “On Day” trigger means that an intervention is applied on the day specified – day being the number of days after the onset of the PI event.
- **% Infectious**: Specification of a “% Infectious” trigger means the intervention will be applied as soon as the percentage of individuals in the subpopulation exceeds the trigger threshold on a single day.
- **Day Range**: Specification of a day range trigger means the intervention will be applied on a range of days specified – from day being the number of days after the onset of the PI event and end day being the number of days when the trigger would end.

### 8.6.1 View Triggers

Triggers Landing Page lists all the existing available ones created by the logged in user and that of all other users in the system.

![Triggers Landing Page](image)

#### 8.6.1.1 Description of Landing Page

- List of All Triggers in the system in alphabetical order. The first Trigger is selected by default when user clicks the Triggers Menu. User can use **MY/ALL** filters to navigate between own and other user’s Triggers.
- **Name of Trigger**
- **Logged in Username** is shown in non-editable Owner Name field.
- **Modified on** indicates the time stamp at which the trigger was created or modified.
- **Action Links** against each Triggers:
  - +New Triggers
  - Duplicate
  - Delete
  - Save
8.6.2 Define Triggers

On clicking New Trigger, on the landing page a new form is presented to enter the details and select the Types.

8.6.2.1 Details

This page can be used to define general details. The fields available on the Details form are as mentioned below:

**Name**
A unique name to identify the Trigger. A system generated name is pre-populated. User can retain the default name or provide own Name. It is a mandatory field.

**Description**
An optional text field to describe or provide additional information for a Trigger.

**Owner**
Refers to the name of the user who created the Trigger. It is a pre-populated non-editable field.

**Modified on**
Indicates the time stamp at which the trigger was created or modified

8.6.2.2 Types

User can define the type as per the onset of interventions
**On Day**
On Day type trigger is used to configure the onset of trigger on specific day. It can be set in either of two ways i.e. Value and Sweep

**Value**
User can mention the day of an experiment in digit using slider.

**Sweep:**
Trigger can be defined in sweep manner also e.g. starting from 3rd day till 9th day with interval of 3 days.
- Initial Value = 3
- Final Value = 9
- Incremental Value = 3
Figure 113: On Day - Sweep

Graph would get populate as per the sweep values provided below the fields.

%Infectious
To configure the onset on the basis of % of infectious individuals in the subpopulation. User can define the trigger for an experiment as per the Subpopulation, % of infected population and Delay.

Subpopulation
User can select the subpopulation type from the prepopulated dropdown for a Trigger. User can select multiple type of subpopulation.
Figure 114: Subpopulation type Age

Details Types

On Day Day Range % Infectious

Subpopulation

Type: Age

Preschool
School-age
Adults
Seniors

Selection: School-age, Adults

Figure 115: Subpopulation type Influenza risk

Details Types

On Day Day Range % Infectious

Subpopulation

Type: Influenza Risk

Tier 1
Tier 2
Tier 3

Selection: Tier 1

% Infectious
User can define the %infectious by providing direct value or sweep value, to perform the experiment with more experimental cells.
Delay

Delay for triggers can be defined in Days or by sweep method for interventions, as interventions cannot be applied on the very first day of event. Delay can be provided as a value. Application has provided the facility to customize the delay.

Day Range

User can define the day range trigger by providing the range of days for which the trigger would be applied. The from day and end day of the trigger are provided as values.
8.6.3 Manage Triggers

8.6.3.1 Edit
Name, Description and type’s fields of a Trigger, not owned by user and not attach with any of the existing interventions can be edited.
8.6.3.2 Duplicate

Trigger can be duplicated from any of the existing Trigger on clicking the button duplicate. Duplicate Trigger gets populated with the details of duplicated Trigger. SIBEL appends the ‘Copy’ in the end of duplicate Trigger; user can edit and save the duplicate Trigger with different Details and Name.
8.6.3.3 Delete
Trigger, owned by user and not attached to any of the existing Interventions, can be deleted.

8.6.3.4 Archive
Triggers owned by the user can be archived from My list only. An archived trigger should be available in archive listing of the trigger.

8.6.3.5 Business Rules
- Edit/Delete/cancel/archive actions cannot be performed on the Triggers owned by other registered users.
- Edit/Delete/cancel actions cannot be performed on the Triggers owned by log in user but attached to some Intervention.
- Archive action can be performed by owner of the trigger from My list only. Archive can be performed for trigger attached to an experiment.
- Slider cannot be moved beyond 100 i.e. 101 and 0 i.e. -1, -2 etc.
8.7  Scripts

8.7.1  Experiment Scripts

Prior to the execution of epifast job of a cell, files created during experiment execution required pre processing which would be executed on these files created. The pre processed files would then be used as an input to epifast job of the cell. The pre processing would be achieved by scripts which would exist on a predefined path on cluster. These scripts would be attached to an experiment while an experiment is defined.

8.7.1.1  View Scripts

Scripts landing Page lists all the existing available experiments and analysis scripts created by the logged in user and that of all other users in the system.

8.7.1.1.1  Description of Landing Page

- List of All scripts in the system in alphabetical order. The first script is selected by default when user clicks the Scripts Menu. User can use MY/ALL filters to navigate between own and other user’s scripts.
- Name of Script
- Name of script file placed at the cluster
- Type of script: Whether the selected script is of experiment or analysis type
- Description of the script, if any.
- ‘Modified On’ indicates the time stamp at which the script was created or modified
- Owner indicates the name of the user who created the script. It is a non-editable field.
- Action Links against each Script:
  - New Script
  - Archive
  - Delete
  - Save
  - Cancel

8.7.1.2  Define Scripts

On clicking New Script, on the landing page a new form is presented to enter the details.

8.7.1.2.1  Details

This page can be used to define general details. The fields available on the Details form are as mentioned below:
Name
A unique name to identify the script. It is a mandatory field.

Script file name
Name of the script file which would exist at a predefined path of cluster. It is a mandatory field.

Script Type
Radio buttons for selecting if the script is a preprocessing script for experiment or a post processing script for analysis.
By default, the Experiment radio button would be selected.

Description
An optional text field to describe or provide additional information for a script.

Owner
Refers to the name of the user who created the script. It is a pre-populated non-editable field.

Modified on
Indicates the time stamp at which the experiment script was created or modified.

8.7.1.3 Manage Scripts

8.7.1.3.1 Edit
Name, Description and Script file name fields of a Script that is not attached with any of the existing experiments can be edited.
8.7.1.3.2 Delete
Script owned by user and not attached to any of the existing experiments can be deleted.

8.7.1.3.3 Archive Scripts
Scripts owned by the user can be archived from My list only. An archived scripts should be available in
archive listing of the scripts.

8.7.2 Analysis Scripts
Similar to pre-processing script executed over a cell input data prior to being sent to EpiFast, user would
be able to select a post processing script to execute on cells of an analysis.

8.7.2.1 View Scripts
Scripts landing Page lists all the existing available experiments and analysis scripts created by the logged
in user and that of all other users in the system

8.7.2.1.1 Description of Landing Page
- List of All scripts in the system in alphabetical order. The first script is selected by default when
  user clicks the Scripts Menu. User can use MY/ALL filters to navigate between own and other
  user’s scripts.
- Name of Script
- Name of script file placed at the cluster
- Type of script: Whether the selected script is of experiment or analysis type
- Description of the script, if any.
- ‘Modified On’ indicates the time stamp at which the script was created or modified
- Owner indicates the name of the user who created the script. It is a non-editable field.
- Action Links against each Script:
  - New Script
  - Archive
  - Delete
  - Save
  - Cancel

8.7.2.2 Define Scripts
On clicking New Script, on the landing page a new form is presented to enter the details for an analysis
script

8.7.2.2.1 Details
This page can be used to define general details. The fields available on the Details form are
as mentioned below:
Name
A unique name to identify the script. It is a mandatory field.

Script file name
Name of the script file which would exist at a predefined path of cluster. It is a mandatory field.

Script Type
Radio buttons for selecting if the script is a preprocessing script for experiment or a post processing script for analysis.
By default, the Experiment radio button would be selected. While creating an analysis script, the user needs to select Analysis radio button.

Description
An optional text field to describe or provide additional information for a script.

Owner
Refers to the name of the user who created the script. It is a pre-populated non-editable field.

Modified on
Indicates the time stamp at which the analysis script was created or modified.

8.7.2.3 Manage Scripts

8.7.2.3.1 Edit
Name, Description and Script file name fields of a Script that is not attached to any of the existing analysis can be edited
8.7.2.3.2 **Delete**
Script owned by user and not attached to any of the existing analysis can be deleted.

8.7.2.3.3 **Archive Scripts**
Scripts owned by the user can be archived from My list only. An archived scripts should be available in archive listing of the scripts.

8.7.3 **Business Rules for Experiment and Analysis Scripts**
- Edit/Delete actions cannot be performed on the scripts owned by other registered users.
- Edit/Delete actions cannot be performed on the scripts owned by log in user but attached to some experiments.
- Archive action can be performed by owner of the scripts from My list only. Archive can be performed for scripts attached to an experiment.

8.8 **Feedback**
Feedback refers to the user experience shared by the user in order to improve the application.

![Feedback Form](image)

Figure 123: Feedback Form

Using this feature user can intimate a defect or request for a feature in order to have a better usability experience. Optionally user can also provide importance level for this feedback. Additionally, user can enter the comments in a free form which will help him explain the issue in a better way. It is mandatory to fill atleast one field in order to submit the feedback form. After user submits the feedback form the feedback with application version details, browser details and OS details is sent to the administrator. This information is used to improve the further versions of SIBEL.

8.9 **Case Study**

**Hepatitis Risk Analysis:**
Here we show how SIBEL can be put to use by epidemiologist to study progression of emerging infectious diseases through US population networks.
Analyzing efficacy of interventions through computer simulations using Epifast algorithm helps execute experiments with high variability and understanding previously uncomputable parameters.
In following study, hepatitis is identified as disease of interest.

**Experiments Design**
Spread of Hepatitis A virus strain over Chicago (size: 5.5) million individuals is set-up for 120 days. Refer screenshot below describing essential parameters set.
Disease model set for Hepatitis A viral strain configures Transmissibility indicating population is at very high risk of infection.

![Screenshot of Hepatitis Study](image)

**Figure 124 : Hepatitis Case Study Experiment**

Regarding Interventions:
We study efficacy of vaccination and social distancing measures to control disease spread.
1. Vaccine 1 applied with Compliance 40% and 70% efficacy on Adults.
2. Social Distancing: Compliance swept from 70-90%.

**Analysis**
To overcome errors due to variability experiments were designed with 10 replicates of each cell.
Following are standard plots representing the interventions highly effective in the population.
9 Appendix:

9.1 Subpopulation list

Subpopulation Sizes in Database

Miami Preschool 141337
Miami School-age 315129
Miami Adults 1363033
Miami Seniors 276128
Miami Miami-Dade 2095627
Miami Critical_Worker 107520
Miami other 1988107
Miami Tier_1 307632
Miami Tier_2 522277
Miami Tier_3 478
Miami other 1265240
Detroit Preschool 341994
Detroit School-age 747894
Detroit Adults 3130923
Detroit Seniors 545764
Detroit Livingston 154625
Detroit Macomb 781278
Detroit Monroe 145776
Detroit Oakland 1186343
Detroit St._Clair 163503
Detroit Washtenaw 302342
Detroit Wayne 2032708
Detroit Critical_Worker 251281
Detroit other 4515294
Detroit Tier_1 669634
Detroit Tier_2 1159588
Detroit Tier_3 2114
Detroit other 2935239
Washington_DC Preschool 269207
Washington_DC School-age 555438
Washington_DC Adults 2601745
Washington_DC Seniors 327785
Washington_DC District_of_Columbia 521270
Washington_DC Montgomery 863449
Washington_DC Prince_George's 769700
Washington_DC Arlington 186311
Washington_DC Fairfax 964458
Washington_DC Loudoun 168990
Washington_DC Prince_William 279997
Washington_DC Critical_Worker 188192
Washington_DC other 3565983
Washington_DC Tier_2 873204
Washington_DC Tier_3 2673
Seattle Pierce 683265
Seattle Snohomish 597580
Seattle Seattle_Critical_Worker 172558
Seattle other 3039169
Seattle Seattle_Tier_1 1187437
Seattle Seattle_Tier_3 1055
Seattle other 2023235
Boston Boston_Preschool 279117
Boston Boston_School-age 592632
Boston Boston_Adults 2773807
Boston Boston_Seniors 503723
Boston Essex 685003
Boston Middlesex 1397891
Boston Norfolk 622399
Boston Plymouth 441932
Boston Suffolk 630645
Boston Rockingham 270625
Boston Strafford 100784
Boston Boston_Critical_Worker 241397
Boston other 3907882
Boston Boston_Tier_1 614554
Boston Boston_Tier_2 1013890
Boston Boston_Tier_3 1847
Boston other 2518988
Dallas Dallas_Preschool 420515
Dallas Dallas_School-age 827545
Dallas Dallas_Adults 3467235
Dallas Dallas_Seniors 383303
Dallas Colliin 491098
Dallas Dallas 2193845
Dallas Delta 5366
Dallas Denton 425787
Dallas Ellis 109979
Dallas Hunt 75151
Dallas Johnson 125196
Dallas Kaufman 70041
Dallas Parker 85401
Dallas Rockwall 43072
Dallas Tarrant 1425698
Dallas Wise 47964
Dallas Dallas_Critical_Worker 254375
Dallas other 4844223
Dallas Dallas_Tier_1 611852
Dallas Dallas_Tier_2 1208765
Dallas Dallas_Tier_3 1833
Dallas other 3276148
Chicago Chicago_Preschool 692952
Chicago Chicago_School-age 1448871
Chicago Chicago_Adults 5950360
Chicago Chicago_Seniors 955391
Chicago Cook 5290224
Chicago DeKalb 81533
Chicago DuPage 892920
Chicago Grundy 37217
Chicago Kane 396828
Chicago Kendall 54296
Chicago Lake 626235
Chicago McHenry 259834
Chicago Will 492164
Chicago Jasper 29106
Chicago Lake 478538
Chicago LaPorte 103724
Chicago Newton 14592
Chicago Porter 144142
Chicago Kenosha 146221
Chicago Chicago_Critical_Worker 482999
Chicago other 8564575
Chicago Chicago_Tier_1 1228205
Chicago Chicago_Tier_2 2220781
Chicago Chicago_Tier_3 3620
Chicago other 5594968
Los_Angeles Los_Angeles_Preschool 1326397
Los_Angeles Los_Angeles_School-age 2797267
Los_Angeles Los_Angeles_Adults 10561425
Los_Angeles Los_Angeles_Seniors 1559337
Los_Angeles Imperial 130352
Los_Angeles Los_Angeles 9371121
Los_Angeles Orange 2812190
Los_Angeles Riverside 1515757
Los_Angeles San_Bernardino 1673073
Los_Angeles Ventura 741933
Los_Angeles Los_Angeles_Critical_Worker 719015
Los_Angeles other 15525411
Los_Angeles Los_Angeles_Tier_1 2130511
Los_Angeles Los_Angeles_Tier_2 3878557
Los_Angeles Los_Angeles_Tier_3 4860
Los_Angeles other 10230498