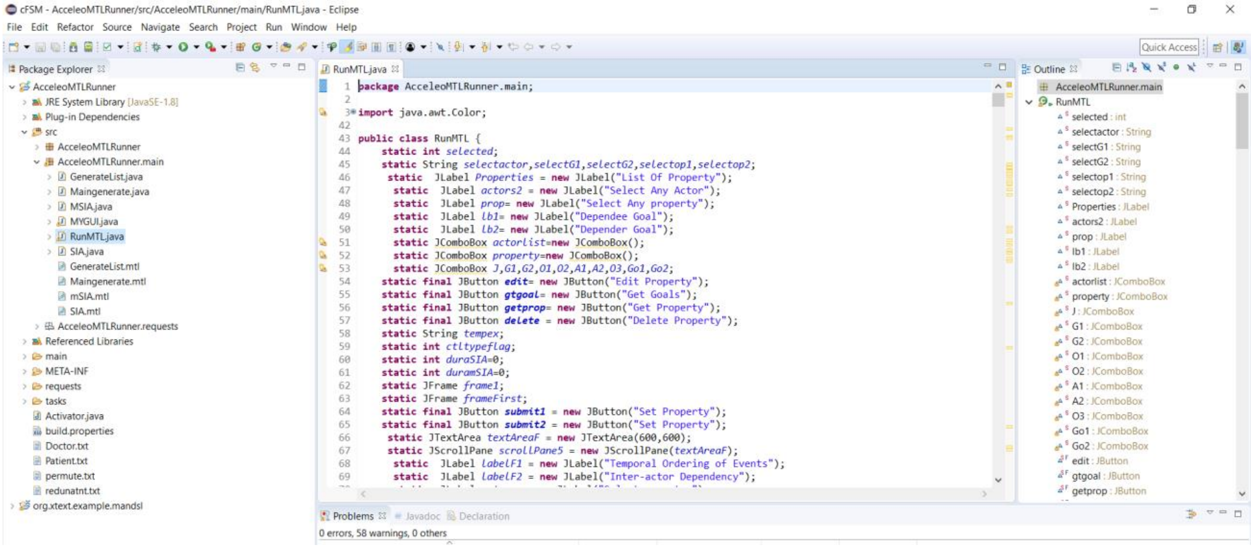
User Manual for SLC Tool

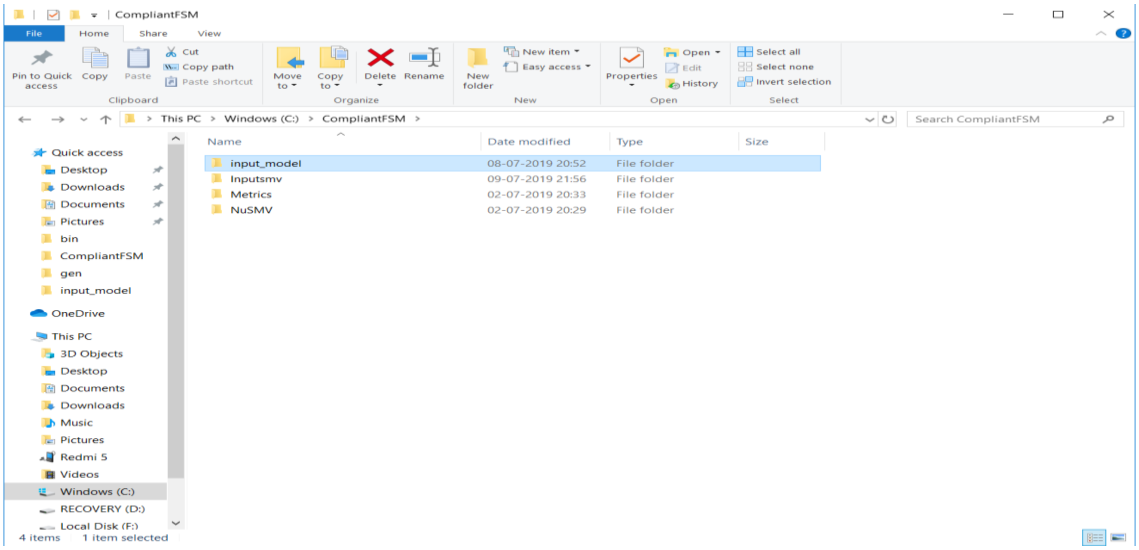
- User needs to download all the files from the URL.
  All Eclipse projects at first needs to be imported in some existing or new workspace (refer Figure 1). The CompliantFSM folder needs to be downloaded as well which provides supporting files for the framework (refer Figure 2) and save it in c:/ drive.



```
package AcceleoMTLRunner.main;

import java.awt.Color;

public class RunMTL {
    static int selected;
    static String selectactor,selectG1,selectG2,selectop1,selectop2;
     static  JLabel Properties = new JLabel("List Of Property");
      static  JLabel actors2 = new JLabel("Select Any Actor");
      static  JLabel prop= new JLabel("Select Any property");
      static  JLabel lb1= new JLabel("Dependee Goal");
      static  JLabel lb2= new JLabel("Depender Goal");
      static JComboBox actorlist=new JComboBox();
      static JComboBox property=new JComboBox();
      static JComboBox J,G1,G2,O1,O2,A1,A2,O3,Go1,Go2;
    static final JButton edit= new JButton("Edit Property");
    static final JButton gtgoal= new JButton("Get Goals");
    static final JButton getprop= new JButton("Get Property");
    static final JButton delete = new JButton("Delete Property");
    static String tempex;
    static int ctltypeflag;
    static int duraSIA=0;
    static int duramSIA=0;
    static JFrame frame1;
    static JFrame frameFirst;
    static final JButton submit1 = new JButton("Set Property");
    static final JButton submit2 = new JButton("Set Property");
     static JTextArea textAreaF = new JTextArea(600,600);
     static JScrollPane scrollPane5 = new JScrollPane(textAreaF);
      static  JLabel labelF1 = new JLabel("Temporal Ordering of Events");
      static  JLabel labelF2 = new JLabel("Inter-actor Dependency");
```

```
0 errors, 58 warnings, 0 others
```

Figure -1



Name	Date modified	Type	Size
input_model	08-07-2019 20:52	File folder	
Inputsmv	09-07-2019 21:56	File folder	
Metrics	02-07-2019 20:33	File folder	
NuSMV	02-07-2019 20:29	File folder	

Figure -2

- Steps of using the tool:-
  - **Step 1:**
    Execute RunMTL.Java file from AcceleoMTLRunner project. SLC Tool- Input initialization frame appears (refer Figure 3).

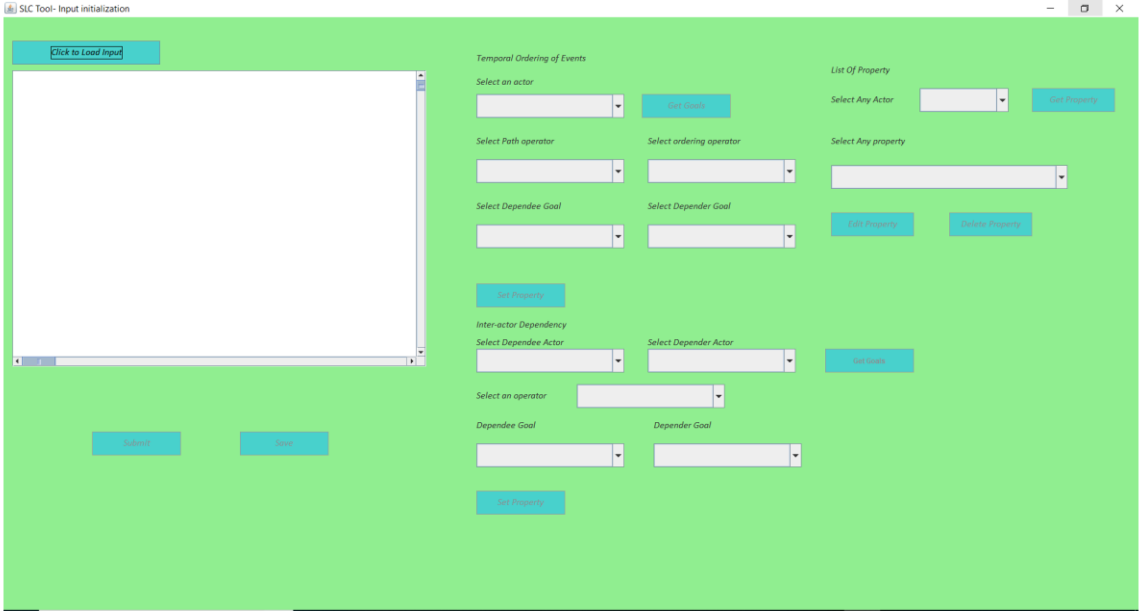
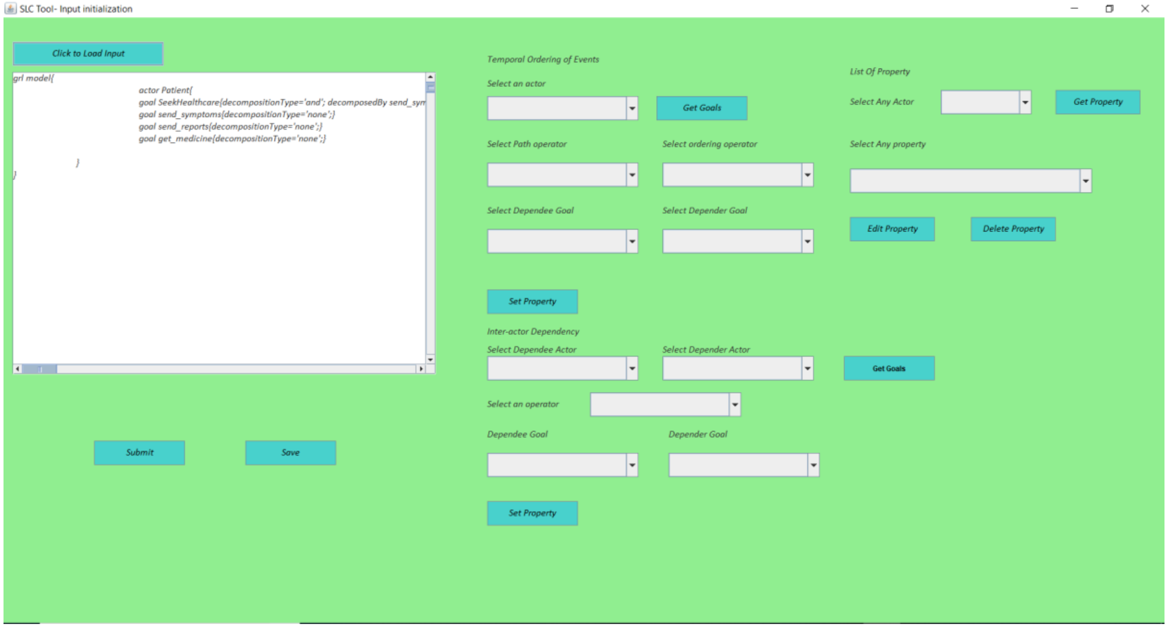


Figure 3

- **Step 2:**
  Select an input file by clicking on "*Click to Load Input*" button (refer Figure 4). After loading input goal model all other buttons get activated (refer Figure 4).



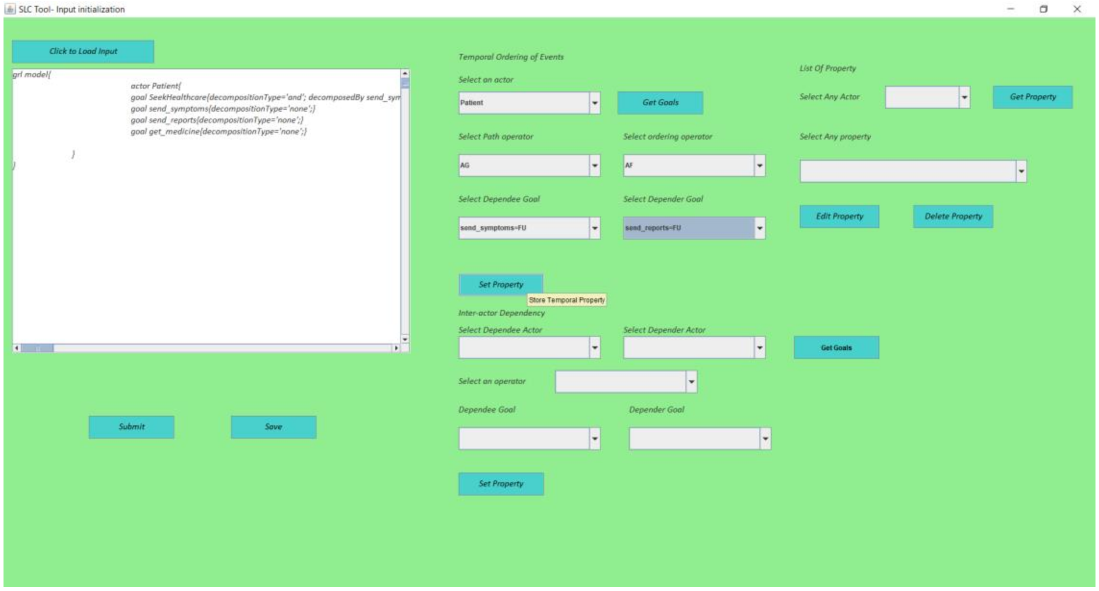
```
grl model{
                    actor Patient{
                    goal SeekHealthcare{decompositionType='and'; decomposedBy send_sym
                    goal send_symptoms{decompositionType='none';}
                    goal send_reports{decompositionType='none';}
                    goal get_medicine{decompositionType='none';}

          }
}
```

Figure 4

- **Step 3:**
  Select an actor from "*Select an actor*" drop down menu and click on *"Get Goals"* button. The goals of the selected actor appear in the drop down menus – "*Select Dependee goal*" and "*Select Depender goal*".

- **Step 4:**

  Select a path operator (“*Select path operator”)*, a temporal ordering (“*Select ordering operator”)* operator and dependee (“*Select Dependee goal”)* and depender goal *(“Select Depender goal”)*. Click on “*Set Property”* button. The property gets saved in a temporary file (refer Figure 5).



```
grl model{
                              actor Patient{
                              goal SeekHealthcare{decompositionType='and'; decomposedBy send_sym
                              goal send_symptoms{decompositionType='none';}
                              goal send_reports{decompositionType='none';}
                              goal get_medicine{decompositionType='none';}

                  }
}
```

Select an actor: Patient

Select Path operator: AG

Select ordering operator: AF

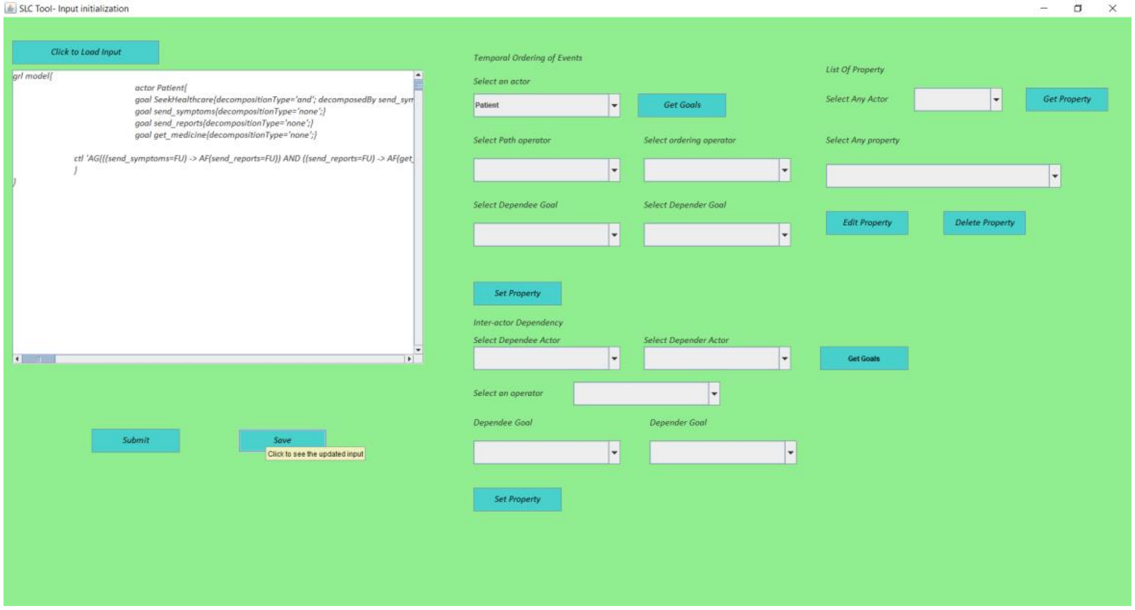
Select Dependee Goal: send_symptoms=FU

Select Depender Goal: send_reports=FU

Figure 5

- **Step 5:**

  Click on “*Save*” button to see the updated input (refer Figure 6).



```
grl model{
                              actor Patient{
                              goal SeekHealthcare{decompositionType='and'; decomposedBy send_sym
                              goal send_symptoms{decompositionType='none';}
                              goal send_reports{decompositionType='none';}
                              goal get_medicine{decompositionType='none';}

                  ctl 'AG(((send_symptoms=FU) -> AF(send_reports=FU)) AND ((send_reports=FU) -> AF(get
                  }
}
```

Select an actor: Patient

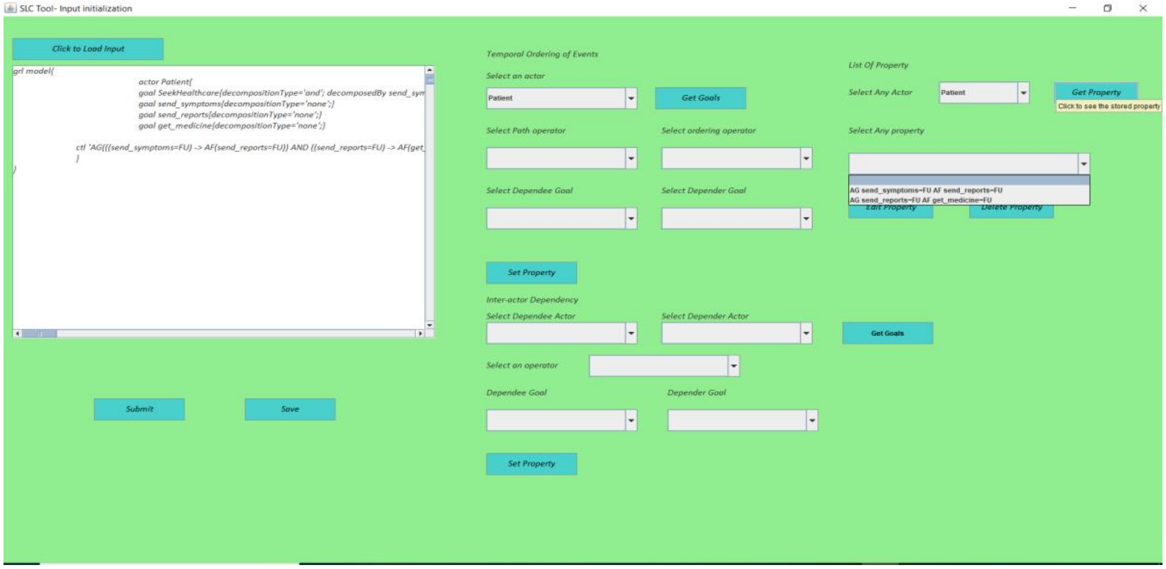
Figure 6

- **Step 6:**

  <u>Modifying property</u>

In “*List of Property*” panel select any actor using “*Select Any Actor”* drop down menu and click on “*Get Property”* button. The saved CTL property appears in the drop-down menu (“*Select Any property”)*. Select any property and click on “*edit*” or “*delete*” button (refer Figure 7).

On clicking “*edit*” button the selected property gets mapped into initial property specifying boxes on immediate left panel. Modify the property and again click on “*Set Property”* button (refer Figure 8).



```
grl model{
                    actor Patient{
                    goal SeekHealthcare{decompositionType='and'; decomposedBy send_sym
                    goal send_symptoms{decompositionType='none';}
                    goal send_reports{decompositionType='none';}
                    goal get_medicine{decompositionType='none';}

          ctl 'AG(((send_symptoms=FU) -> AF(send_reports=FU)) AND ((send_reports=FU) -> AF(get_
          }
}
```

Select an actor: Patient

Select Path operator:

Select ordering operator:

Select Dependee Goal:

Select Depender Goal:

Select Dependee Actor:

Select Depender Actor:

Select an operator:

Dependee Goal:

Depender Goal:

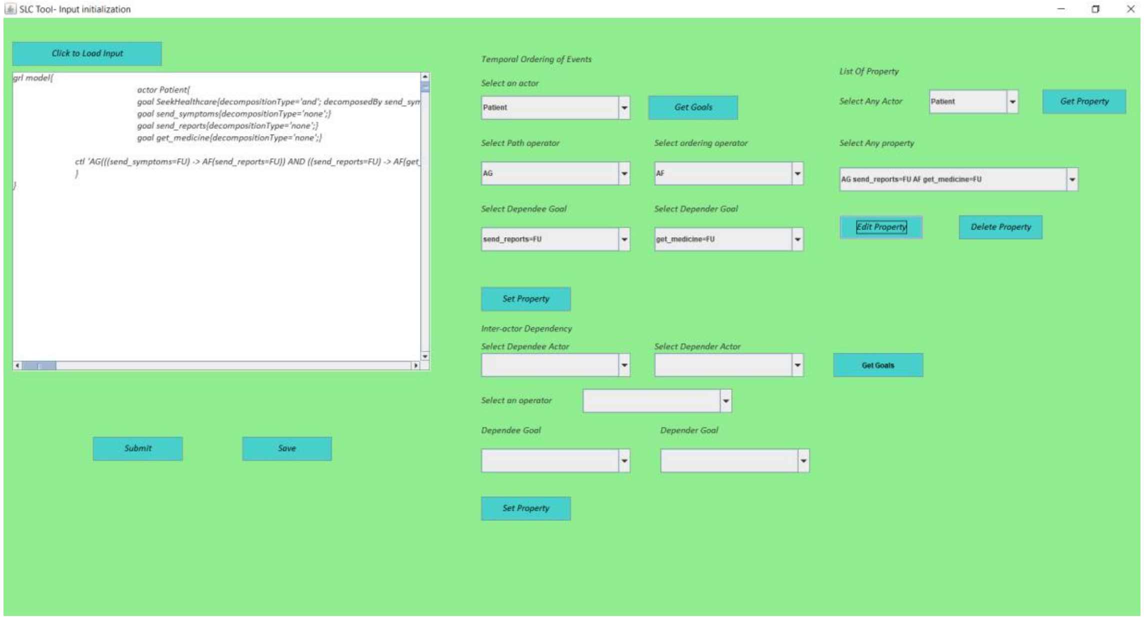
Select Any Actor: Patient

Select Any property:

AG send_symptoms=FU AF send_reports=FU

AG send_reports=FU AF get_medicine=FU

Figure 7



```
grl model{
                    actor Patient{
                    goal SeekHealthcare{decompositionType='and'; decomposedBy send_sym
                    goal send_symptoms{decompositionType='none';}
                    goal send_reports{decompositionType='none';}
                    goal get_medicine{decompositionType='none';}

          ctl 'AG(((send_symptoms=FU) -> AF(send_reports=FU)) AND ((send_reports=FU) -> AF(get_
          }
}
```

Select an actor: Patient

Select Path operator: AG

Select ordering operator: AF

Select Dependee Goal: send_reports=FU

Select Depender Goal: get_medicine=FU

Select Dependee Actor:

Select Depender Actor:

Select an operator:

Dependee Goal:

Depender Goal:

Select Any Actor: Patient

Select Any property: AG send_reports=FU AF get_medicine=FU

Figure 8

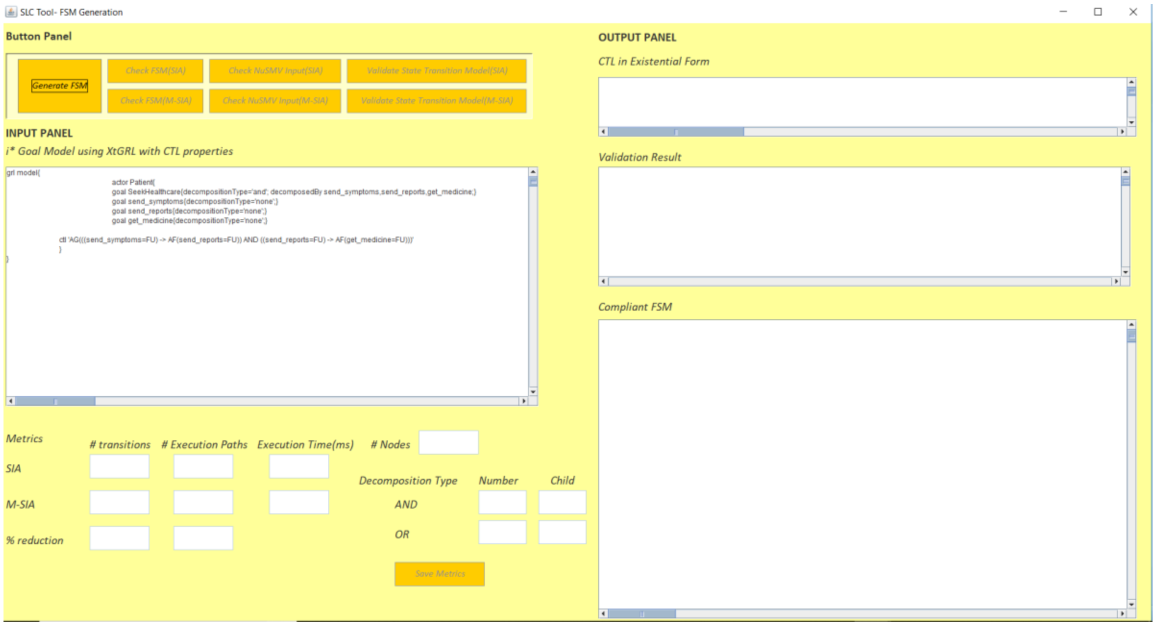
- **Step 7:**

  Setting Inter-Actor property:

  Select dependee ("*Select Dependee Actor*") and depender ("*Select Depender Actor*") actor, a temporal operator ("*Select an operator*"), and the goals ("*Dependee goal*" and "*Depender Goal*"). Then Click on "*Set Property*" button below.

- **Step 8:**

  Click on "*submit*" button to generate compliant finite state model. The SLC Tool- FSM Generation frame appears. The "*INPUT PANEL*" consists of the input selected and modified in the previous frame (refer Figure 9).

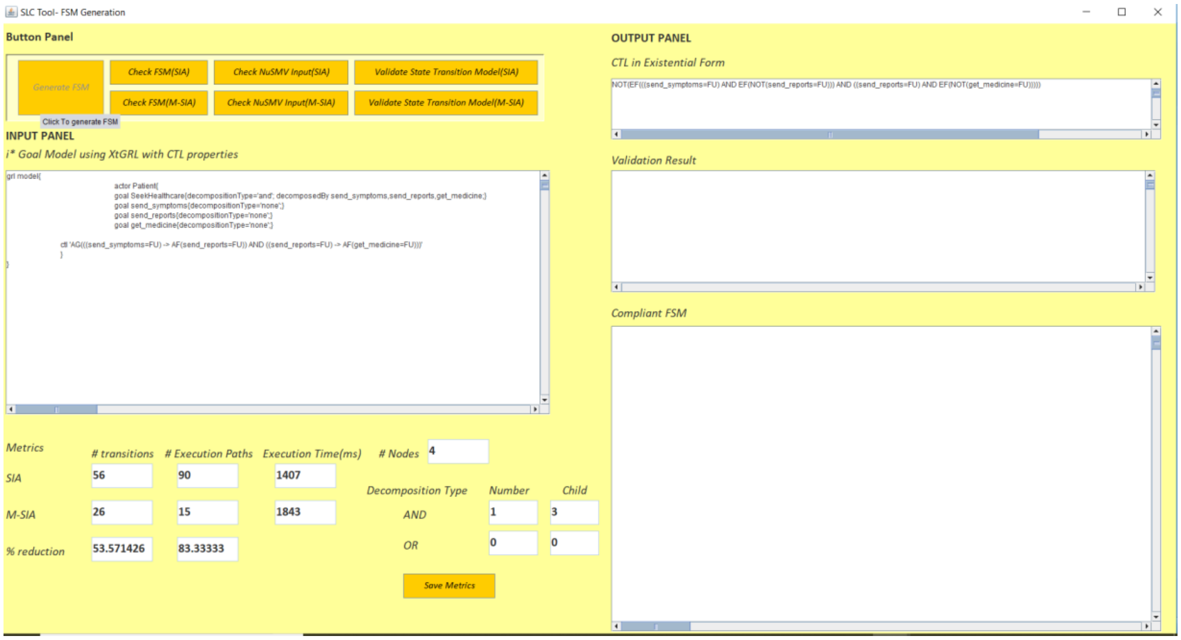


```
grl model(
                    actor Patient(
                    goal SeekHealthcare(decompositionType='and'; decomposedBy send_symptoms,send_reports,get_medicine;)
                    goal send_symptoms(decompositionType='none';)
                    goal send_reports(decompositionType='none';)
                    goal get_medicine(decompositionType='none';)

          ctl 'AG(((send_symptoms=FU) -> AF(send_reports=FU)) AND ((send_reports=FU) -> AF(get_medicine=FU)))'
          )
)
```

Figure 9

- **Step 9:**

  Click on "*Generate FSM*" button to initiate FSM generation. After FSM generation is complete all other buttons in the button panel gets activated. The different metrics that provide a comparison between two algorithms appear in the left-bottom panel (refer Figure 10) Click on "*Save Metrics*" button to save the metrics in "*Metrics.txt*" file.



SLC Tool- FSM Generation

Button Panel

INPUT PANEL

i Goal Model using XtGRL with CTL properties*

```
grl model{
                    actor Patient{
                    goal SeekHealthcare{decompositionType='and'; decomposedBy send_symptoms,send_reports,get_medicine;}
                    goal send_symptoms{decompositionType='none';}
                    goal send_reports{decompositionType='none';}
                    goal get_medicine{decompositionType='none';}

          ctl 'AG(((send_symptoms=FU) -> AF(send_reports=FU)) AND ((send_reports=FU) -> AF(get_medicine=FU)))'
          }
}
```

Metrics	# transitions	# Execution Paths	Execution Time(ms)
SIA	56	90	1407
M-SIA	26	15	1843
% reduction	53.571426	83.33333	

# Nodes 4

Decomposition Type	Number	Child
AND	1	3
OR	0	0

OUTPUT PANEL

CTL in Existential Form

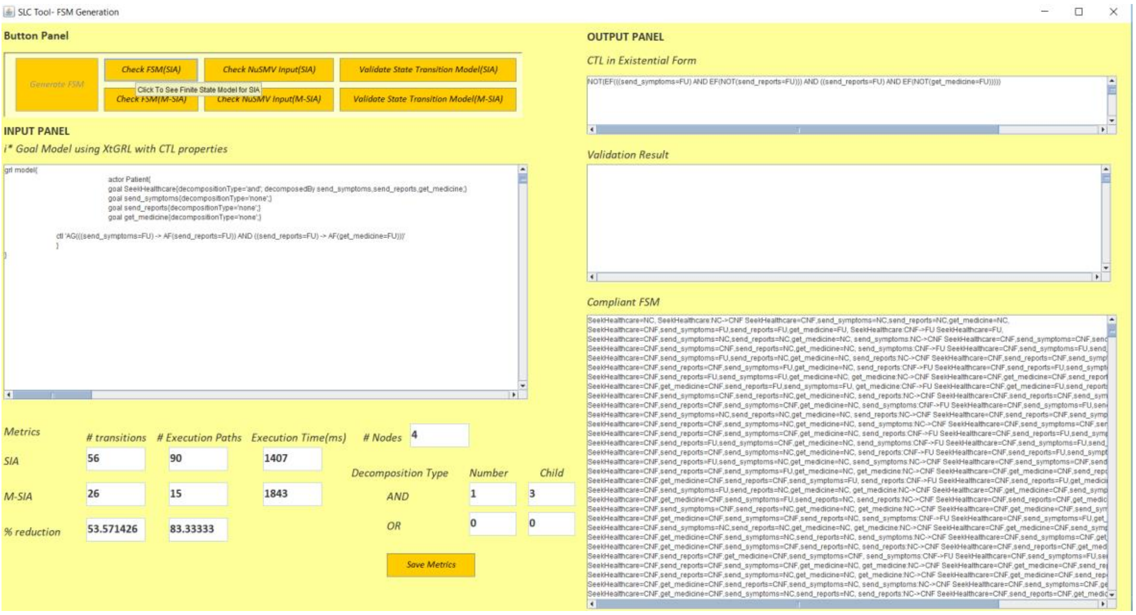
```
NOT(EF(((send_symptoms=FU) AND EF(NOT(send_reports=FU))) AND ((send_reports=FU) AND EF(NOT(get_medicine=FU)))))
```

Validation Result

Compliant FSM

Figure 10

- **Step 10:**
  Click on "*Check FSM(SIA)*" or "*Check NuSMV Input(SIA)*" button to check the finite state machine and NuSMV input generated using SIA (refer Figure 11).
- **Step 11:**
  Click on "*Check FSM(M-SIA)*" or "*Check NuSMV Input(M-SIA)*" button to check the finite state machine and NuSMV input generated using M- SIA.



SLC Tool- FSM Generation

Button Panel

Generate FSM
Check FSM(SIA)
Check NuSMV Input(SIA)
Validate State Transition Model(SIA)
Check FSM(M-SIA)
Check NuSMV Input(M-SIA)
Validate State Transition Model(M-SIA)
Click To See Finite State Model for SIA

INPUT PANEL

i Goal Model using XtGRL with CTL properties*

```
grl model{
                    actor Patient{
                    goal SeekHealthcare{decompositionType='and'; decomposedBy send_symptoms,send_reports,get_medicine;}
                    goal send_symptoms{decompositionType='none';}
                    goal send_reports{decompositionType='none';}
                    goal get_medicine{decompositionType='none';}

          ctl 'AG(((send_symptoms=FU) -> AF(send_reports=FU)) AND ((send_reports=FU) -> AF(get_medicine=FU)))'
          }
}
```

Metrics	# transitions	# Execution Paths	Execution Time(ms)
SIA	56	90	1407
M-SIA	26	15	1843
% reduction	53.571426	83.33333	

# Nodes 4

Decomposition Type	Number	Child
AND	1	3
OR	0	0

OUTPUT PANEL

CTL in Existential Form

```
NOT(EF(((send_symptoms=FU) AND EF(NOT(send_reports=FU))) AND ((send_reports=FU) AND EF(NOT(get_medicine=FU)))))
```

Validation Result

Compliant FSM

```
SeekHealthcare=NC, SeekHealthcare:NC->CNF SeekHealthcare=CNF,send_symptoms=NC,send_reports=NC,get_medicine=NC,
SeekHealthcare=CNF,send_symptoms=FU,send_reports=FU,get_medicine=FU, SeekHealthcare:CNF->FU SeekHealthcare=FU,
SeekHealthcare=CNF,send_symptoms=NC,send_reports=NC,get_medicine=NC, send_symptoms:NC->CNF SeekHealthcare=CNF,send_symptoms=CNF,send
SeekHealthcare=CNF,send_symptoms=CNF,send_reports=NC,get_medicine=NC, send_symptoms:CNF->FU SeekHealthcare=CNF,send_symptoms=FU,send_
SeekHealthcare=CNF,send_symptoms=FU,send_reports=NC,get_medicine=NC, send_reports:NC->CNF SeekHealthcare=CNF,send_reports=CNF,send_symp
SeekHealthcare=CNF,send_reports=CNF,send_symptoms=FU,get_medicine=NC, send_reports:CNF->FU SeekHealthcare=CNF,send_reports=FU,send_sympt
SeekHealthcare=CNF,send_reports=FU,send_symptoms=FU,get_medicine=NC, get_medicine:NC->CNF SeekHealthcare=CNF,get_medicine=CNF,send_report
SeekHealthcare=CNF,get_medicine=CNF,send_reports=FU,send_symptoms=FU, get_medicine:CNF->FU SeekHealthcare=CNF,get_medicine=FU,send_reports
SeekHealthcare=CNF,send_symptoms=CNF,send_reports=NC,get_medicine=NC, send_reports:NC->CNF SeekHealthcare=CNF,send_reports=CNF,send_sym
SeekHealthcare=CNF,send_reports=CNF,send_symptoms=CNF,get_medicine=NC, send_symptoms:CNF->FU SeekHealthcare=CNF,send_symptoms=FU,sen
SeekHealthcare=CNF,send_symptoms=NC,send_reports=NC,get_medicine=NC, send_reports:NC->CNF SeekHealthcare=CNF,send_reports=CNF,send_symp
SeekHealthcare=CNF,send_reports=CNF,send_symptoms=NC,get_medicine=NC, send_symptoms:NC->CNF SeekHealthcare=CNF,send_symptoms=CNF,ser
SeekHealthcare=CNF,send_reports=CNF,send_symptoms=CNF,get_medicine=NC, send_reports:CNF->FU SeekHealthcare=CNF,send_reports=FU,send_symp
SeekHealthcare=CNF,send_reports=FU,send_symptoms=CNF,get_medicine=NC, send_symptoms:CNF->FU SeekHealthcare=CNF,send_symptoms=FU,send_
SeekHealthcare=CNF,send_reports=CNF,send_symptoms=NC,get_medicine=NC, send_reports:CNF->FU SeekHealthcare=CNF,send_reports=FU,send_sympt
SeekHealthcare=CNF,send_reports=FU,send_symptoms=NC,get_medicine=NC, send_symptoms:NC->CNF SeekHealthcare=CNF,send_symptoms=CNF,send
SeekHealthcare=CNF,send_reports=CNF,send_symptoms=FU,get_medicine=NC, get_medicine:NC->CNF SeekHealthcare=CNF,get_medicine=CNF,send_repo
SeekHealthcare=CNF,get_medicine=CNF,send_reports=CNF,send_symptoms=FU, send_reports:CNF->FU SeekHealthcare=CNF,send_reports=FU,get_medici
SeekHealthcare=CNF,send_symptoms=FU,send_reports=NC,get_medicine=NC, get_medicine:NC->CNF SeekHealthcare=CNF,get_medicine=CNF,send_symp
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SeekHealthcare=CNF,send_symptoms=CNF,send_reports=NC,get_medicine=NC, get_medicine:NC->CNF SeekHealthcare=CNF,get_medicine=CNF,send_sym
SeekHealthcare=CNF,get_medicine=CNF,send_symptoms=CNF,send_reports=NC, send_symptoms:CNF->FU SeekHealthcare=CNF,send_symptoms=FU,get_
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SeekHealthcare=CNF,get_medicine=CNF,send_symptoms=CNF,send_reports=NC, send_reports:NC->CNF SeekHealthcare=CNF,send_reports=CNF,get_med
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SeekHealthcare=CNF,get_medicine=CNF,send_reports=CNF,send_symptoms=NC, send_symptoms:NC->CNF SeekHealthcare=CNF,send_symptoms=CNF,ge
SeekHealthcare=CNF,get_medicine=CNF,send_symptoms=NC,send_reports=NC, send_reports:NC->CNF SeekHealthcare=CNF,send_reports=CNF,get_medic
```

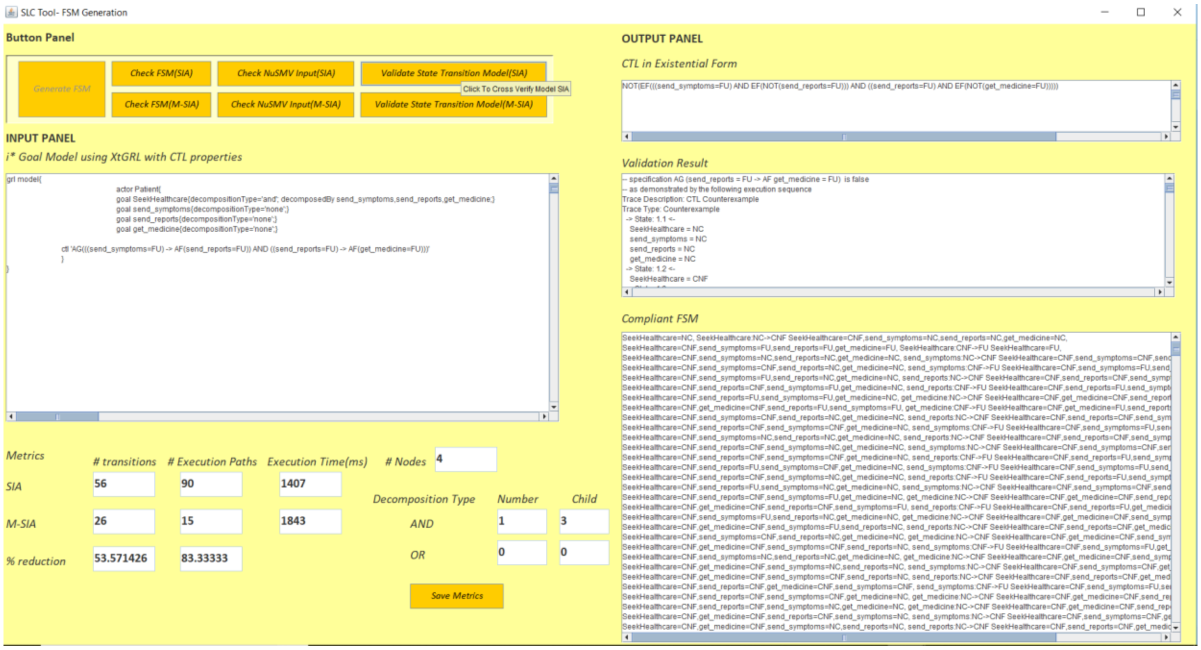
Figure 11

- **Step 12:**

Click on “*Validate State Transition Model(SIA)”* to peform model checking for FSM generated using SIA with the given CTL properties (refer Figure 12).

- **Step 13:**

  Click on “*Validate State Transition Model(M-SIA)”* to peform model checking for FSM generated using SIA with the given CTL properties.



INPUT PANEL

i Goal Model using XtGRL with CTL properties*

```
grl model{
                              actor Patient{
                              goal SeekHealthcare{decompositionType='and'; decomposedBy send_symptoms,send_reports,get_medicine;}
                              goal send_symptoms{decompositionType='none';}
                              goal send_reports{decompositionType='none';}
                              goal get_medicine{decompositionType='none';}

                 ctl 'AG(((send_symptoms=FU) -> AF(send_reports=FU)) AND ((send_reports=FU) -> AF(get_medicine=FU)))'
                 }
}
```

Metrics	# transitions	# Execution Paths	Execution Time(ms)
SIA	56	90	1407
M-SIA	26	15	1843
% reduction	53.571426	83.33333	

Nodes: 4

Decomposition Type	Number	Child
AND	1	3
OR	0	0

OUTPUT PANEL

CTL in Existential Form

```
NOT(EF(((send_symptoms=FU) AND EF(NOT(send_reports=FU))) AND ((send_reports=FU) AND EF(NOT(get_medicine=FU)))))
```

Validation Result

```
-- specification AG (send_reports = FU -> AF get_medicine = FU)  is false
-- as demonstrated by the following execution sequence
Trace Description: CTL Counterexample
Trace Type: Counterexample
  -> State: 1.1 <-
    SeekHealthcare = NC
    send_symptoms = NC
    send_reports = NC
    get_medicine = NC
  -> State: 1.2 <-
    SeekHealthcare = CNF
```

Compliant FSM

```
SeekHealthcare=NC, SeekHealthcare:NC->CNF SeekHealthcare=CNF,send_symptoms=NC,send_reports=NC,get_medicine=NC,
SeekHealthcare=CNF,send_symptoms=FU,send_reports=FU,get_medicine=FU, SeekHealthcare:CNF->FU SeekHealthcare=FU,
SeekHealthcare=CNF,send_symptoms=NC,send_reports=NC,get_medicine=NC, send_symptoms:NC->CNF SeekHealthcare=CNF,send_symptoms=CNF,send
SeekHealthcare=CNF,send_symptoms=CNF,send_reports=NC,get_medicine=NC, send_symptoms:CNF->FU SeekHealthcare=CNF,send_symptoms=FU,send_
SeekHealthcare=CNF,send_symptoms=FU,send_reports=NC,get_medicine=NC, send_reports:NC->CNF SeekHealthcare=CNF,send_reports=CNF,send_symp
SeekHealthcare=CNF,send_reports=CNF,send_symptoms=FU,get_medicine=NC, send_reports:CNF->FU SeekHealthcare=CNF,send_reports=FU,send_sympt
SeekHealthcare=CNF,send_reports=FU,send_symptoms=FU,get_medicine=NC, get_medicine:NC->CNF SeekHealthcare=CNF,get_medicine=CNF,send_repor
SeekHealthcare=CNF,get_medicine=CNF,send_reports=FU,send_symptoms=FU, get_medicine:CNF->FU SeekHealthcare=CNF,get_medicine=FU,send_reports
SeekHealthcare=CNF,send_symptoms=CNF,send_reports=NC,get_medicine=NC, send_reports:NC->CNF SeekHealthcare=CNF,send_reports=CNF,send_sym
SeekHealthcare=CNF,send_reports=CNF,send_symptoms=CNF,get_medicine=NC, send_symptoms:CNF->FU SeekHealthcare=CNF,send_symptoms=FU,sen
SeekHealthcare=CNF,send_symptoms=NC,send_reports=NC,get_medicine=NC, send_reports:NC->CNF SeekHealthcare=CNF,send_reports=CNF,send_symp
SeekHealthcare=CNF,send_reports=CNF,send_symptoms=NC,get_medicine=NC, send_symptoms:NC->CNF SeekHealthcare=CNF,send_symptoms=CNF,ser
SeekHealthcare=CNF,send_reports=CNF,send_symptoms=CNF,get_medicine=NC, send_reports:CNF->FU SeekHealthcare=CNF,send_reports=FU,send_symp
SeekHealthcare=CNF,send_reports=FU,send_symptoms=CNF,get_medicine=NC, send_symptoms:CNF->FU SeekHealthcare=CNF,send_symptoms=FU,send_
SeekHealthcare=CNF,send_reports=CNF,send_symptoms=NC,get_medicine=NC, send_reports:CNF->FU SeekHealthcare=CNF,send_reports=FU,send_sympt
SeekHealthcare=CNF,send_reports=FU,send_symptoms=NC,get_medicine=NC, send_symptoms:NC->CNF SeekHealthcare=CNF,send_symptoms=CNF,send
SeekHealthcare=CNF,send_reports=CNF,send_symptoms=FU,get_medicine=NC, get_medicine:NC->CNF SeekHealthcare=CNF,get_medicine=CNF,send_repo
SeekHealthcare=CNF,get_medicine=CNF,send_reports=CNF,send_symptoms=FU, send_reports:CNF->FU SeekHealthcare=CNF,send_reports=FU,get_medici
SeekHealthcare=CNF,send_symptoms=FU,send_reports=NC,get_medicine=NC, get_medicine:NC->CNF SeekHealthcare=CNF,get_medicine=CNF,send_symp
SeekHealthcare=CNF,get_medicine=CNF,send_symptoms=FU,send_reports=NC, send_reports:NC->CNF SeekHealthcare=CNF,send_reports=CNF,get_medic
SeekHealthcare=CNF,send_symptoms=CNF,send_reports=NC,get_medicine=NC, get_medicine:NC->CNF SeekHealthcare=CNF,get_medicine=CNF,send_sym
SeekHealthcare=CNF,get_medicine=CNF,send_symptoms=CNF,send_reports=NC, send_symptoms:CNF->FU SeekHealthcare=CNF,send_symptoms=FU,get_
SeekHealthcare=CNF,send_symptoms=NC,send_reports=NC,get_medicine=NC, get_medicine:NC->CNF SeekHealthcare=CNF,get_medicine=CNF,send_symp
SeekHealthcare=CNF,get_medicine=CNF,send_symptoms=NC,send_reports=NC, send_symptoms:NC->CNF SeekHealthcare=CNF,send_symptoms=CNF,get
SeekHealthcare=CNF,get_medicine=CNF,send_symptoms=CNF,send_reports=NC, send_reports:NC->CNF SeekHealthcare=CNF,send_reports=CNF,get_med
SeekHealthcare=CNF,send_reports=CNF,get_medicine=CNF,send_symptoms=CNF, send_symptoms:CNF->FU SeekHealthcare=CNF,send_symptoms=FU,se
SeekHealthcare=CNF,send_reports=CNF,send_symptoms=CNF,get_medicine=NC, get_medicine:NC->CNF SeekHealthcare=CNF,get_medicine=CNF,send_re
SeekHealthcare=CNF,send_reports=CNF,send_symptoms=NC,get_medicine=NC, get_medicine:NC->CNF SeekHealthcare=CNF,get_medicine=CNF,send_rep
SeekHealthcare=CNF,get_medicine=CNF,send_reports=CNF,send_symptoms=NC, send_symptoms:NC->CNF SeekHealthcare=CNF,send_symptoms=CNF,ge
SeekHealthcare=CNF,get_medicine=CNF,send_symptoms=NC,send_reports=NC, send_reports:NC->CNF SeekHealthcare=CNF,send_reports=CNF,get_medic
```

Figure 12