Tabletop Exercises for Bioterrorism by Smallpox and Pandemic by new flu via Agent Based Social Simulation by SOARS

- Toward Program & Project Management for Pandemic Protection -

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Agenda

- Mission and methodology
- Structure of Model Module
- Filter Model for Contamination, Infection and its protection
- Design for Tabletop Exercise for Bioterrorism by Smallpox
- Result of Tabletop Exercise at Keio University Global Security Lab. with professionals of bioterrorism
- Pandemic Protection Management against New Flu
- Program & Project Management for Pandemic Protection by Social Filter Controlling Policy

Mission & Methodology

- **Bioterrorism by Smallpox is very serious.**
- **Human to Human Outbreak of new flu will happen within several years as a terrorism from the natural world.**
- **How we can protect this crisis !!**
- **We introduce social simulation based epidemiology and tabletop exercise against these crisis.**

- New type of Bird Flue is now spreading.
- Human to Human Outbreak will happen within several years.
- How can we protect this pandemic?
- Epidemiological approach should include socio-economic factors in its action program.
- Vaccination & anti-virus drug are not the unique answer for the program.

- On the other hand, Vaccination policy is effective and essential for bioterrorism by smallpox.
- We have developed simulation based epidemiology with infection process model depending on social structure and filter type protection policy model with vaccination policy.
- We have also introduced simulation based tabletop exercise and analyzed program and project management for pandemic protection.

Structure of Model Module

Model Structure

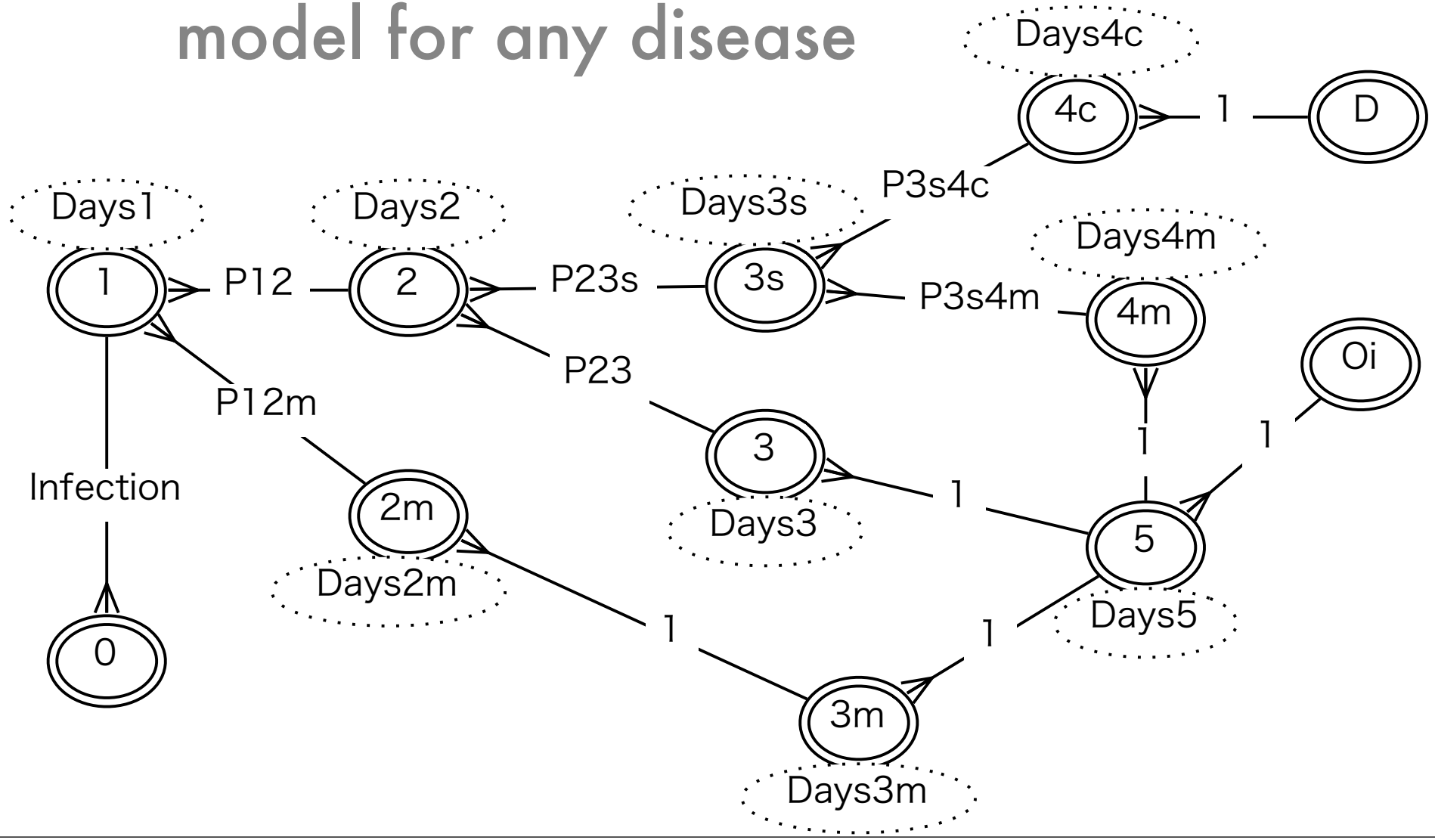
- We divide our infection process model to three basic models.
  - The one is a stage transition model of disease under the physical condition and medical treatment.
  - The second is a city structure model and human activity model on the virtual city that contains several types of social activities of agents.
  - The third is a contamination and infection model that contain six filter types of protection policy against contamination and infection.

Model Structure

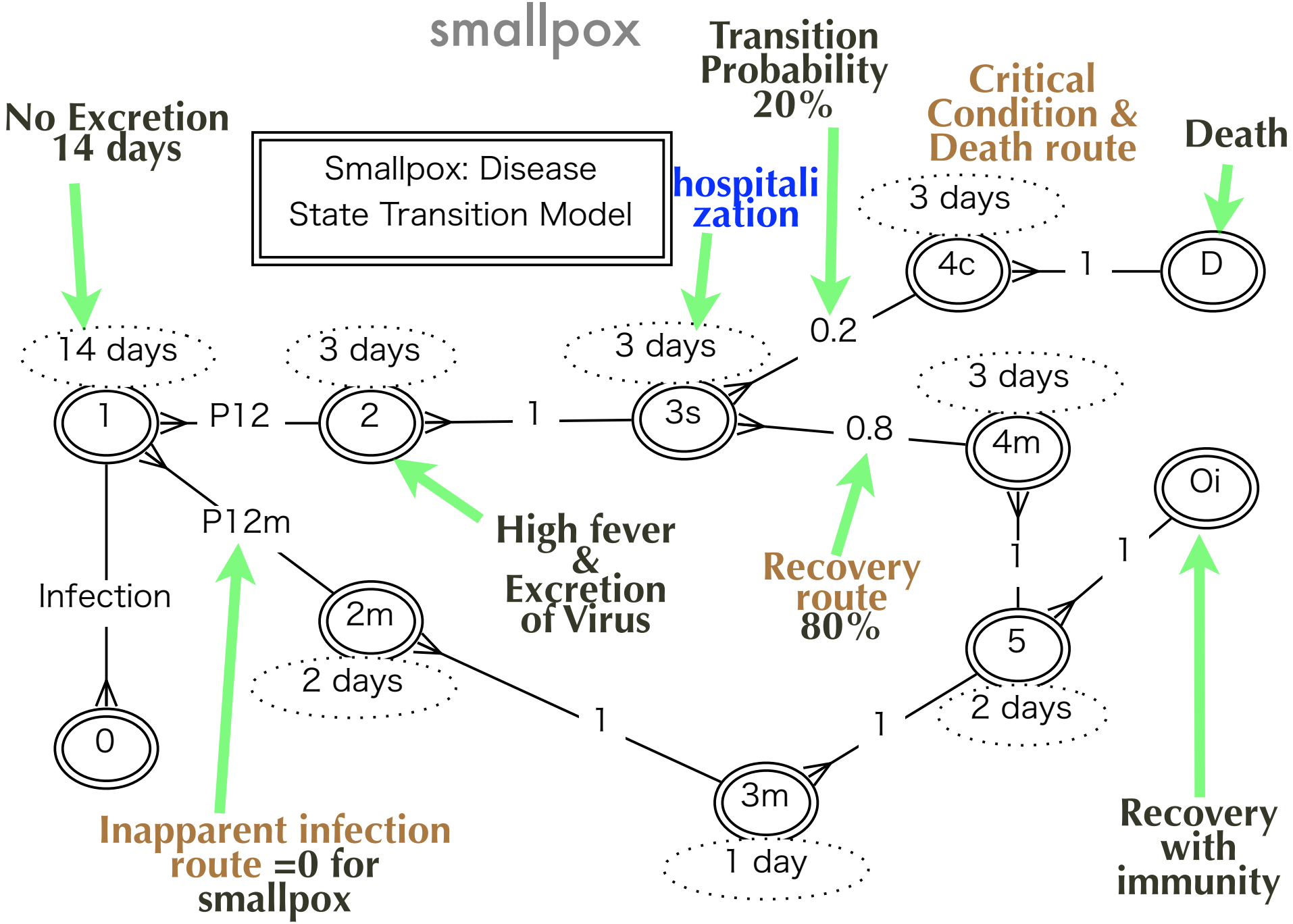
- Three modules for Pandemic Simulation Model
- (1) Disease Stage Model
- (2) City Structure Model and Human Activity Model on the City
- (3) Contamination and Infection Process Model

(1) Disease Stage Model

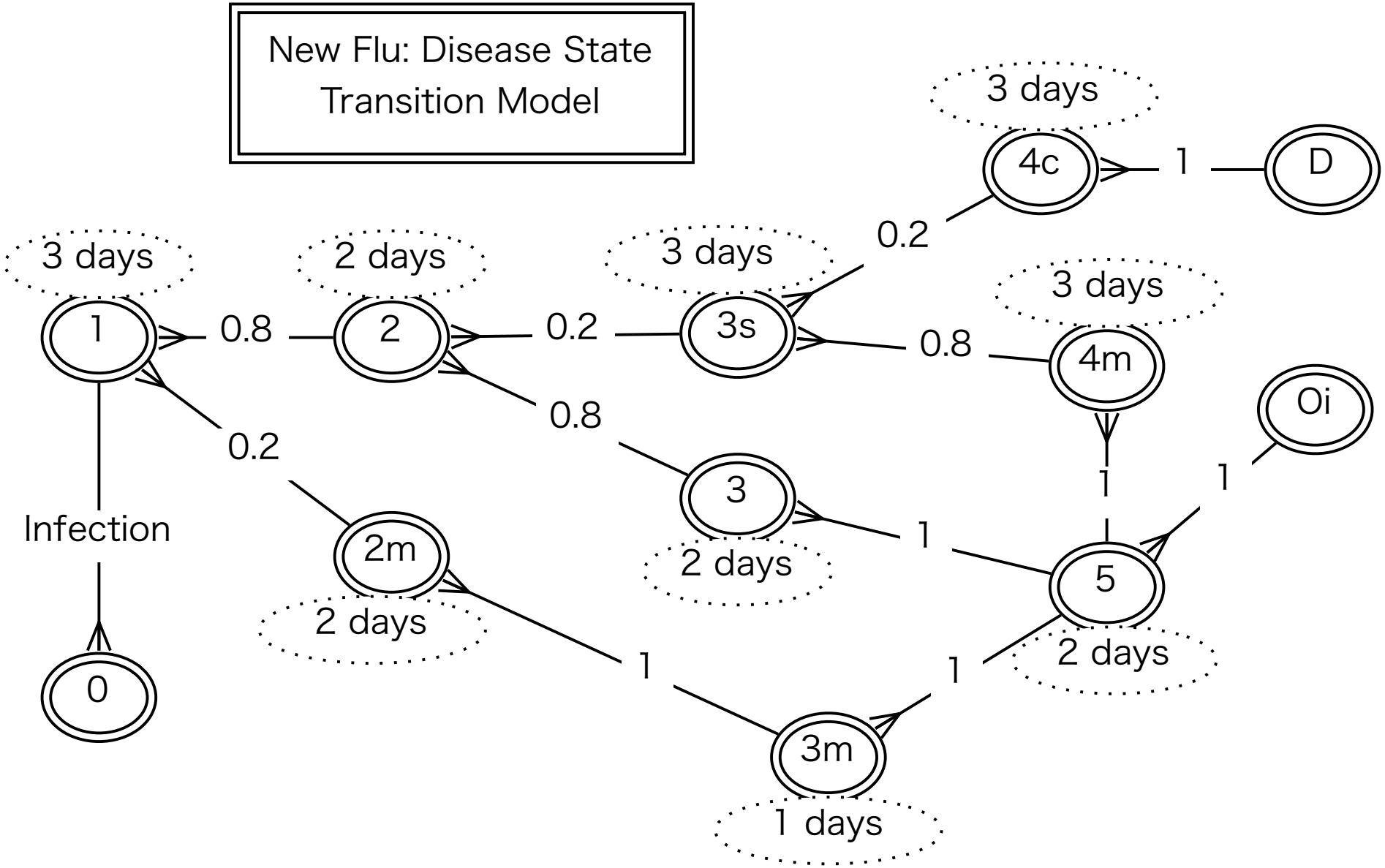
Pathological transition: general model for any disease



Pathological transition model for smallpox



Pathological transition model for influenza



Generic City Structure Model

Population, Family Structure and Age Bracket characterize the generic cigy

A	B	C	D	E
City Structure		CenterArea	CenterArea	
Total Population	10000	Cent. Area Pop.	10000	
Family Structure	Name of Spot	Pop. Ratio	Popuration	NumofHousehold
1(Single)	1home	0.2	2000	2000
2	2home	0.3	3000	1500
3	3home	0.15	1500	500
4	4home	0.1	1000	250
5	5home	0.1	1000	200
6	6home	0.05	500	83
7	7home	0.03	300	42
8	8home	0.02	200	25
9	9home	0.02	200	22
10	10home	0.03	300	30
Sum Total	10000	1	10000	4652
				9990

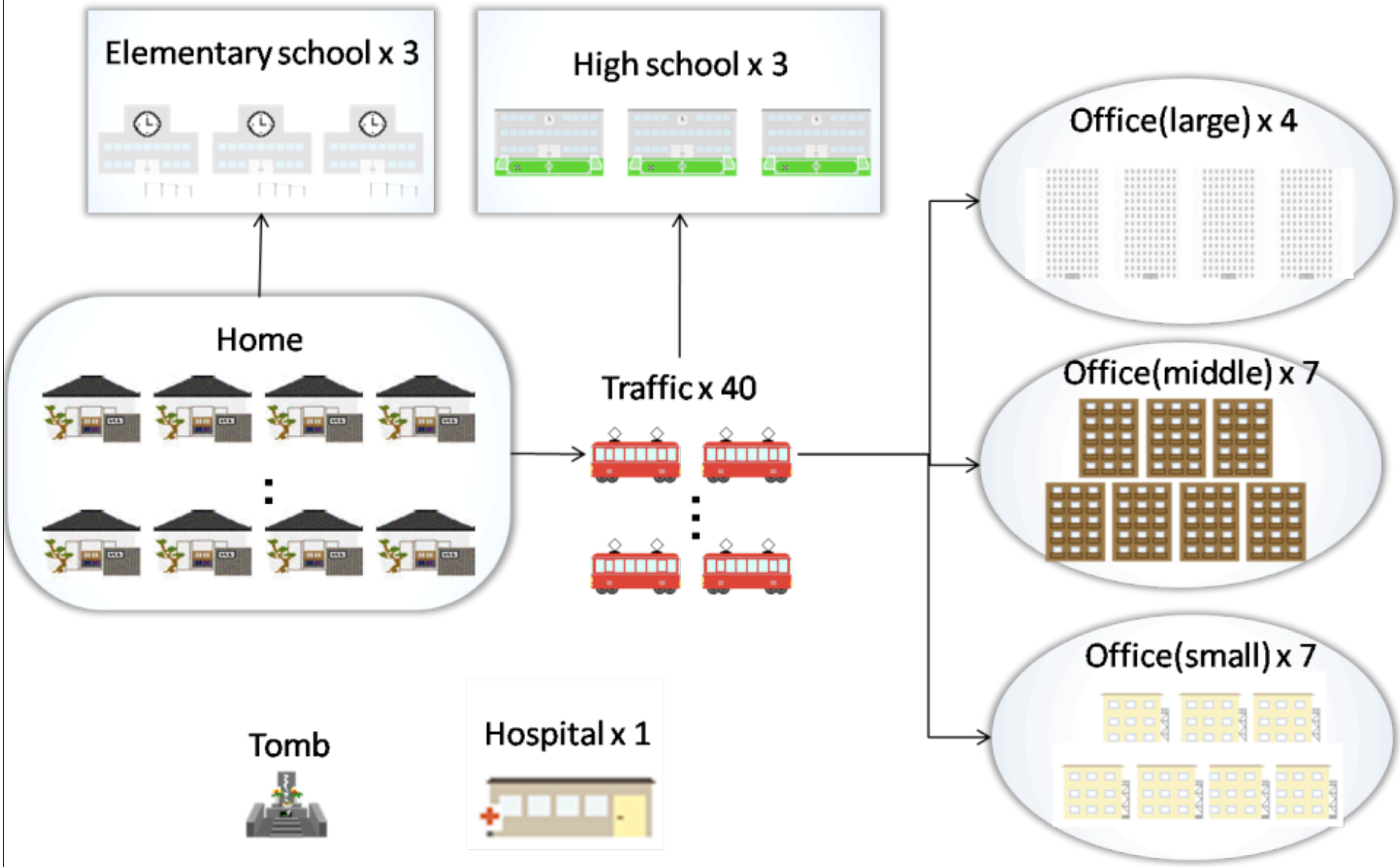
Total Population

Family Structure
Ratio of the single family
Ratio of the family of two
Ratio of the family of three
.....

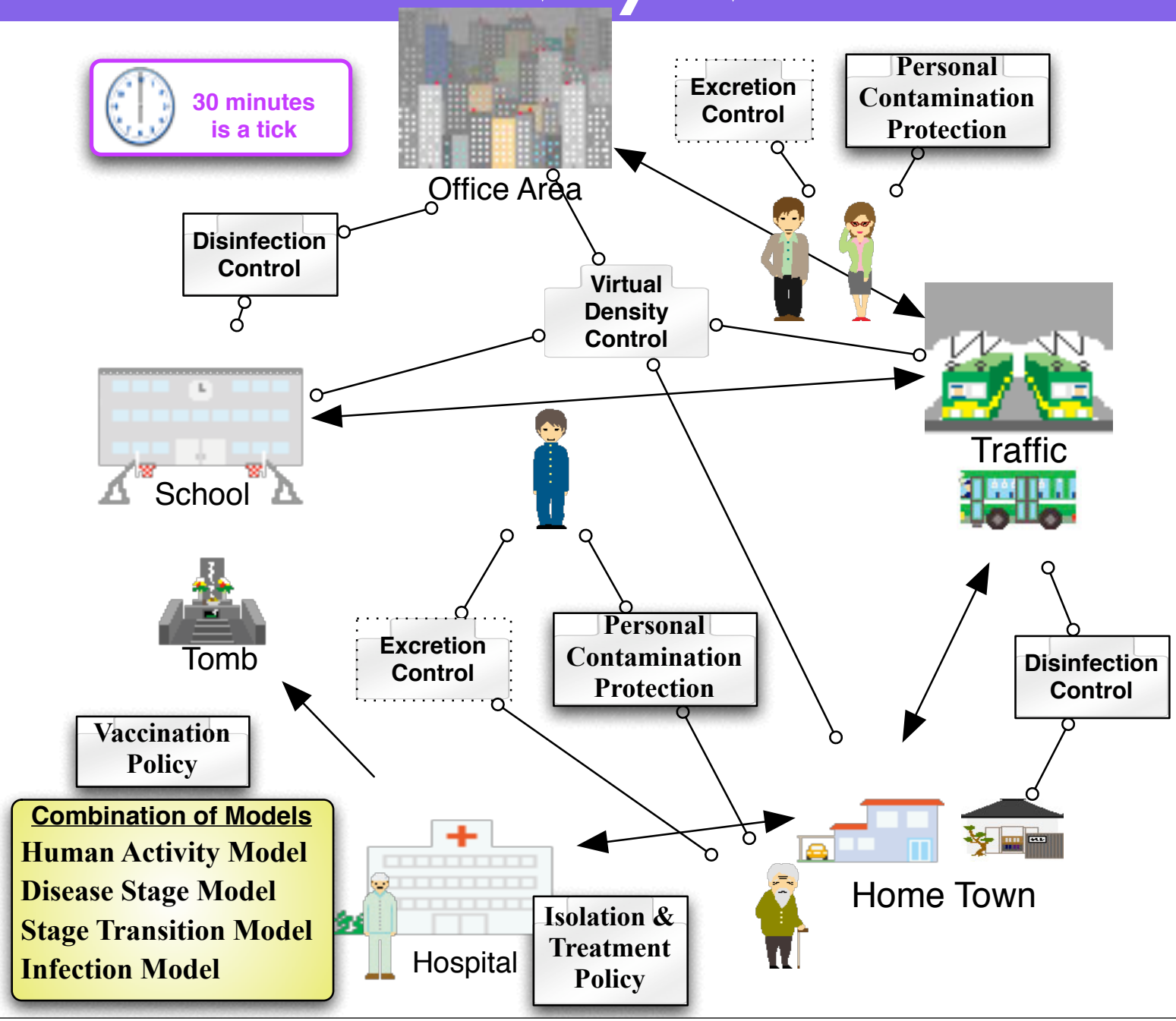
		CenterArea	CenterArea	
age		Age Ratio	Popuration	
0-5 years	baby	0.1	1000	
6-12 years	schoolchildren	0.2	2000	
13-18 years	student	0.2	2000	
19-34 yerars	young	0.2	2000	
35-59 years	middle	0.2	2000	
60- years	old	0.1	1000	
Sum Total	10000	1	10000	

Age bracket Structure

Generic City:pop. 10,000

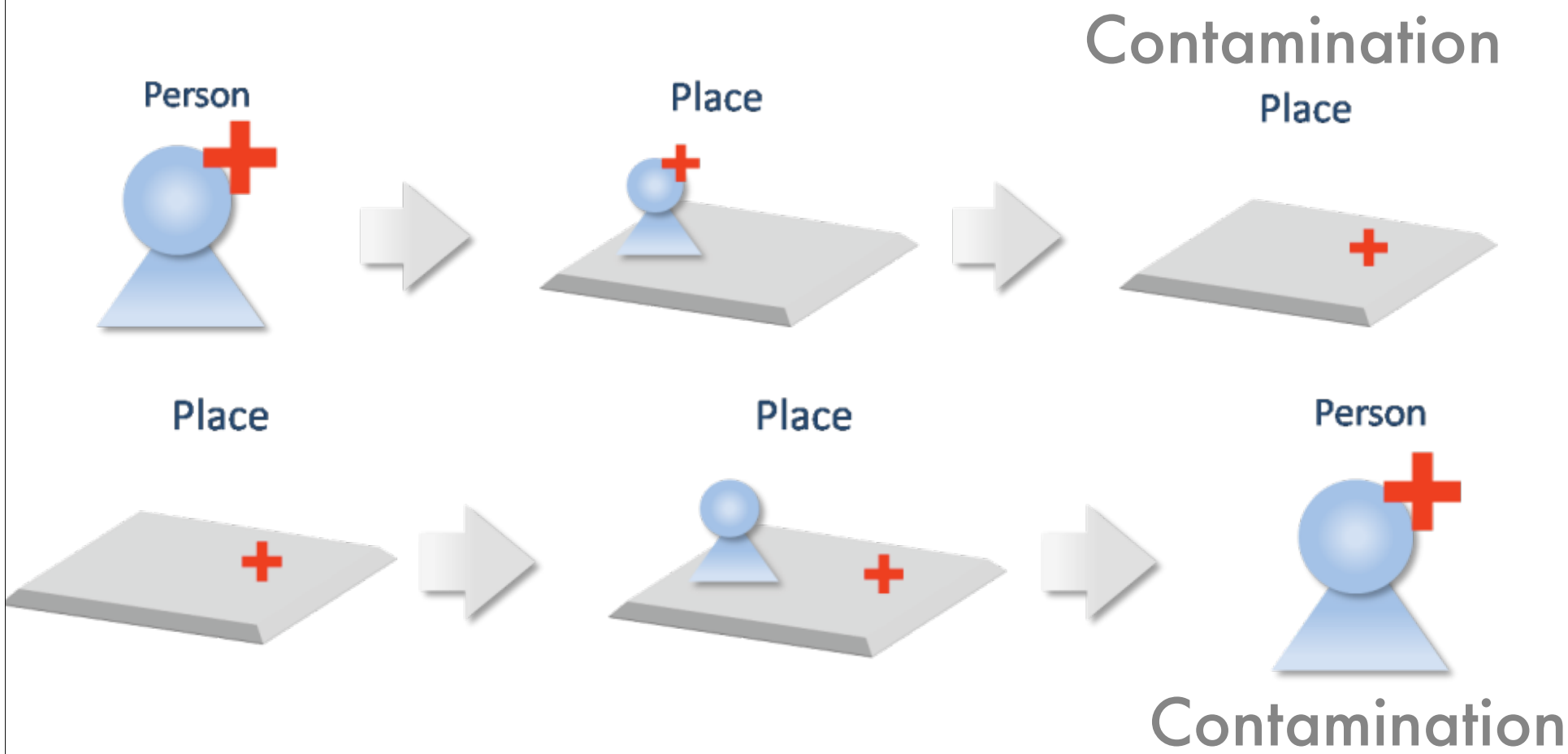


Human Activity Model of a City

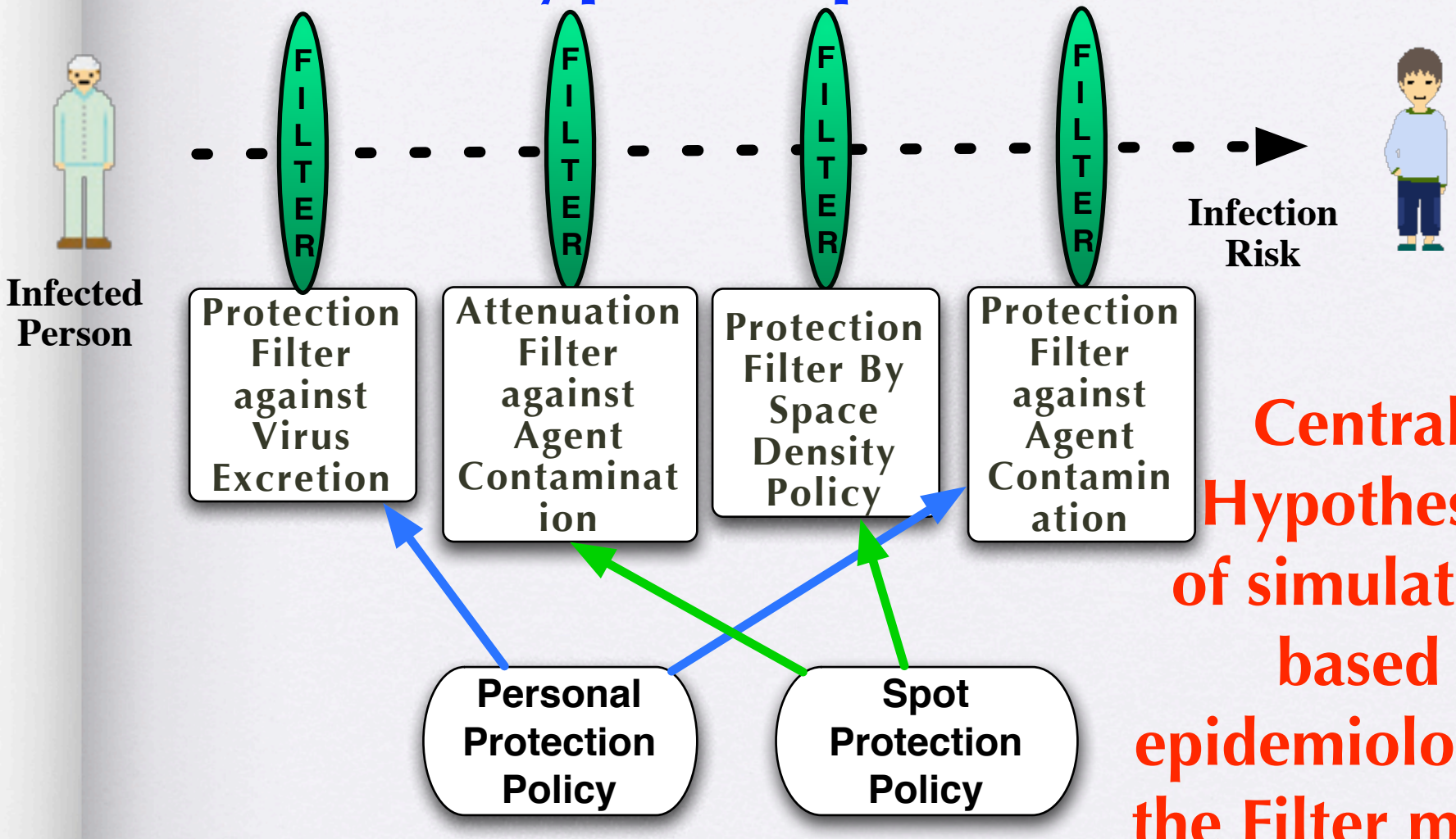


Filter Model for Contamination, Infection and its protection

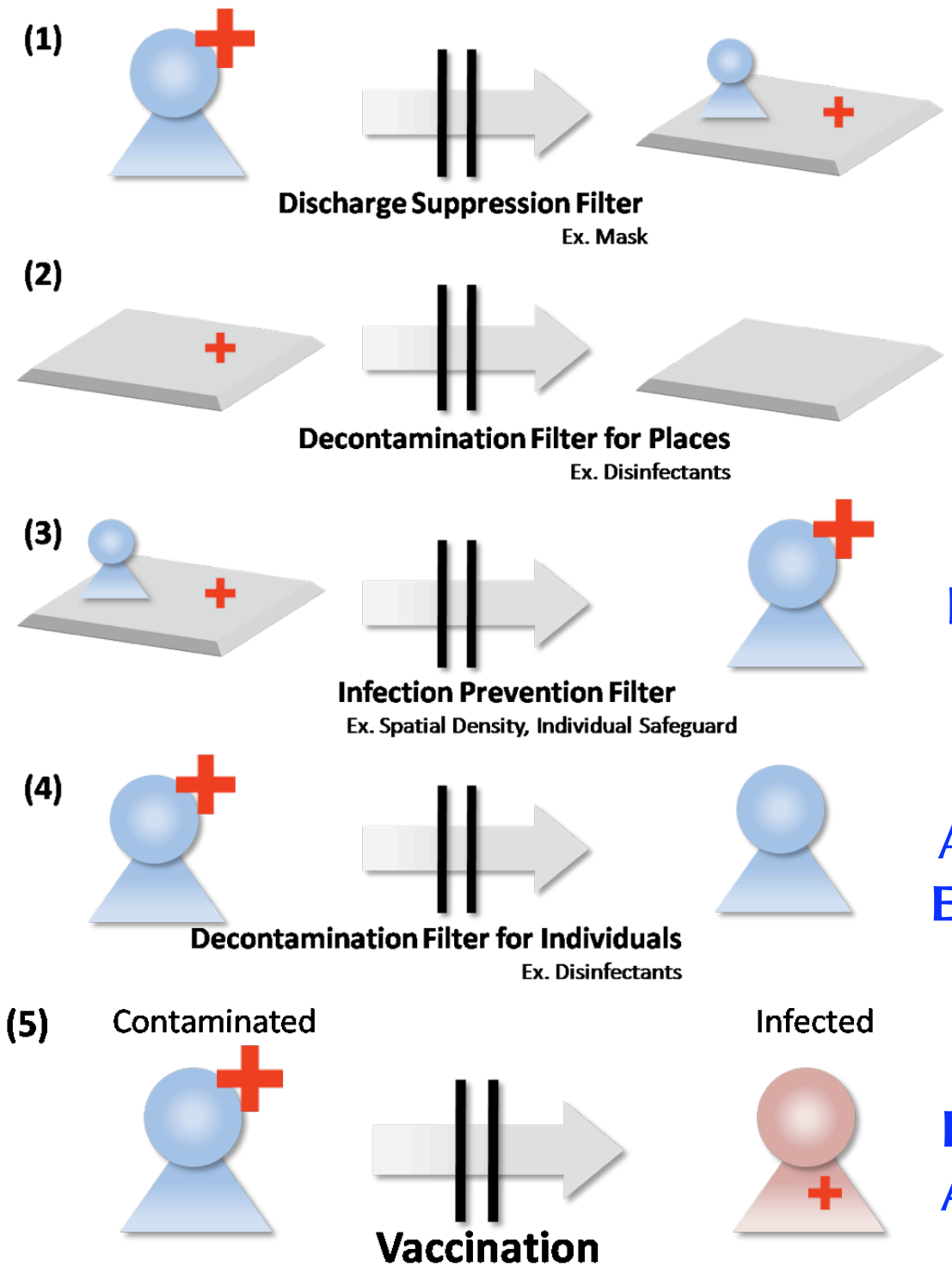
Contamination of Place and Agent



Social Infection Protection Policy is Characterized by the combination of different types of protection filters



Central Hypothesis of simulation based epidemiology is the Filter model



Excretion Protection Filter

Spot Attenuation Filter by Environment & Sterilization

Agent Contamination Protection Filter: Spacial Density & N95 Mask

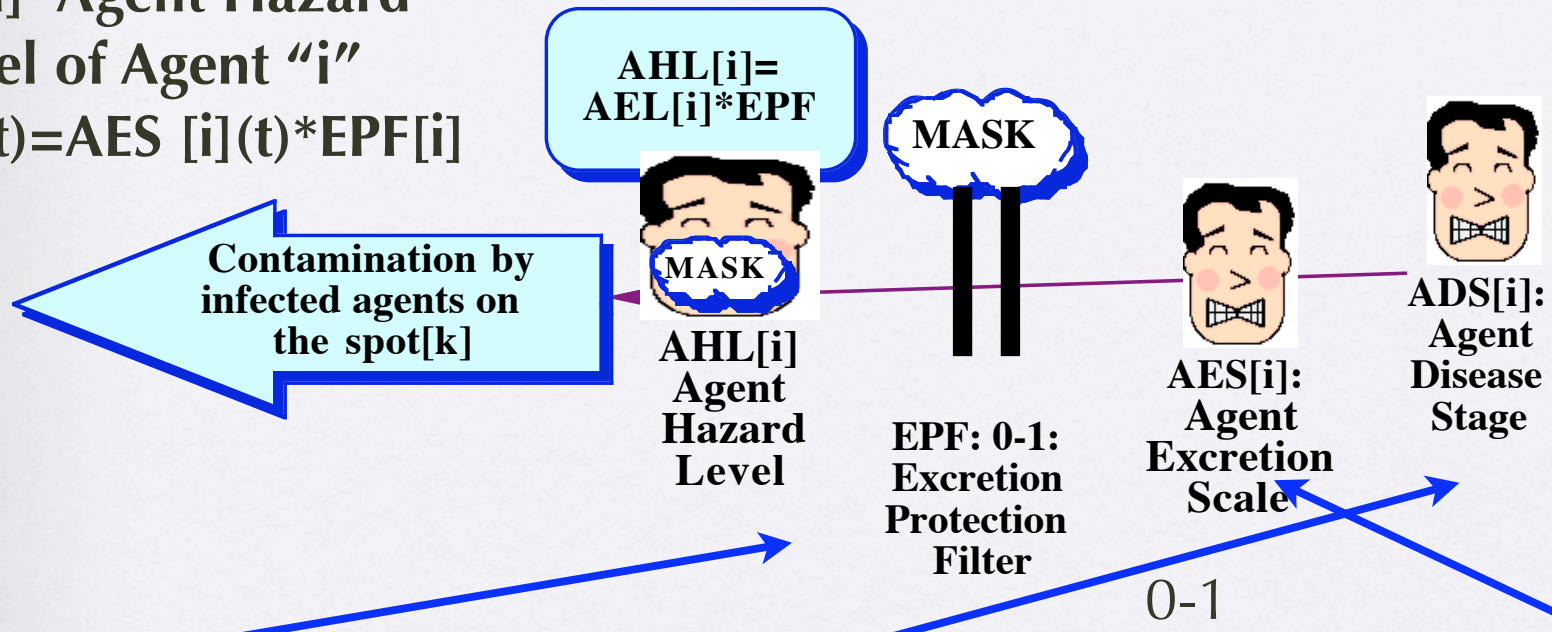
Agent Attenuation Filter by Environment & Sterilization

Infection Protection Filter by Antibody Condition

Protection Filter against Virus Excretion

AHL[i] Agent Hazard Level of Agent "i"

AHL[i](t)=AES [i](t)*EPF[i]



0-1

EPF: 0-1: Excretion Protection Filter

Stage	Explanation	Period	Excretion	Scale
0i	Recovery with immunity		No	0
1	First Stage	2 days	little	0.2
2	Second Stage: high fever	2 days	large	0.6
2m	Second Mild Stage: slight fever	2 days	little+	0.4
3	Third Stage: feaver	2 days	large+	0.8
3m	Third Mild Stage: slight feaver	1 day	medium	0.5
3s	Third Severe Stage	3 days	large	0.6
3p	Third Pneumonia Stage	3 days	large	0.6
4c	Fourth Critical Stage	3 days	medium	0.5
4m	Fourth Mild Stage	3 days	medium	0.5
5	Fifth Recovery Stage	2 days	little	0.2
D	Death		No	0

1: No Mask

0.4-0.6: Standard Mask

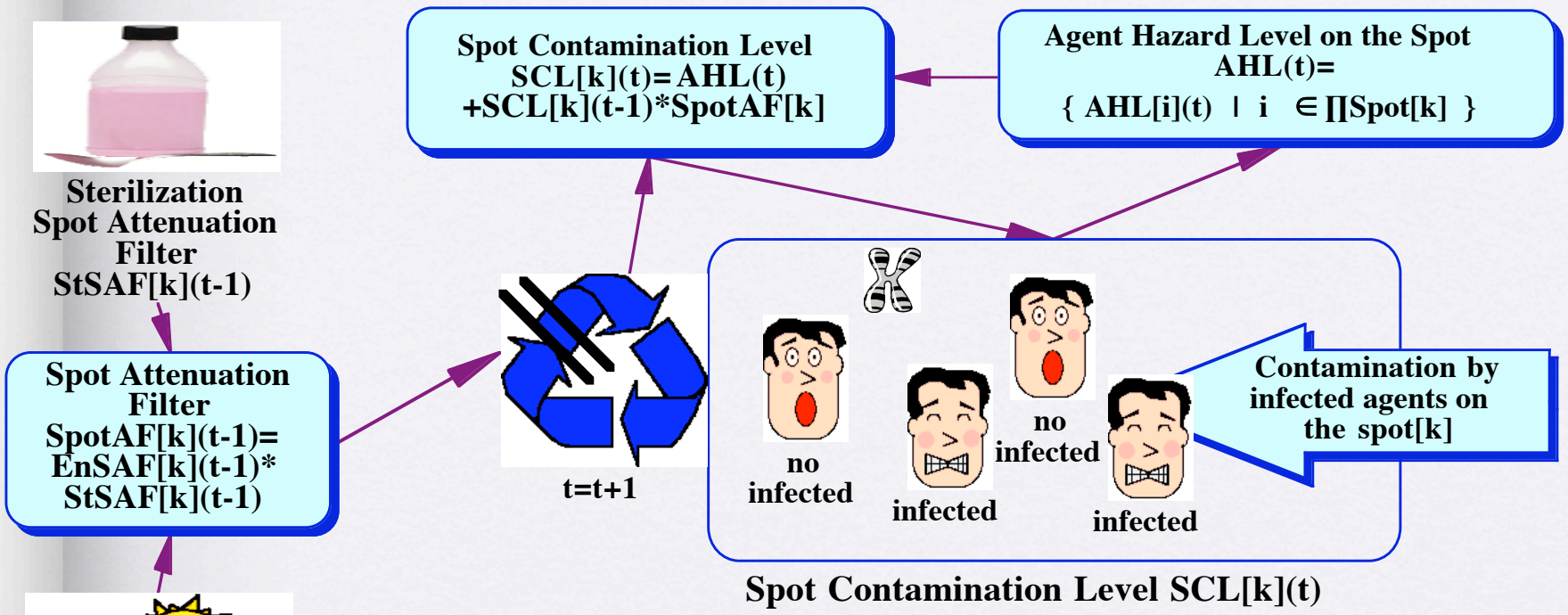
0: N95 Mask

Spot Contamination Level & Attenuation Filter against the contamination

SCL Spot Contamination Level

$$SCL[k](t)=AHL(t)+SCL[k](t-1)*SpotAF[k]$$

$$AHL[k]=\Sigma\{AHL[i] \mid i\in Spot[k]\}$$



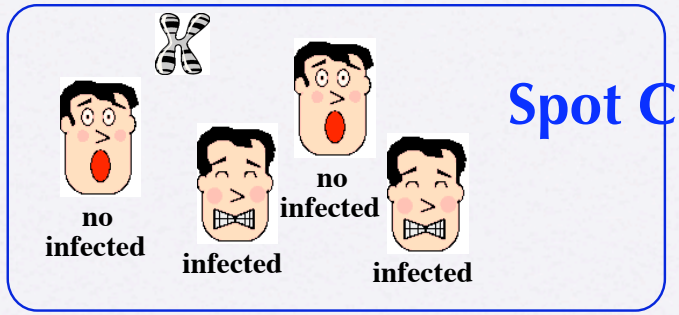
Spot Attenuation Filter by Environment: EnSAF[k](t-1) 0-1

Spot Attenuation Filter by Sterilization: StSAF[k](t-1) 0-1

Total Spot Attenuation Filter SpotAF[k]=EnSAF[k]*StSAF[k]

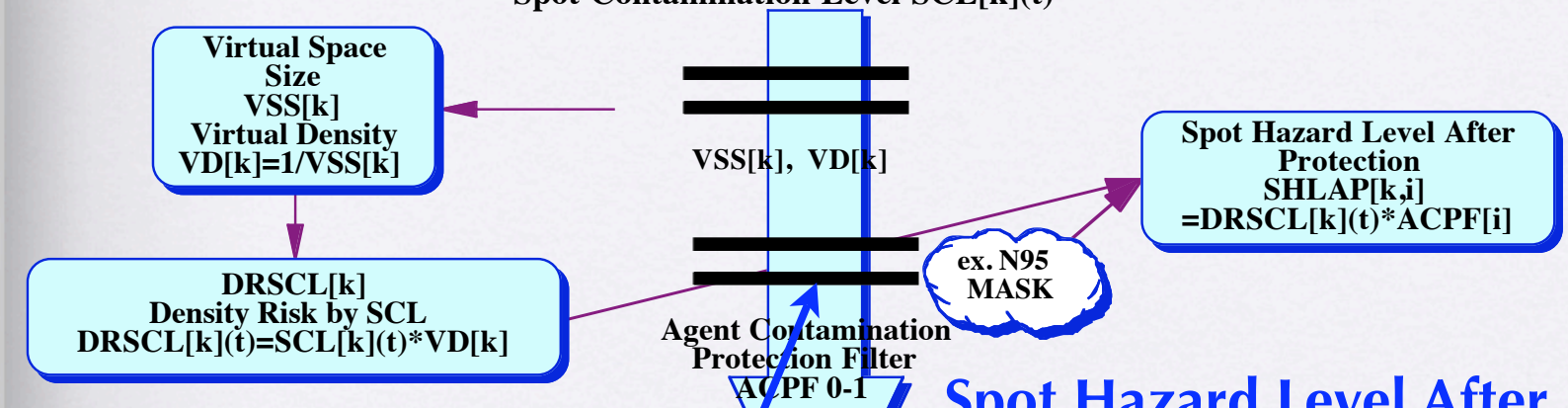
Virtual Space Size & Protection Filter against Agent Contamination

Virtual Space Size:VSS[k] & Virtual Density:VD[k]



Spot Contamination Level
SLC[k](t)

Spot Contamination Level SCL[k](t)



DRSCL[k]:Density Risk by SCL
DRSCL[k](t)=SCL[k](t)*VD[k]

Spot Hazard Level After Protection
SHLAP[k,i]=DRSCL[k](t)*ACPF[i]

Protection Filter against Agent Contamination:ACPF

Agent Contamination Level
ACL[i]=SHLAP[k,i]
+ACL[i](t)*AgentAF[i]

Agent Contamination Level
ACL[i](t)=SHLAP[k,i](t)
+ACL[i](t-1)*AgentAF[i](t-1)

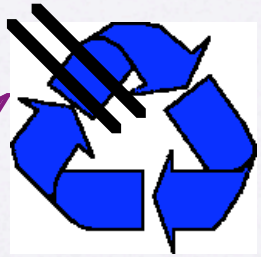
Agent Contamination Level & Attenuation Filter against agent contamination

SterilizationAgent Attenuation Filter StAAF[i](t-1)

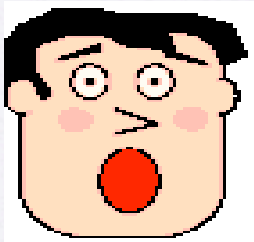
Agent Contamination Level

ACL[i](t)=SHLAP[k,i](t) +ACL[i](t-1)*AgentAF[i](t-1)

Agent Attenuation Filter AgentAF[i](t-1)= EnAAF[i](t-1)* StAAF[i](t-1)



t=t+1



Agent Contamination Level ACL[i]=SHLAP[k,i] +ACL[i](t)*AgentAF[i]

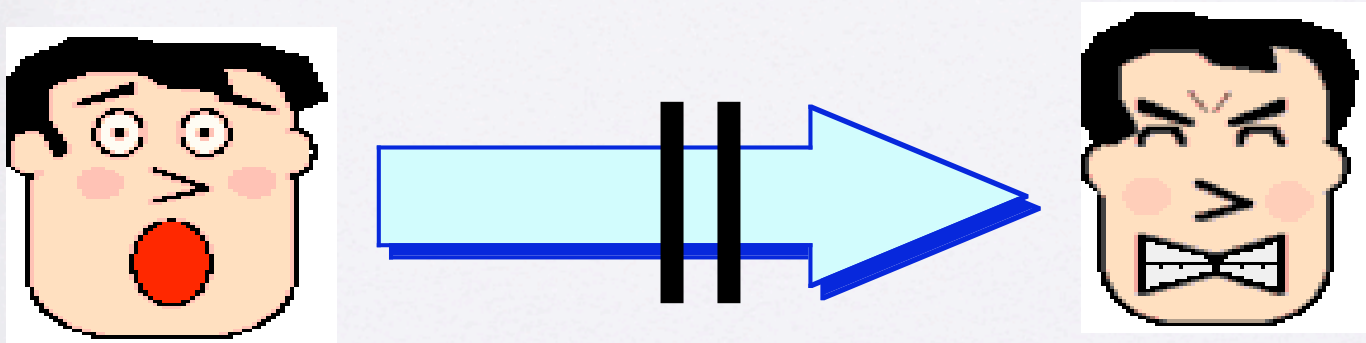
Environment Agent Attenuation Filter EnAAF[i](t-1)

Agent Attenuation Filter by Environment: EnAAF[i]

Agent Attenuation Filter by Sterilization: StAAF[i]

Total Agent Attenuation Filter: AgentAF[i]=EnAAF[i]*StAAF[i]

Physical Condition of Agent & Infection Probability



Agent Contamination Level
ACL[i]=SHLAP[k,i]
+ACL[i](t)*AgentAF[i]

PC: Phisical Condition such as Vaccination, Age,etc and Infection Probability

ADS[i]: Agent Disease Stage

P(infection of agent "i" per Step)=1-exp(-FP*TP*ACL[i])

Fitting Parameter:FP is determined by vaccination level

Protection Policy

- We have distinguished several types of medical and social protection policy of infection and contamination of virus in the models.
- We also have evaluated the protection policy from the viewpoint of program and project management.
- As a result, we point out the importance of the four types of social protection policies except vaccination and anti virus drugs.
  - 1) Excretion control policy by free mask
  - 2) Attenuation control policy by humidity and sterilization control of spot
  - 3) Self protection policy by N95 mask
  - 4) Space density control policies by several approaches such as flex time work to control overcrowded train or bus, space density control in classroom, office, hospital and family life style.

Design for Tabletop Exercise for Bioterrorism by Smallpox

Effective for training but difficult to understand total perspective of pandemic and its protection policy

Traditional Tabletop Exercise for bioterrorism such as Dark Winter

DARK WINTER

Traditional Tabletop Exercise

Andrews Air Force Base

22 - 23 June 2001

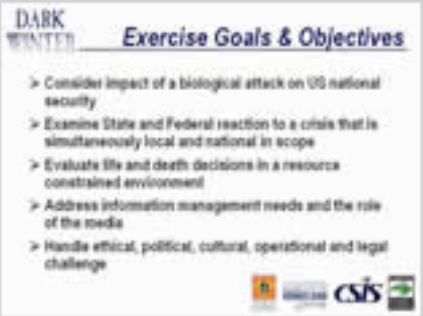
slide 01

slide 02

slide 03

slide 04

slide 05



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slide 07

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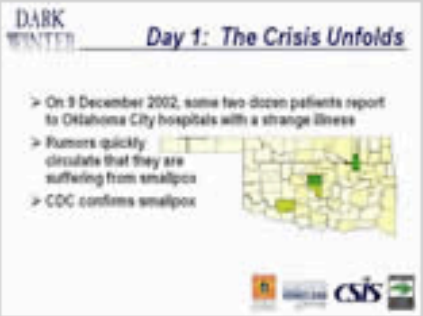

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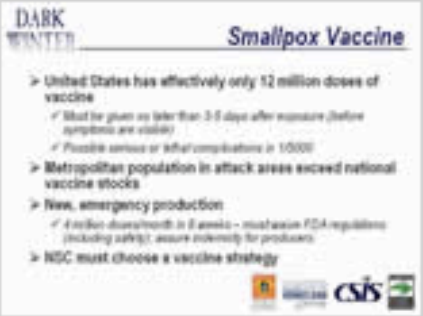
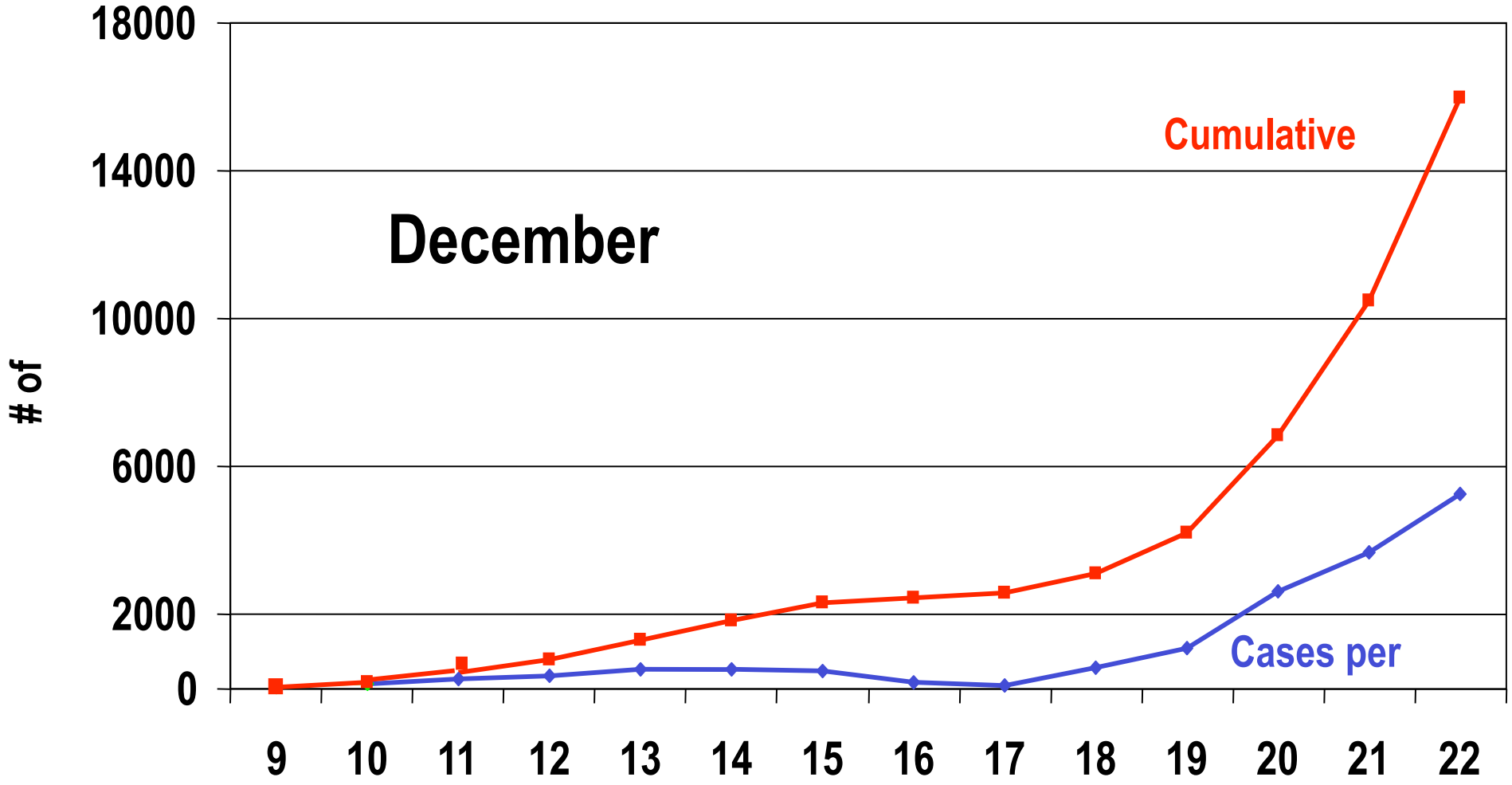


slide 12

Assuming a Standard Scenario for Tabletop Exercise

DARK WINTER

Cumulative Reported Smallpox



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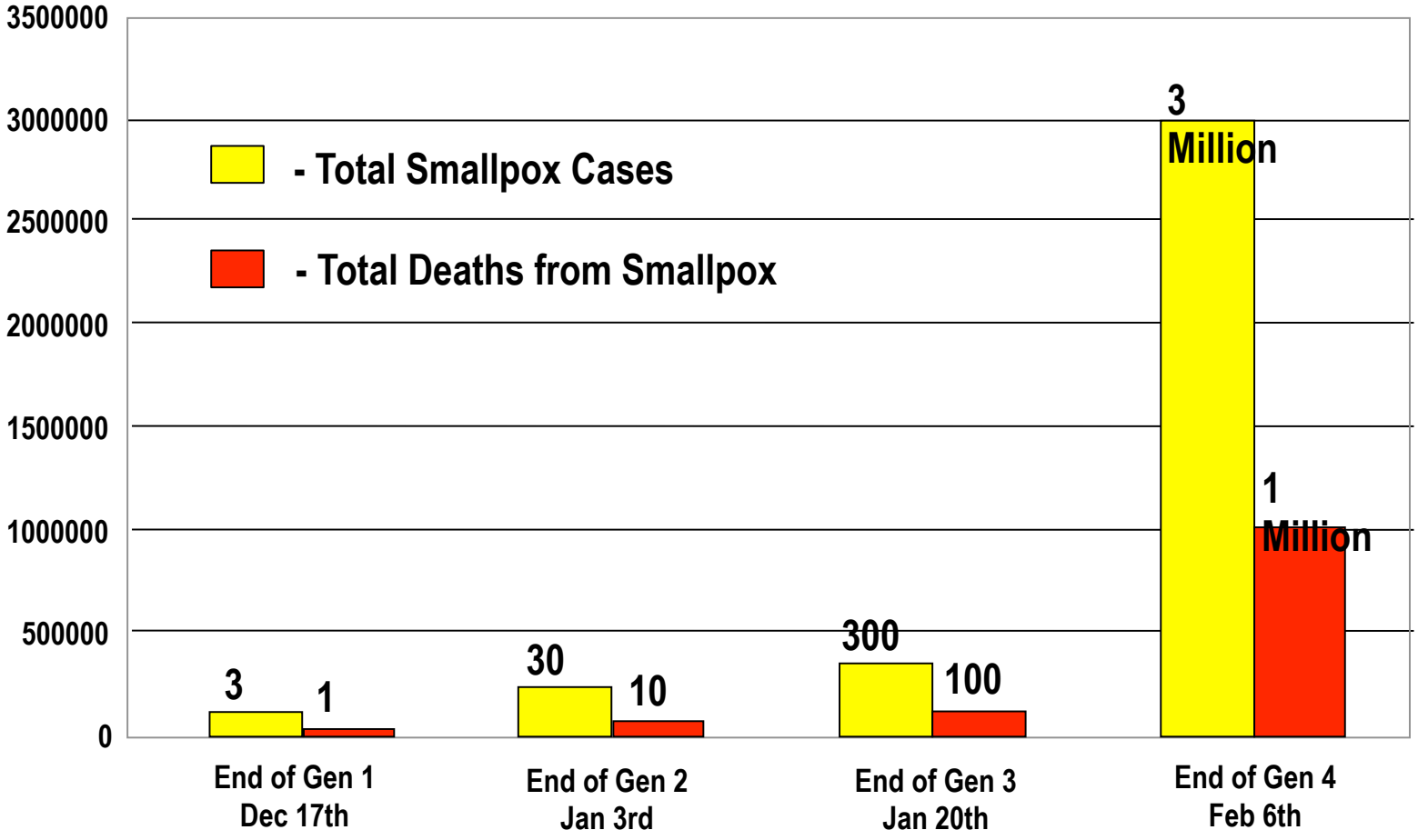
ON AMERICAN SOIL OKLAHOMA CITY NATIONAL MEMORIAL

DARK WINTER

Projected Smallpox Cases



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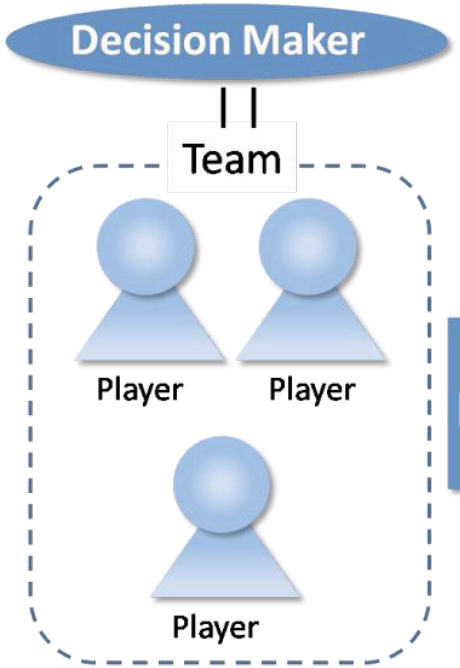
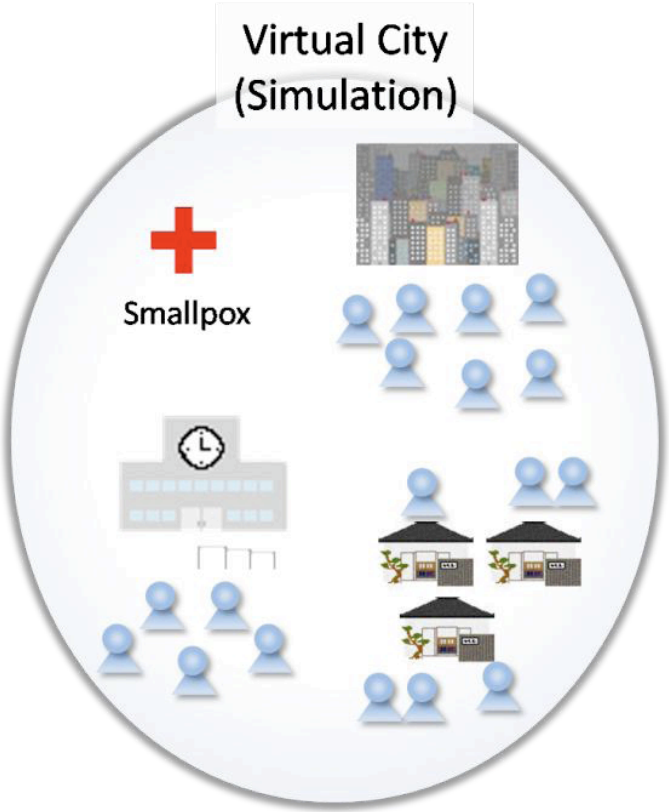
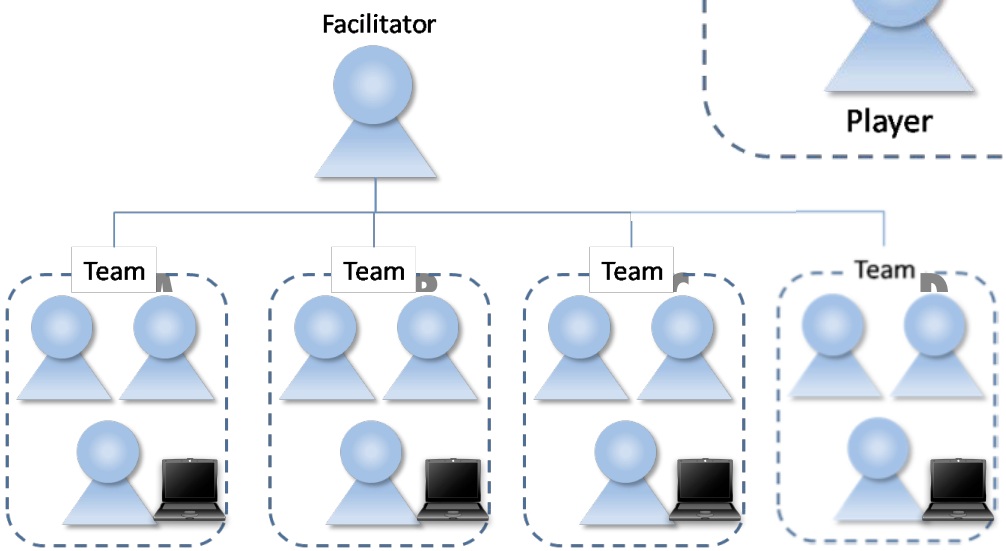
Design of Gaming Simulation for Our Tabletop Exercise





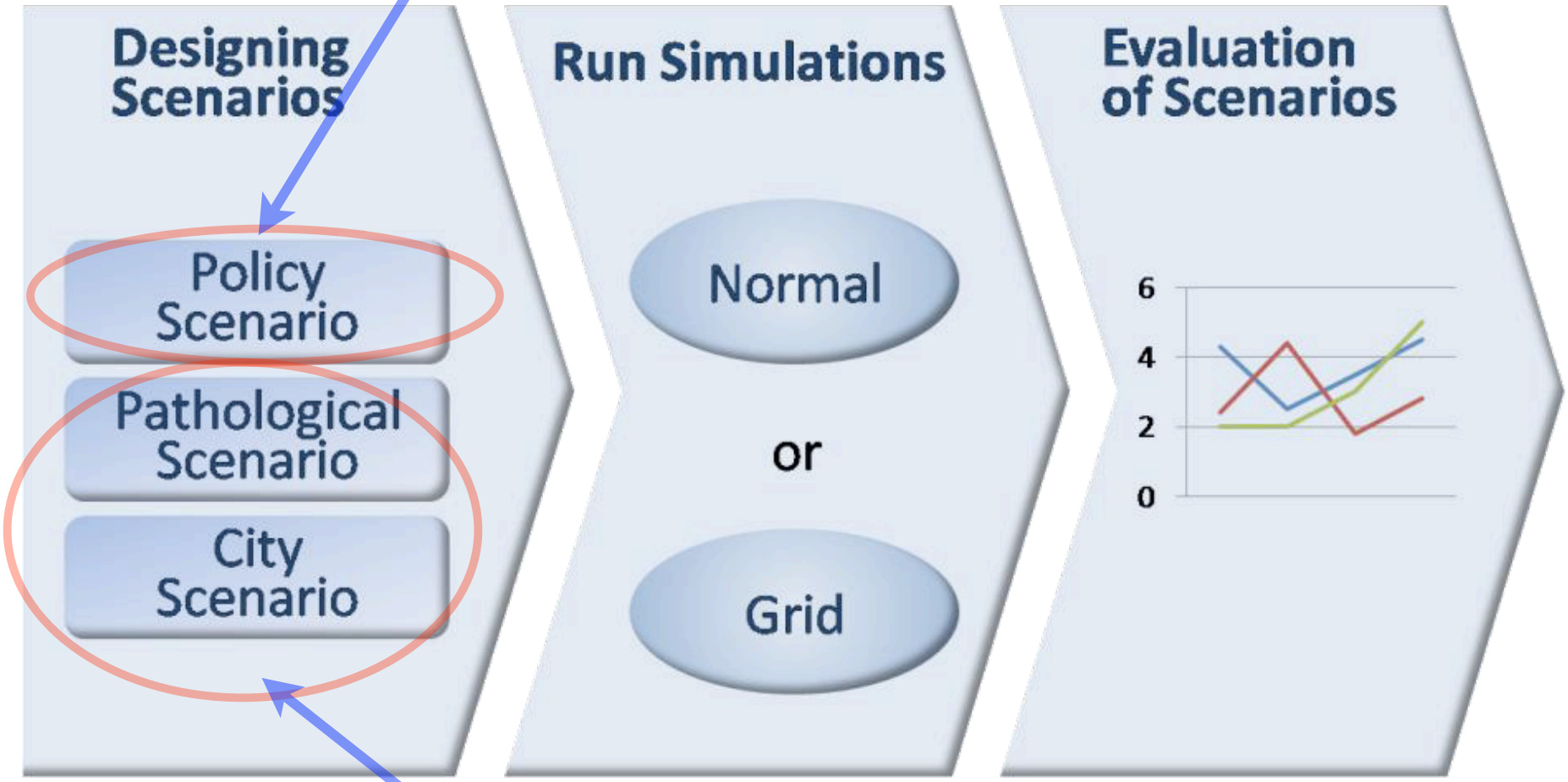
4 Teams



- **Purpose: Minimize the Crisis**

Simulation Based Tabletop Exercise

Decision Making for Protection Policy Scenario



Given Scenario of Infection & City Structure

Pandemic Preparedness

Policy Scenario

- Vaccination Policy Scenario
- Filter Policy Scenario
- School and Office Closure Scenario
- Segregation Scenario

Pathological Scenario

- Pathological Transition Scenario
- Initial Antibody Scenario

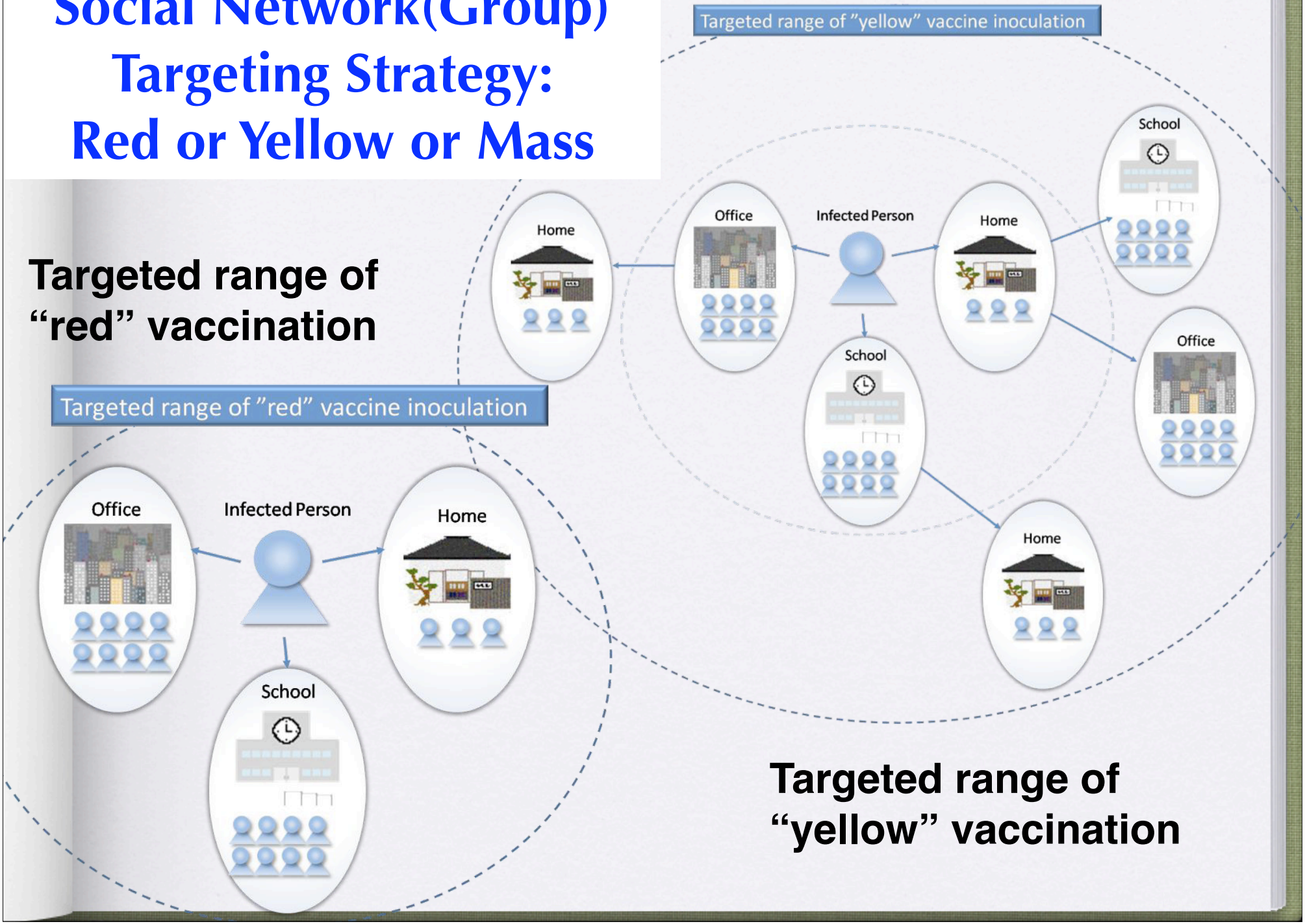
City Scenario

- Population Structure Scenario
- Traffic Scenario

Policy Scenario Creation

- In this game, vaccination-related scenarios are mainly selected as the basic strategy against smallpox. Here, we will select scenarios by combining the following six factors.
- (1) Vaccine stocks, as a proportion of population (30%, 60%, 100%): 3 types
- (2) School shutdown (yes/no): 2 types
- (3) Number of vaccinations per day per 10,000 people (20/day, 300/day): 2 types
- (4) Delay in commencement of vaccination (none, 7 days, 14 days): 3 types
- (5) Targeted generations for vaccination strategy (all, young): 2 types
- (6) Targeted social networks for vaccination strategy (random, red, yellow): 3 types
- These factors are not selected freely. The following selection methods are used.

Social Network(Group) Targeting Strategy: Red or Yellow or Mass



Preparation of Scenario Cards

- Prepare some cards for each of the six scenario factors for selection. (As an alternative, if you cannot prepare cards, you can write the factors on a whiteboard.)

Vaccine Stock Card 3 0 % Tabletop Exercise	Vaccine Stock Card 3 0 % Tabletop Exercise
Vaccine Stock Card 6 0 % Tabletop Exercise	Vaccine Stock Card 1 0 0 % Tabletop Exercise

School Shutdown Card Yes Tabletop Exercise	School Shutdown Card Yes Tabletop Exercise
School Shutdown Card No Tabletop Exercise	School Shutdown Card No Tabletop Exercise

Vaccination Speed Card 20 persons / day Tabletop Exercise	Vaccination Speed Card 300 persons / day Tabletop Exercise
Vaccination Speed Card 300 persons / day Tabletop Exercise	Vaccination Speed Card 300 persons / day Tabletop Exercise

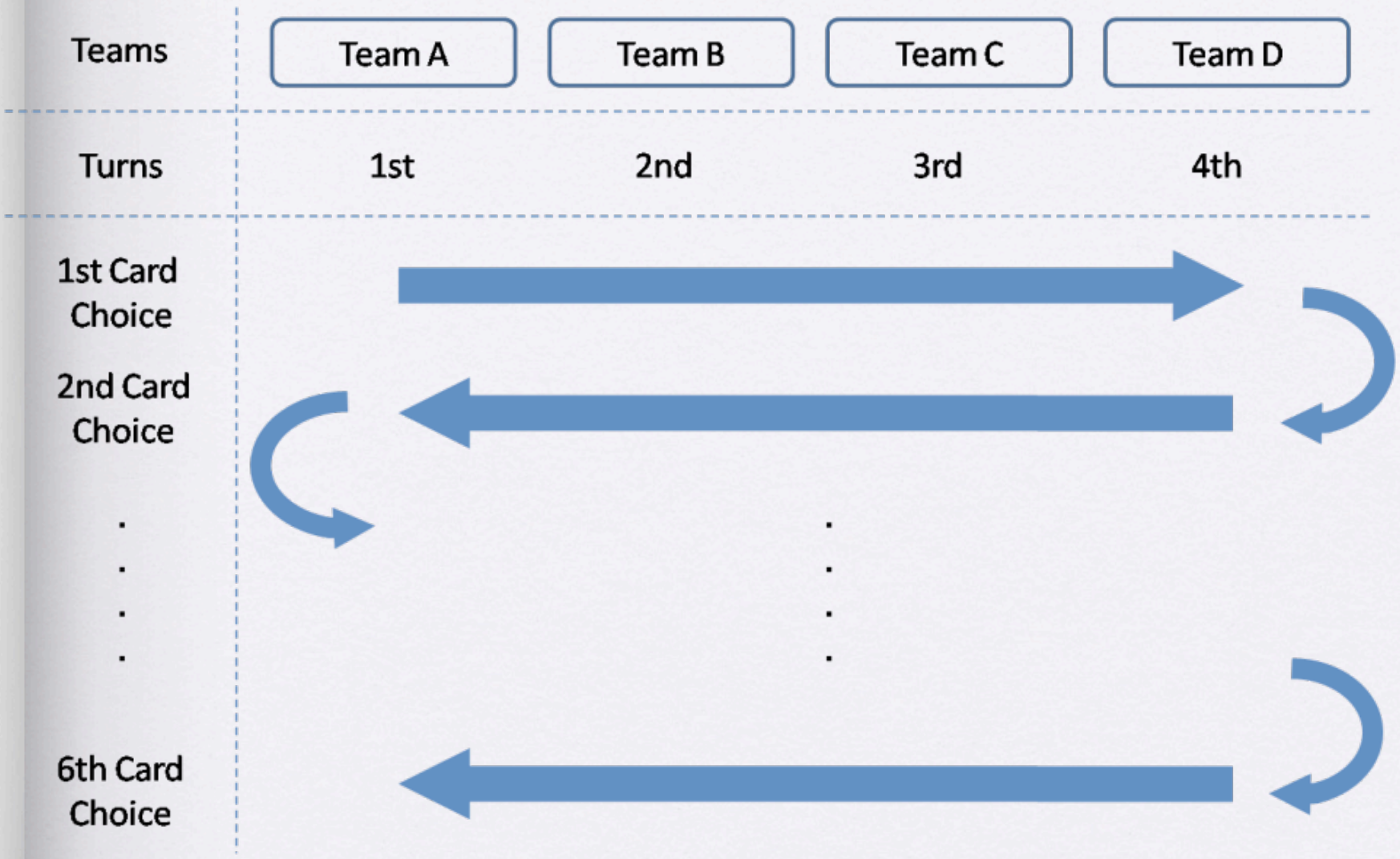
Vaccination Delay Card No Delay Tabletop Exercise	Vaccination Delay Card 7 days Tabletop Exercise
Vaccination Delay Card 7 days Tabletop Exercise	Vaccination Delay Card 14 days Tabletop Exercise

Targeted Generation Card All Tabletop Exercise	Targeted Generation Card All Tabletop Exercise
Targeted Generation Card Young (Under 36) Tabletop Exercise	Targeted Generation Card Young (Under 36) Tabletop Exercise

Targeted Social network Card Random Tabletop Exercise	Targeted Social network Card Random Tabletop Exercise
Targeted Social network Card Red Tabletop Exercise	Targeted Social network Card Yellow Tabletop Exercise

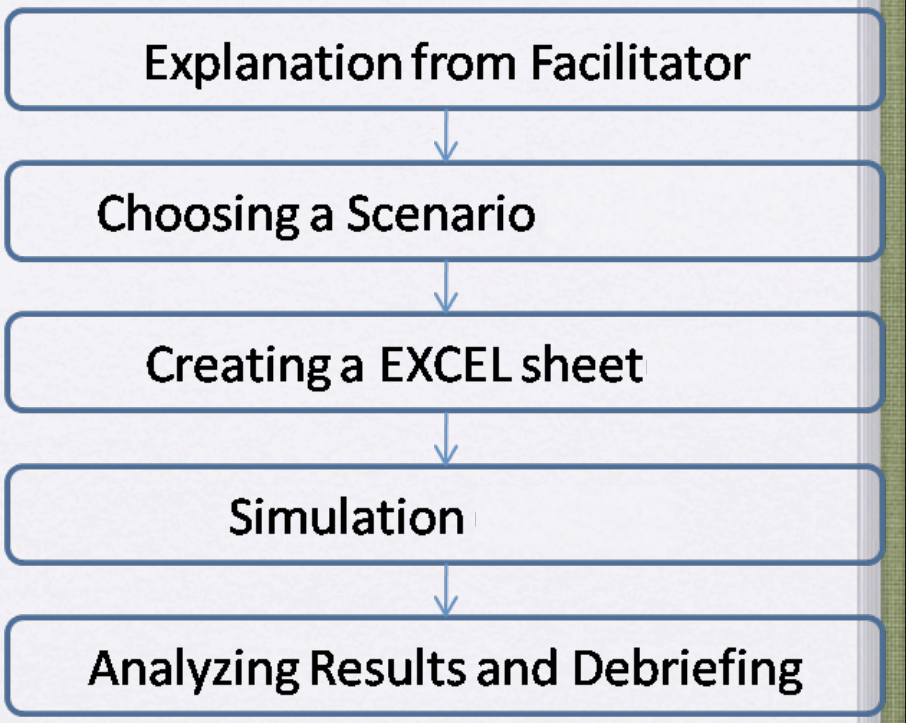
Order of card selection

- Select scenario cards using the "Weber Method," as used in the draft.

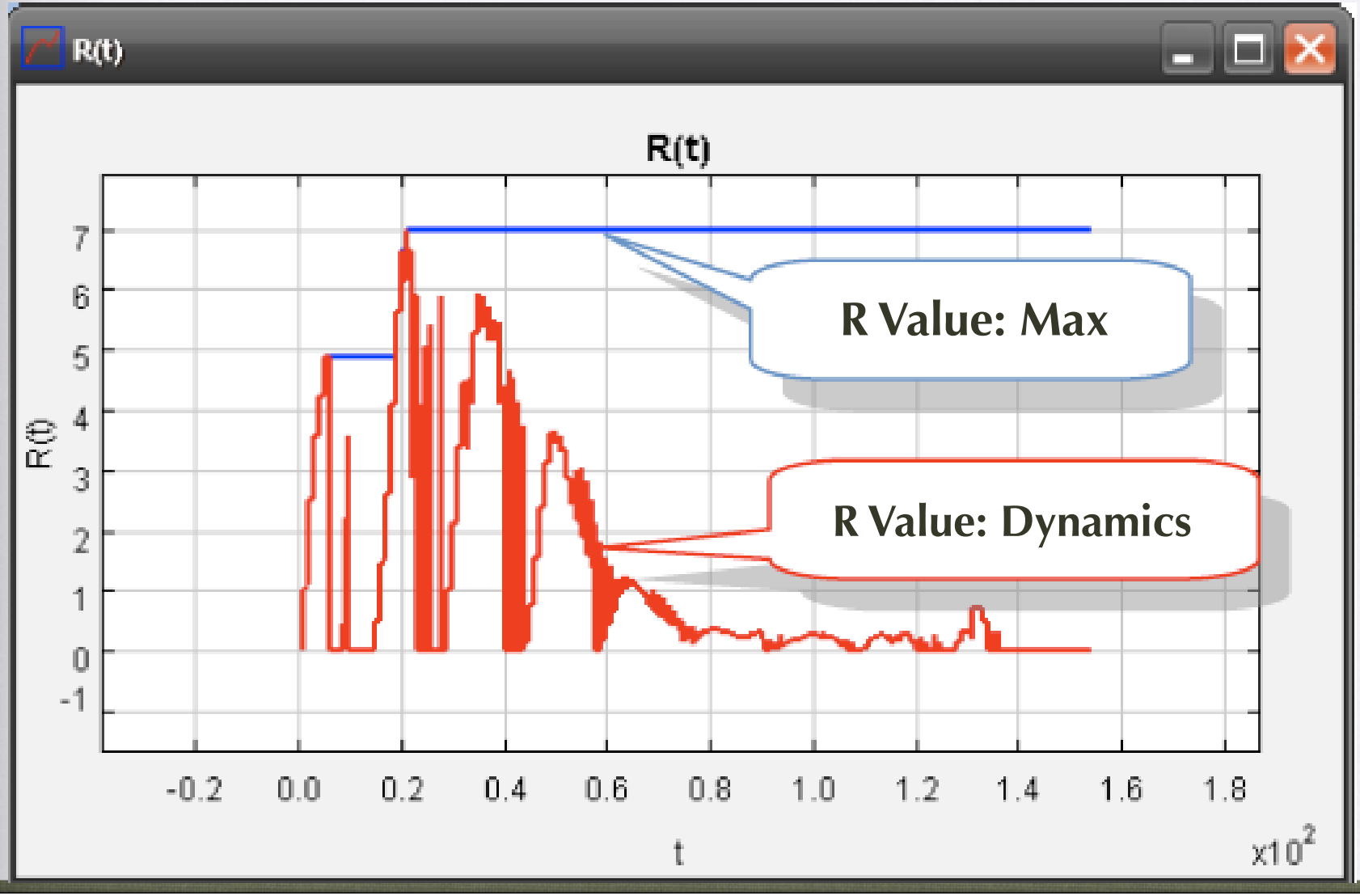


Time Table of our Tabletop Exercise

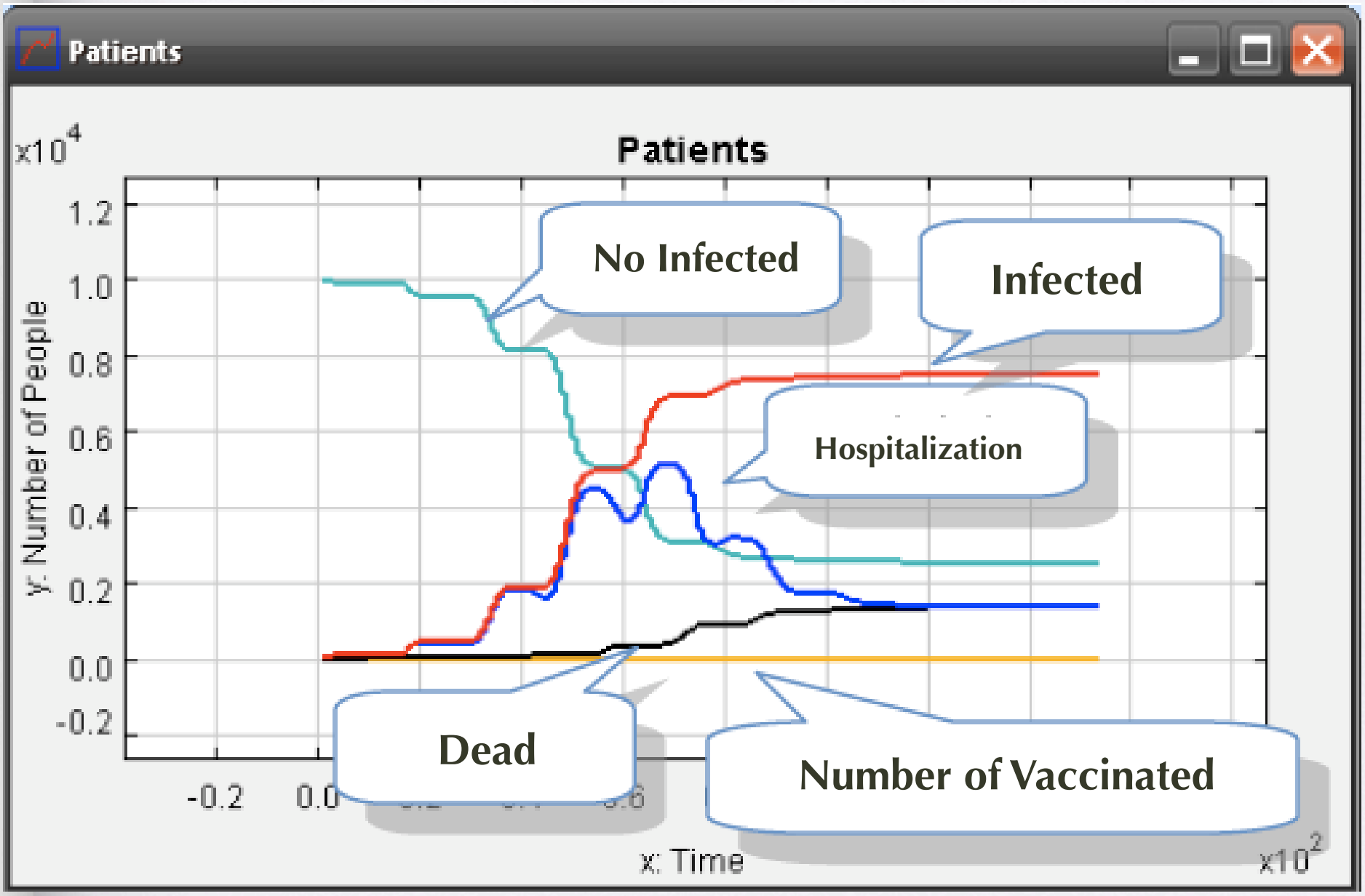
- 0:00～0:30 Explanation and team forming, preparation e.g. setting up PCs
- 0:30～1:30 Tabletop exercise (scenario selection and simulation)
- 0:30～0:50 Scenario selection
- 0:50～1:10 Initial value data creation
- 1:10～1:30 Simulation
- 1:30～2:30 Results analysis and debriefing
  - (incl. break, preparation for team presentation, and discussion)
- 2:30～3:00 Case studies on other infectious diseases, and overall summary



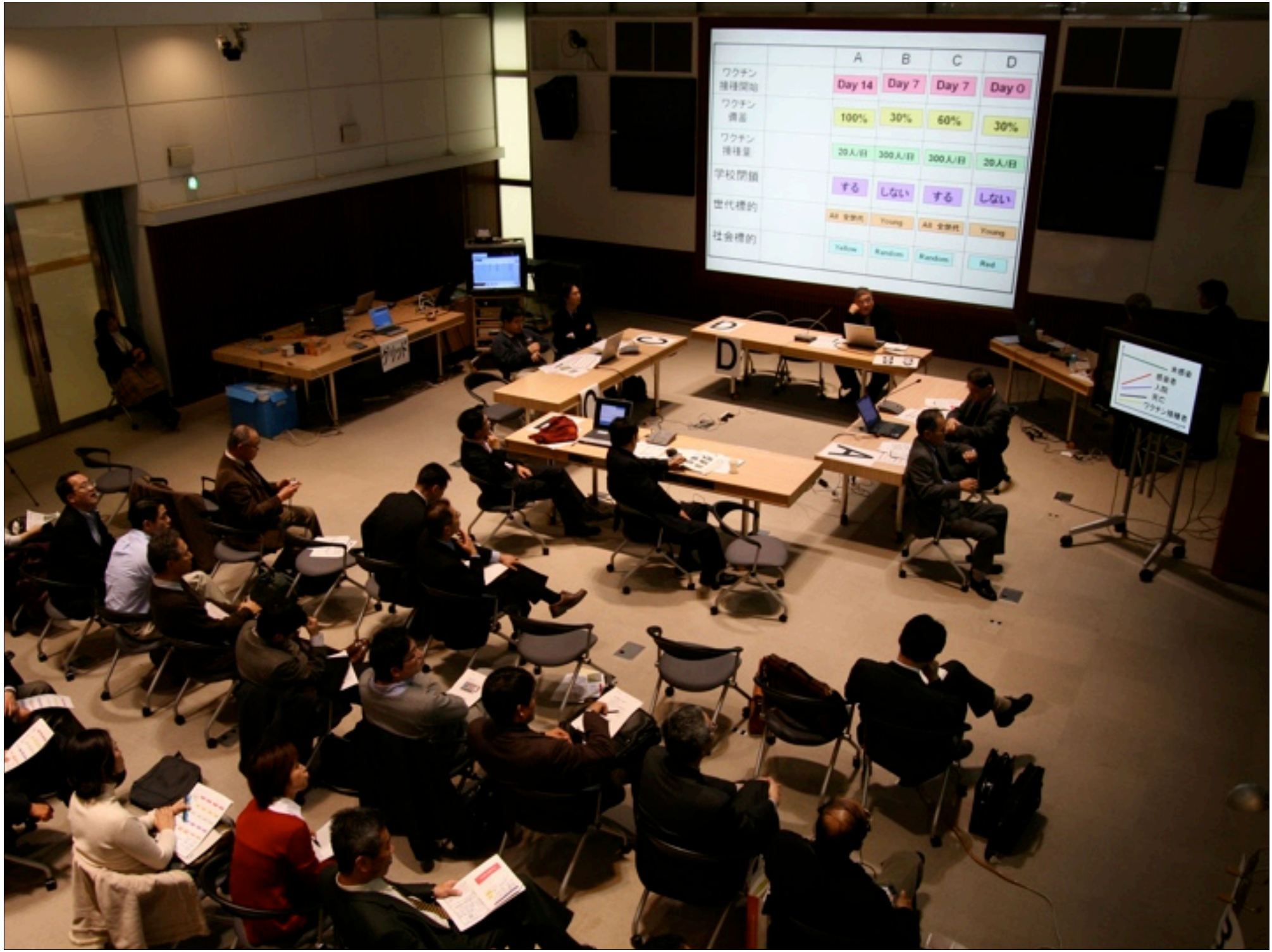
Simulation Result Chart 1
Reproduction Rate (Agents Average) Dynamics & Max value



Simulation Result Chart 2

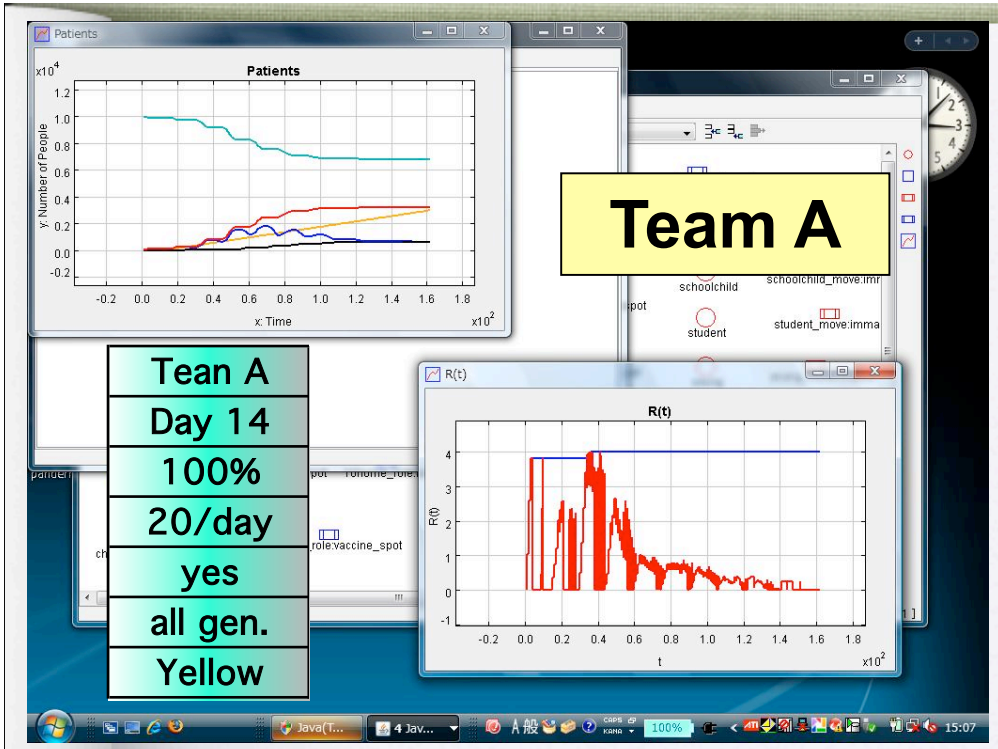


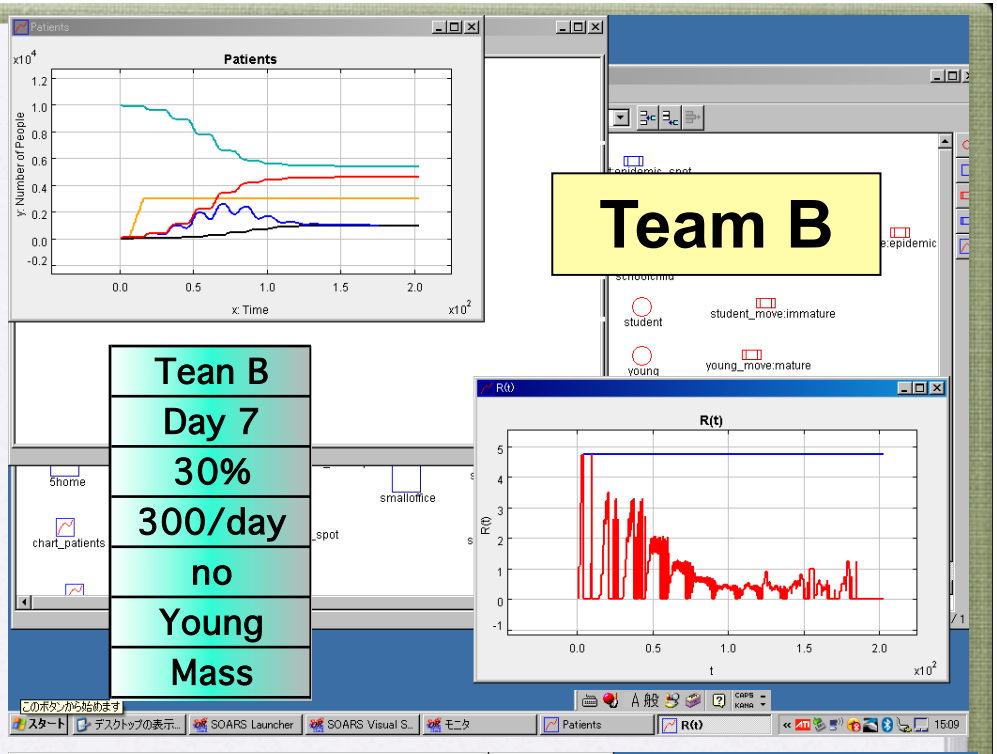
Result of Tabletop Exercise at Keio University Global Security Lab. with professionals of bioterrorism

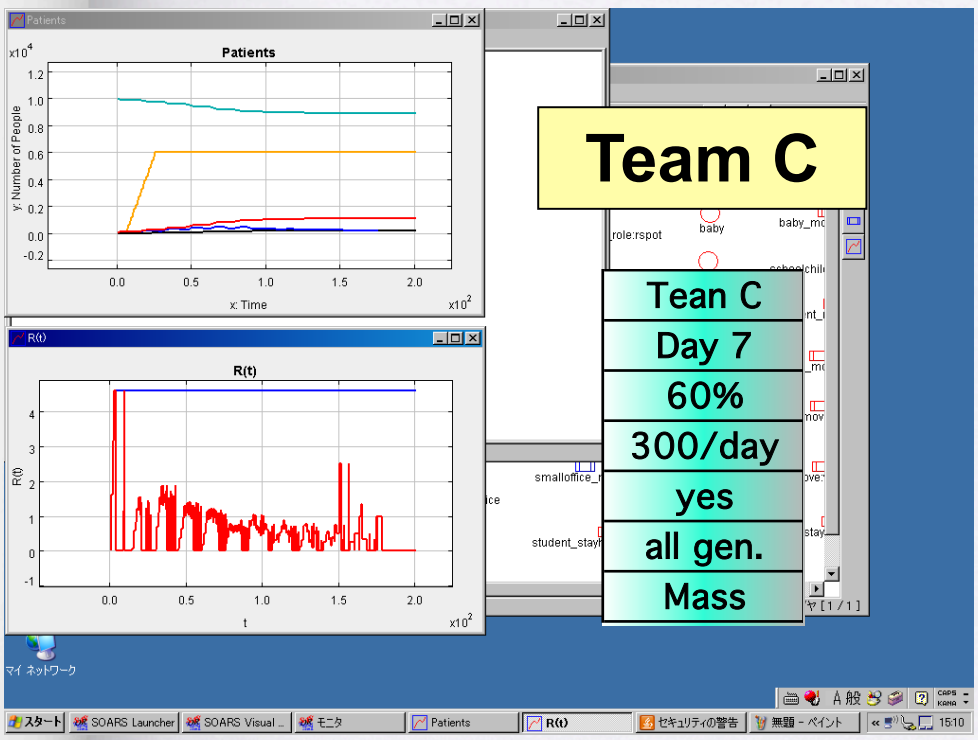

A
B
C
D
Day 14
Day 7
Day 7
Day 0
100%
30%
60%
30%
20人/日
300人/日
300人/日
20人/日
する
しない
する
しない
Yellow
Random
Random
Red
D
A

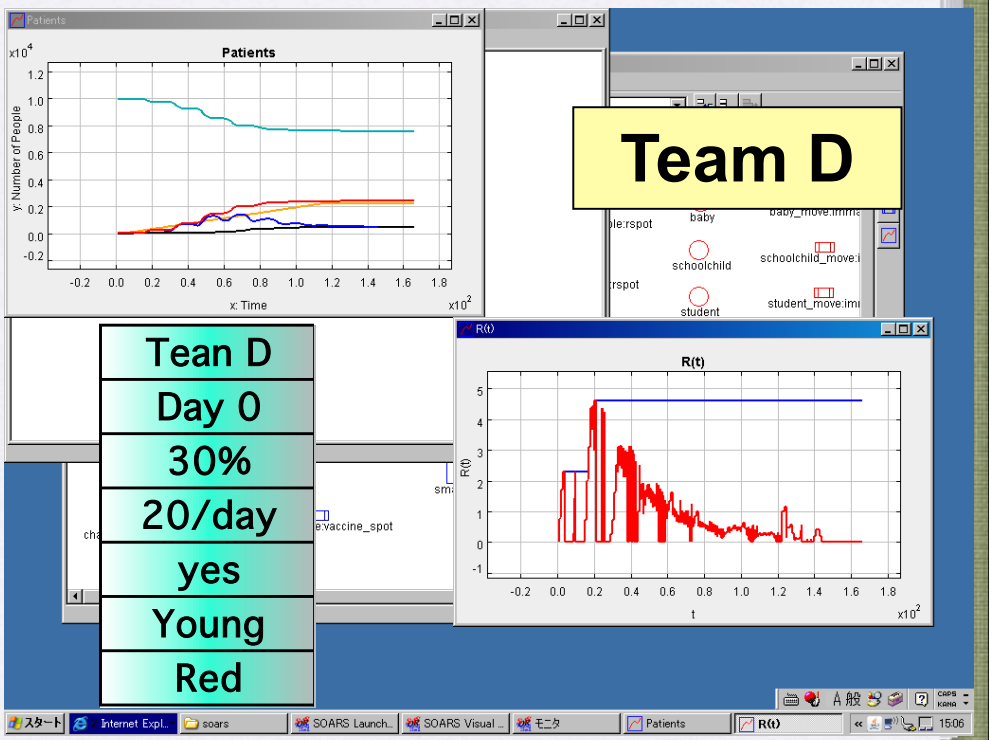
		TeamA	TeamB	TeamC	TeamD
Delay of Vaccination		**Day 14**	**Day 7**	**Day 7**	**Day 0**
Stock of Vaccine		**100%**	**30%**	**60%**	**30%**
Vaccination par Day		**20 /** Day	**300/**Day	**300/**Day	**20 /** Day
School Close		Yes	No	Yes	No
Generation Target		**All** Generation	**Young** Generation	**All** Generation	**Young** Generation
Group Target		**Yellow**	**Random (mass)**	**Random (mass)**	**Red**
	Audience	1	5	21	21

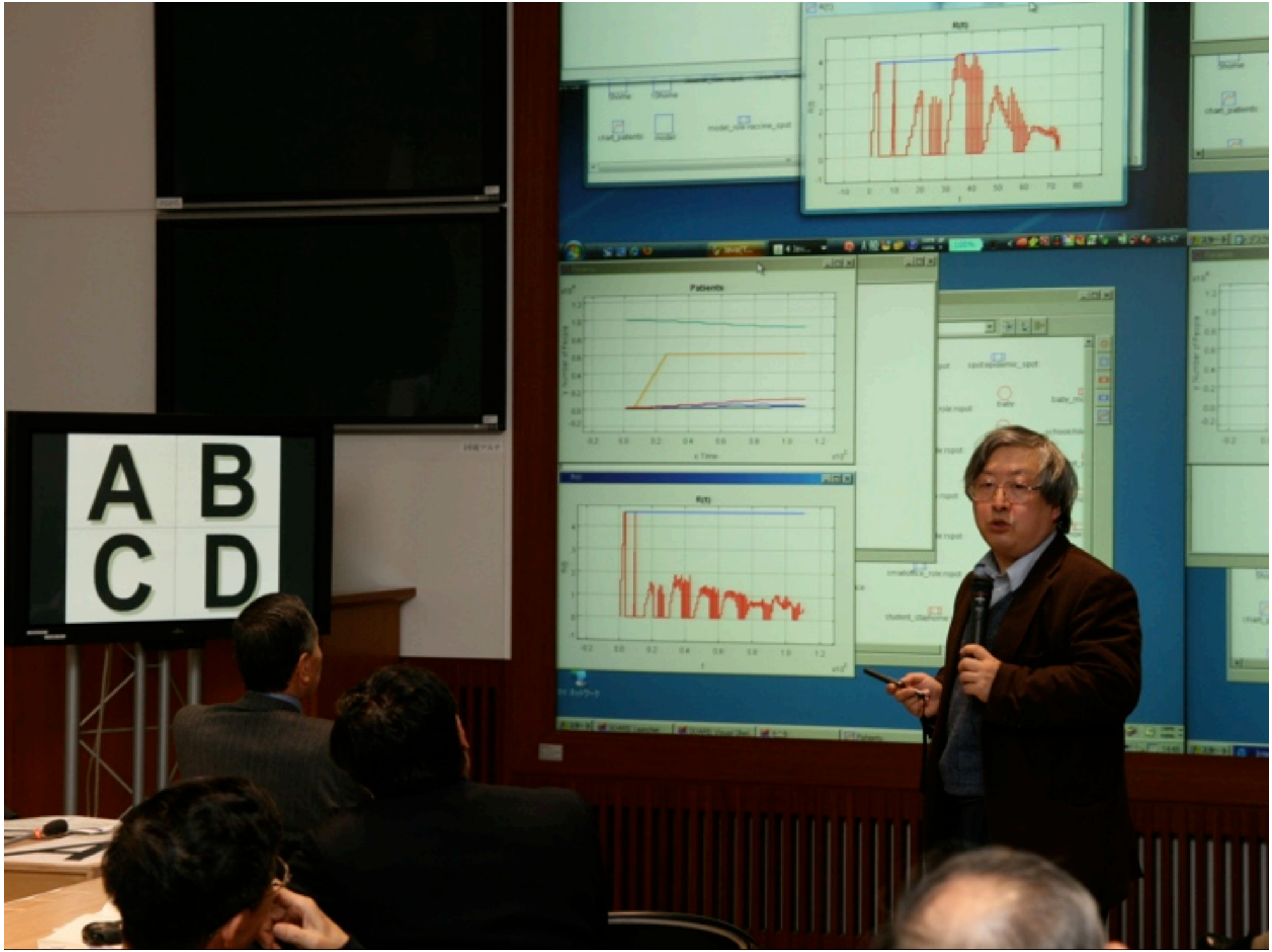
A
B
A B
C D


Team A
Patients
R(t)
Tean A
Day 14
100%
20/day
yes
all gen.
Yellow

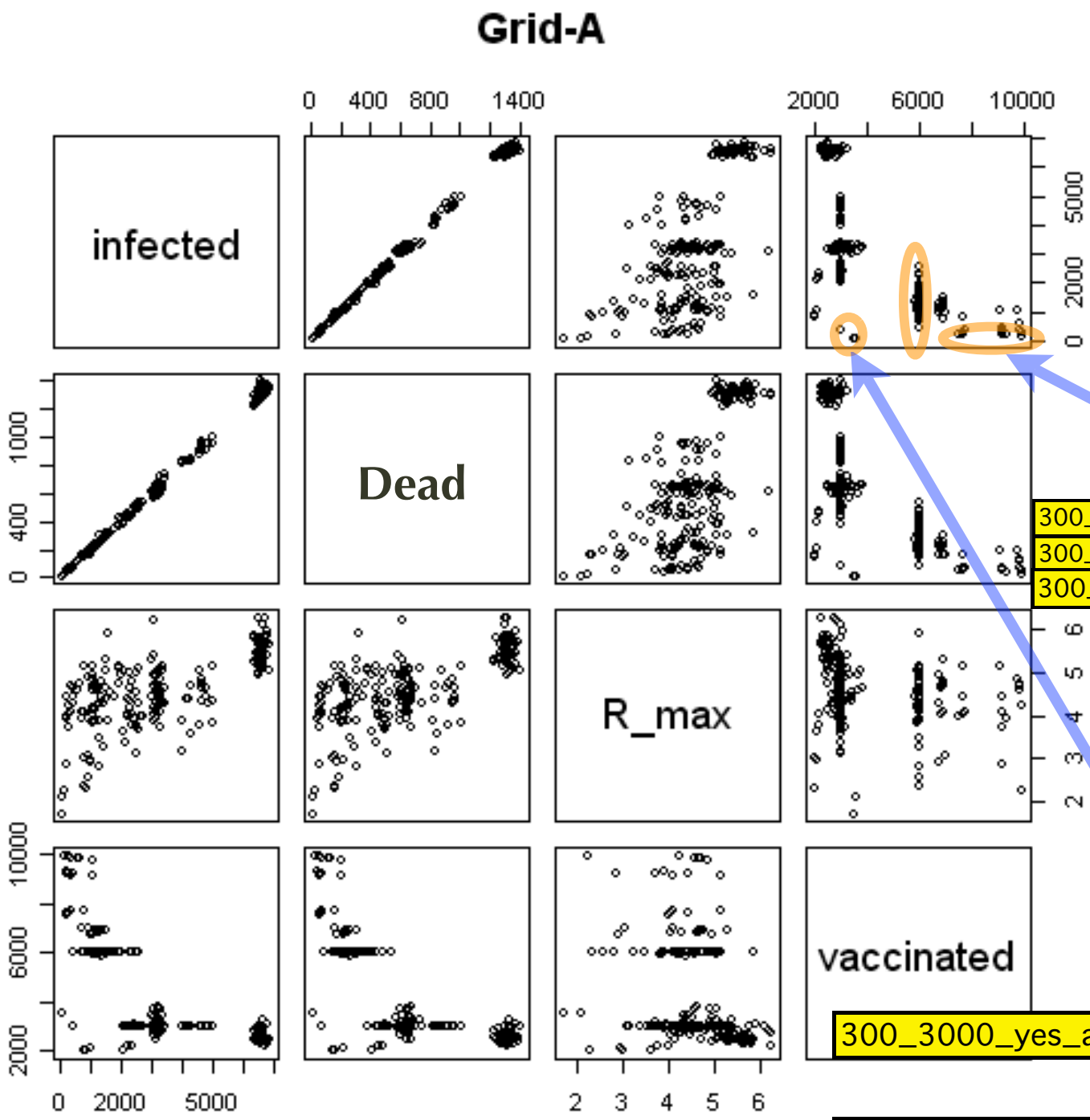

Team B
Patients
R(t)
Tean B
Day 7
30%
300/day
no
Young
Mass


Team C
Patients
R(t)
Tean C
Day 7
60%
300/day
yes
all gen.
Mass


Team D
Patients
R(t)
Tean D
Day 0
30%
20/day
yes
Young
Red


A B
C D
R(t)
Patients
R(t)

Grid Simulation of 216 Scenarios A

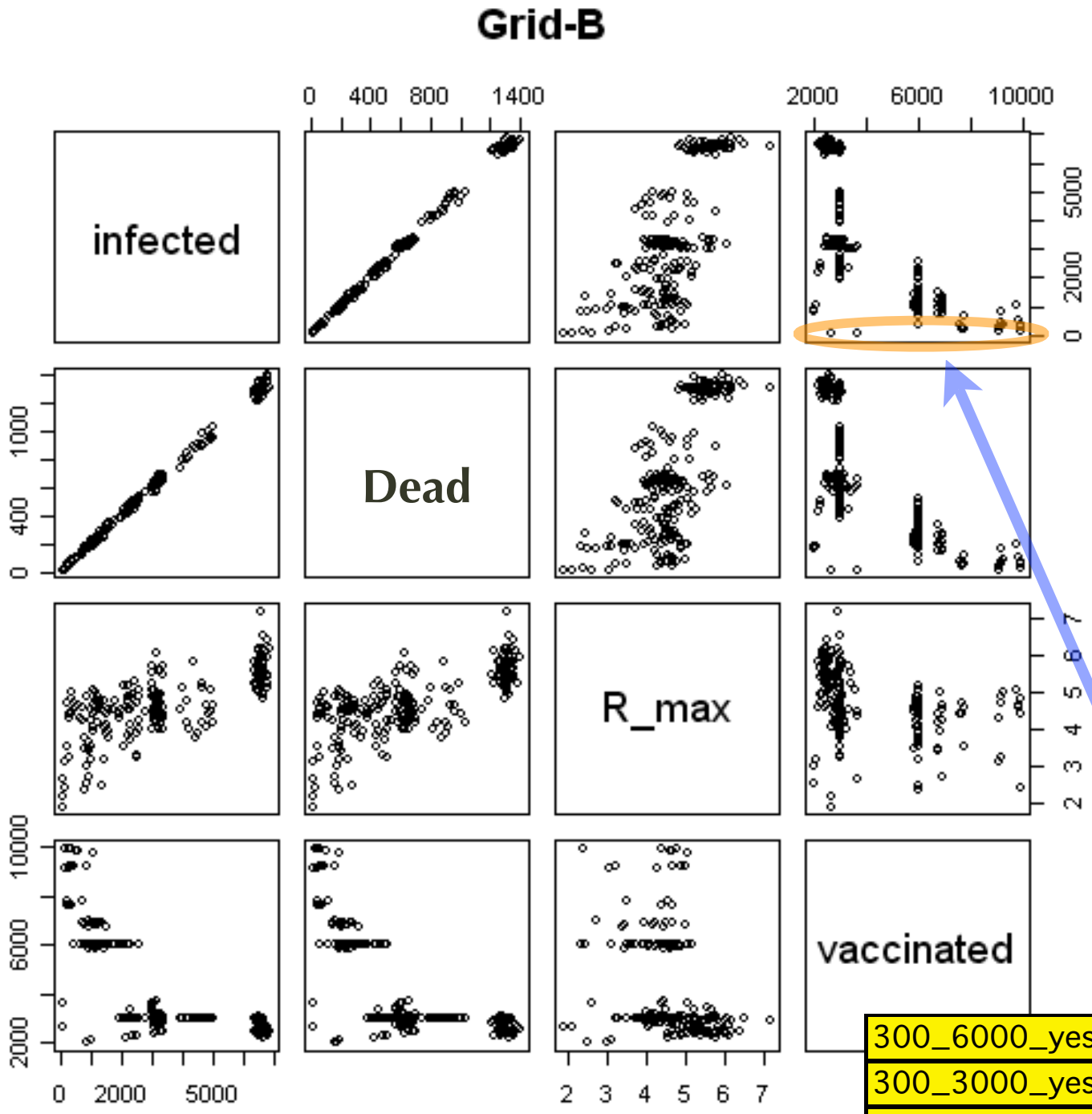


300_6000_yes_allr_0	54
300_10000_yes_allr_0	68
300_10000_yes_all_0	121

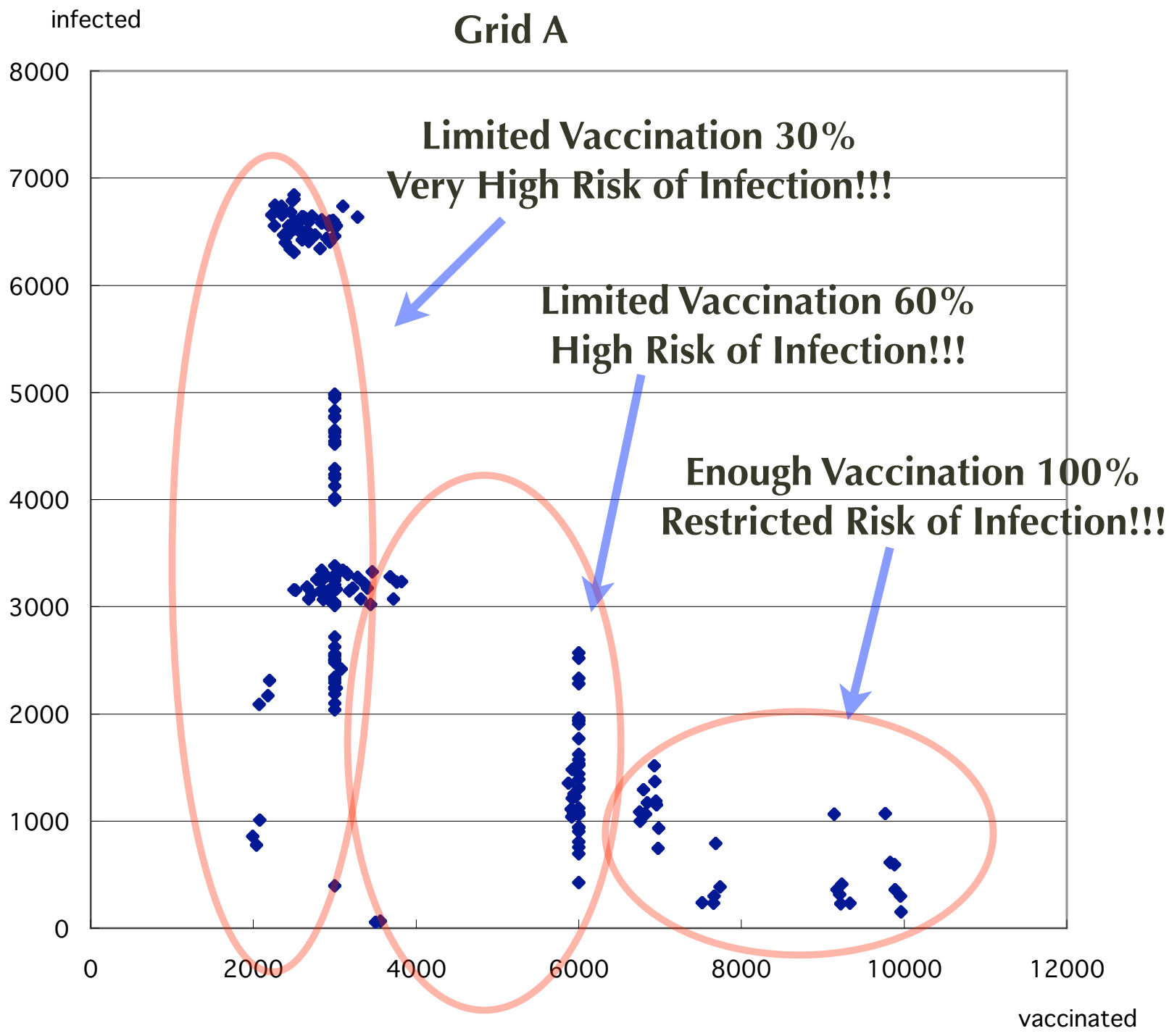
300_3000_yes_allr_0	393

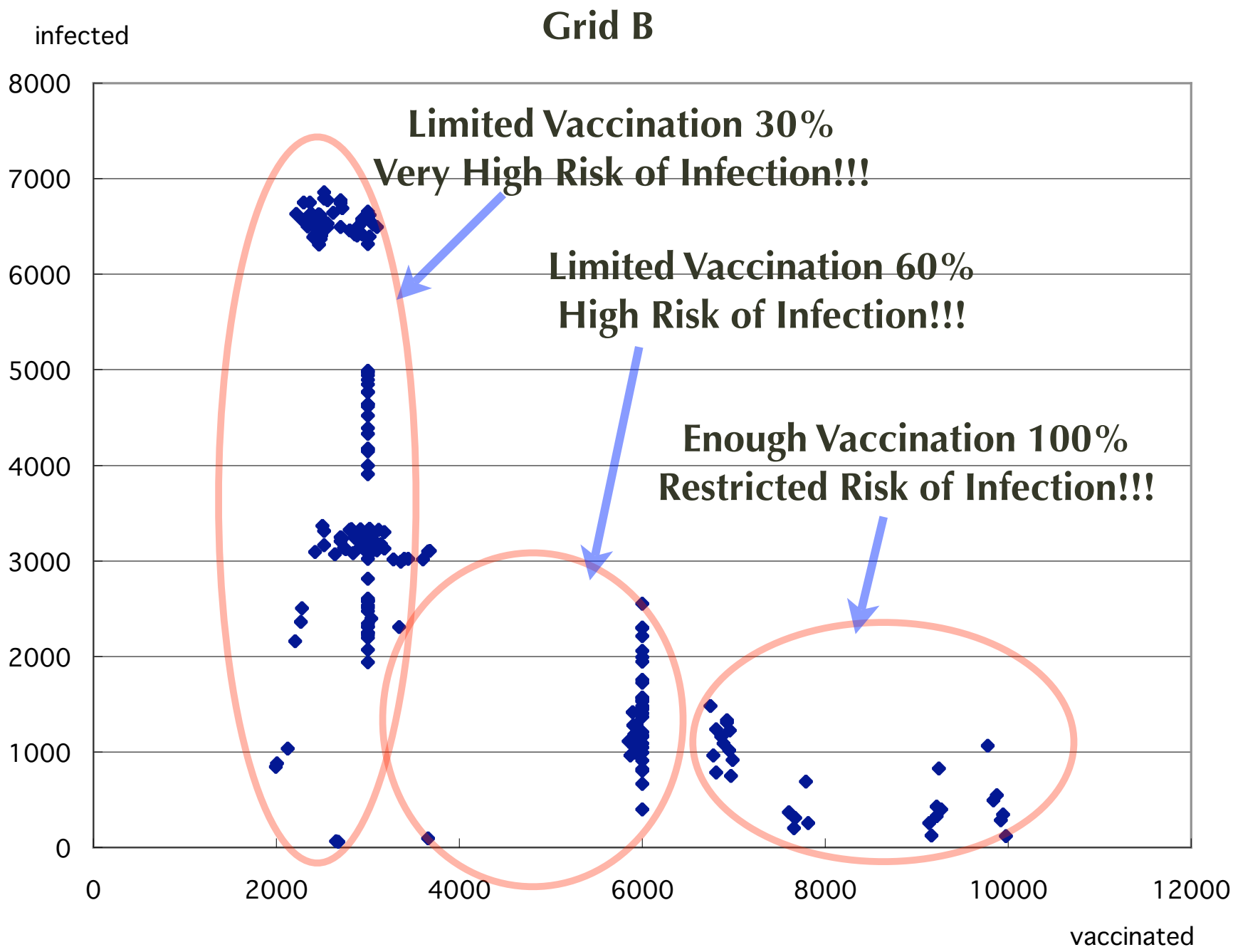
300_3000_yes_yr_0	778

Grid Simulation of 216 Scenarios B



300_6000_yes_allr_0	62
300_3000_yes_allr_0	65
300_10000_yes_allr_0	93


Grid A
infected
8000
7000
6000
5000
4000
3000
2000
1000
0
0
2000
4000
6000
8000
10000
12000
vaccinated
Limited Vaccination 30%
Very High Risk of Infection!!!
Limited Vaccination 60%
High Risk of Infection!!!
Enough Vaccination 100%
Restricted Risk of Infection!!!

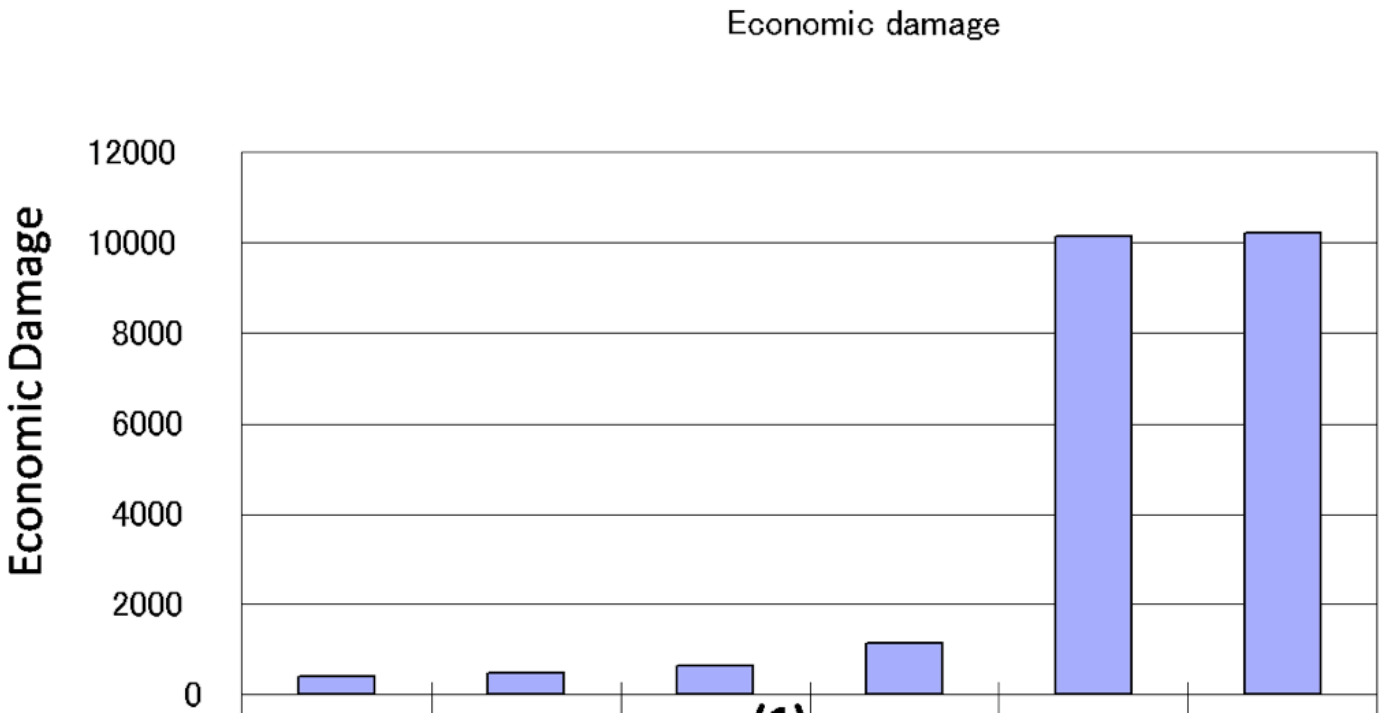

Grid B
infected
8000
7000
6000
5000
4000
3000
2000
1000
0
0
2000
4000
6000
8000
10000
12000
vaccinated
Limited Vaccination 30%
Very High Risk of Infection!!!
Limited Vaccination 60%
High Risk of Infection!!!
Enough Vaccination 100%
Restricted Risk of Infection!!!

old PC	Ability	Max Vaccine	Vaccination Strategy	del ay	Office Close	School Close	Infected	Dead	R Max	days	Vaccinated	Economic damage

old PC	Ability	Max Vaccine	Vaccination Strategy	del ay	Office Close	School Close	Infected	Dead	R Max	days	Vaccinated	Economic damage
0	300	10000	all	10	no	yes	213	37	4.1	61/16:00	9916	708
0.3	300	10000	all	10	no	yes	265	46	3.75	61/19:30	9902	805
0	300	10000	all	15	no	yes	298	67	4.05	70/18:30	9879	988
0	300	10000	all	10	no	no	563	118	3.85	60/19:30	9863	1458
0	20	10000	all	0	no	no	5040	1022	4.9	153/15:00	3080	10920
0	20	10000	all	10	no	no	5130	1016	5.26	153/15:30	2900	10980

0	300	10000	All Red	10	no	yes	128	28	3.15	57/19:00	7566	558
0	300	10000	All Red	15	no	yes	150	25	3	60/20:30	7476	580
0	300	10000	All Red	0	no	no	280	64	4.35	44/19:00	7485	825
0.3	300	10000	All Red	10	no	yes	256	47	4.7	74/13:00	7665	866
0	300	10000	All Red	10	no	no	370	72	4.5	72/05:30	7472	1090
0	300	6000	All Red	10	no	yes	275	52	3.55	123/20:00	6000	1155
0	300	6000	All Red	10	no	yes	294	65	4.1	153/15:30	6000	1389
0	300	6000	All Red	0	no	no	550	121	4.25	140/12:30	6000	1860
0	300	6000	All Red	0	no	no	594	129	3.7	200/09:30	6000	2239
0	300	6000	All Red	10	no	no	823	151	5.05	155/13:00	6000	2358
0	300	6000	All Red	10	no	no	830	152	4.25	186/17:30	6000	2525
0	300	3000	All Red	0	no	no	3196	615	4.1	201/19:30	3000	7281
0	300	3000	All Red	10	no	no	3078	642	3.6	213/13:00	3000	7358
0	20	10000	All Red	10	no	no	5091	980	5.26	148/14:30	2800	10736

old PC	Ability	Max Vaccine	Vaccination Strategy	del ay	Office Close	School Close	Infected	Dead	R Max	days	Vaccinated	Economic damage
0	300	6000	Young Red	10	no	yes	139	22	3.65	57/00:00	5787	534
0	300	6000	Young Red	0	no	no	141	26	3.55	58/18:30	5762	566
0	300	10000	Young Red	15	no	yes	193	33	3.8	58/10:00	5673	648
0	300	6000	Young Red	10	no	yes	196	33	4.4	58/19:00	5794	656
0	300	10000	Young Red	0	no	no	162	24	3.9	76/17:30	5812	667
0	300	6000	Young Red	0	no	no	172	28	3.95	72/03:0	5752	672
0	300	10000	Young Red	10	no	yes	181	35	3.5	73/10:00	5846	721
0	300	6000	Young Red	10	no	no	264	52	3.4	57/21:00	5800	814
0	300	6000	Young Red	10	no	no	270	50	3.8	60/02:30	5718	820
0	300	10000	Young Red	10	no	no	290	48	3.95	78/03:00	5810	920
0	300	3000	Young Red	10	no	yes	812	153	3.95	267/18:00	3000	2917
0	300	3000	Young Red	10	no	yes	872	177	3.65	342/19:00	3000	3472
0.3	300	10000	Young Red	10	no	yes	1102	228	4.7	318/13:30	15291	3837
0	300	3000	Young Red	10	no	no	2331	473	4.45	266/18:30	3000	6031
0	300	3000	Young Red	0	no	no	2228	468	2.9	313/21:30	3000	6138
0	300	3000	Young Red	0	no	no	2340	462	3	311/17:00	3000	6210
0	300	3000	Young Red	10	no	no	2280	461	3.65	359/12:0	3000	6385
0	20	10000	Young Red	10	no	no	4751	1000	4.55	135/12:30	2465	10431



Strategy						
School Shutdown	yes	yes	yes	no	no	no
Office Shutdown	no	no	no	no	no	no
Vaccination Delay	10	10	15	10	0	10
Vaccination Strategy	all	all	all	all	all	all
Vaccine Stocks	10000	10000	10000	10000	10000	10000
Vaccination Speed (/day)	300	300	300	300	20	20
Middle and old Immunity	0	0.3	0	0	0	0

(1) If there are sufficient vaccine stocks (10,000) and there is a school shutdown, then a "mass random" strategy can be effective.

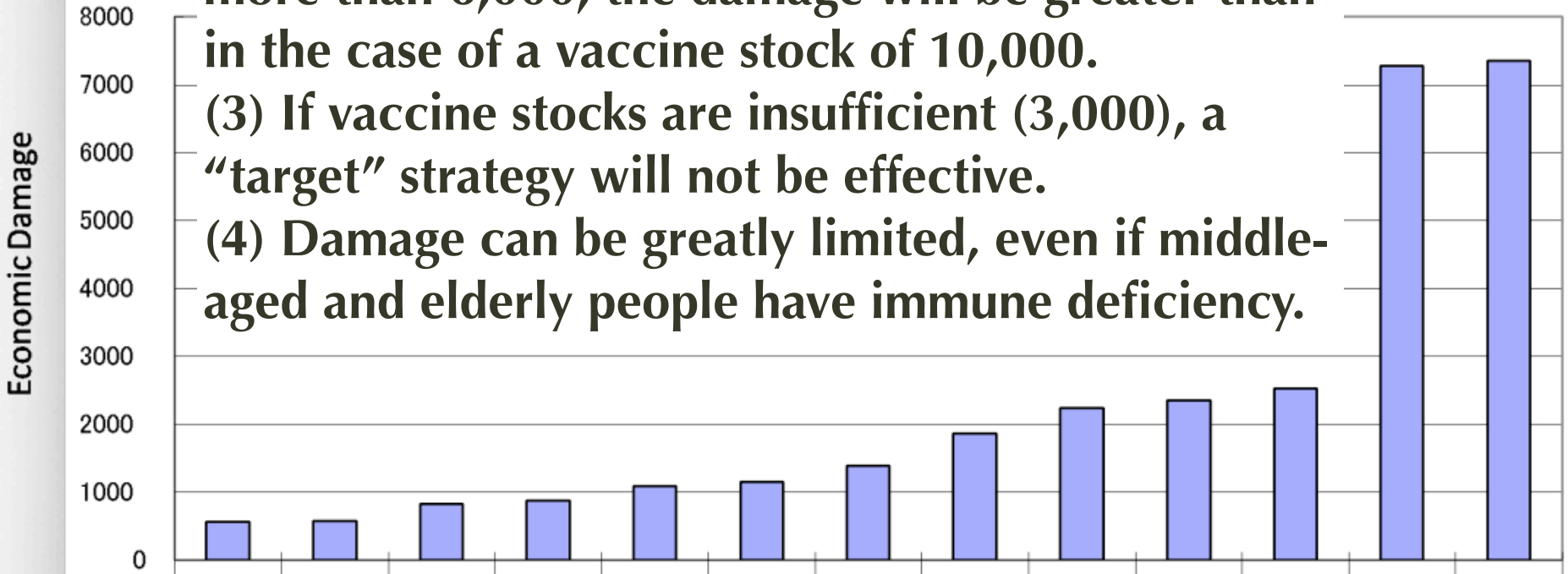
(2) However, if vaccination is delayed, then no effect can be expected – even if there are sufficient stocks.

(1) As there is sufficient vaccination stock (10,000), the "target" strategy brings very good results.

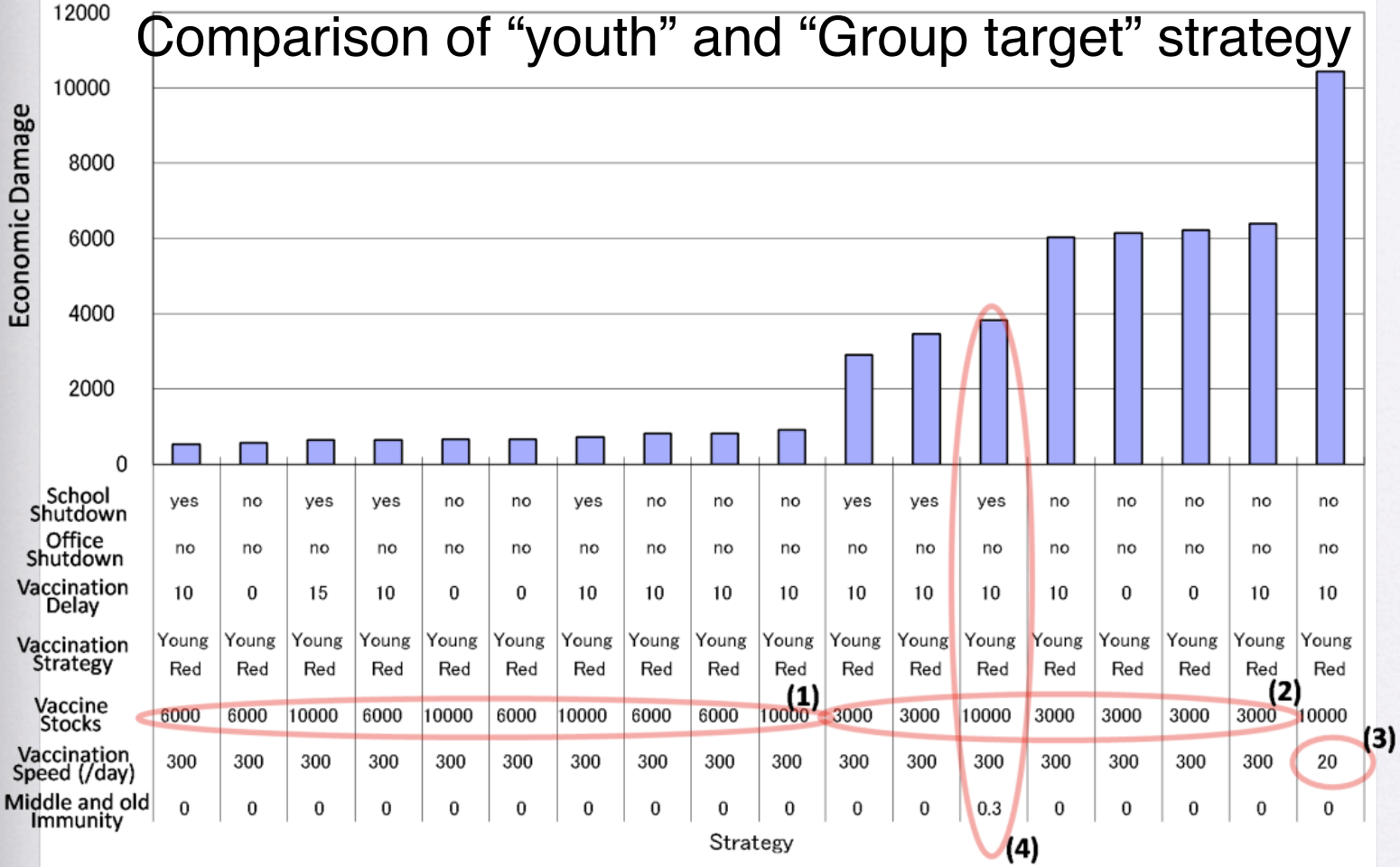
(2) As the required number of vaccinations is more than 6,000, the damage will be greater than in the case of a vaccine stock of 10,000.

(3) If vaccine stocks are insufficient (3,000), a "target" strategy will not be effective.

(4) Damage can be greatly limited, even if middle-aged and elderly people have immune deficiency.



School Shutdown	yes	yes	no	yes	no	yes	yes	no	no	no	no	no	no
Office Shutdown	no	no	no	no	no	no	no	no	no	no	no	no	no
Vaccination Delay	10	15	0	10	10	10	10	0	0	10	10	0	10
Vaccination Strategy	All Red	All Red	All Red	All Red	All Red	All Red	All Red	All Red	All Red	All Red	All Red	All Red	All Red
Vaccine Stocks	10000	10000	10000	10000	10000 (1)	6000	6000	6000	6000	6000	6000 (2)	3000	3000 (3)
Vaccination Speed (/day)	300	300	300	300	300	300	300	300	300	300	300	300	300
Middle and old Immunity	0	0	0	0.3 (4)	0	0	0	0	0	0	0	0	0



School Shutdown	yes	no	yes	yes	no	no	yes	no	no	no	yes	yes	yes	no	no	no	no	no
Office Shutdown	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
Vaccination Delay	10	0	15	10	0	0	10	10	10	10	10	10	10	10	0	0	10	10
Vaccination Strategy	Young Red	Young Red	Young Red	Young Red	Young Red	Young Red	Young Red	Young Red	Young Red	Young Red	Young Red	Young Red	Young Red	Young Red	Young Red	Young Red	Young Red	Young Red
Vaccine Stocks	6000	6000	10000	6000	10000	6000	10000	6000	6000	10000	3000	3000	10000	3000	3000	3000	3000	10000
Vaccination Speed (/day)	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	20
Middle and old Immunity	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0	0	0	0	0

(1) The reason why there is no difference between the cases of 100% vaccine stocks and 60% vaccine stocks where there is little damage, is that the virus eradication standard is 60% or lower.

(2) The effect is slight when vaccine stocks are below the eradication standard.

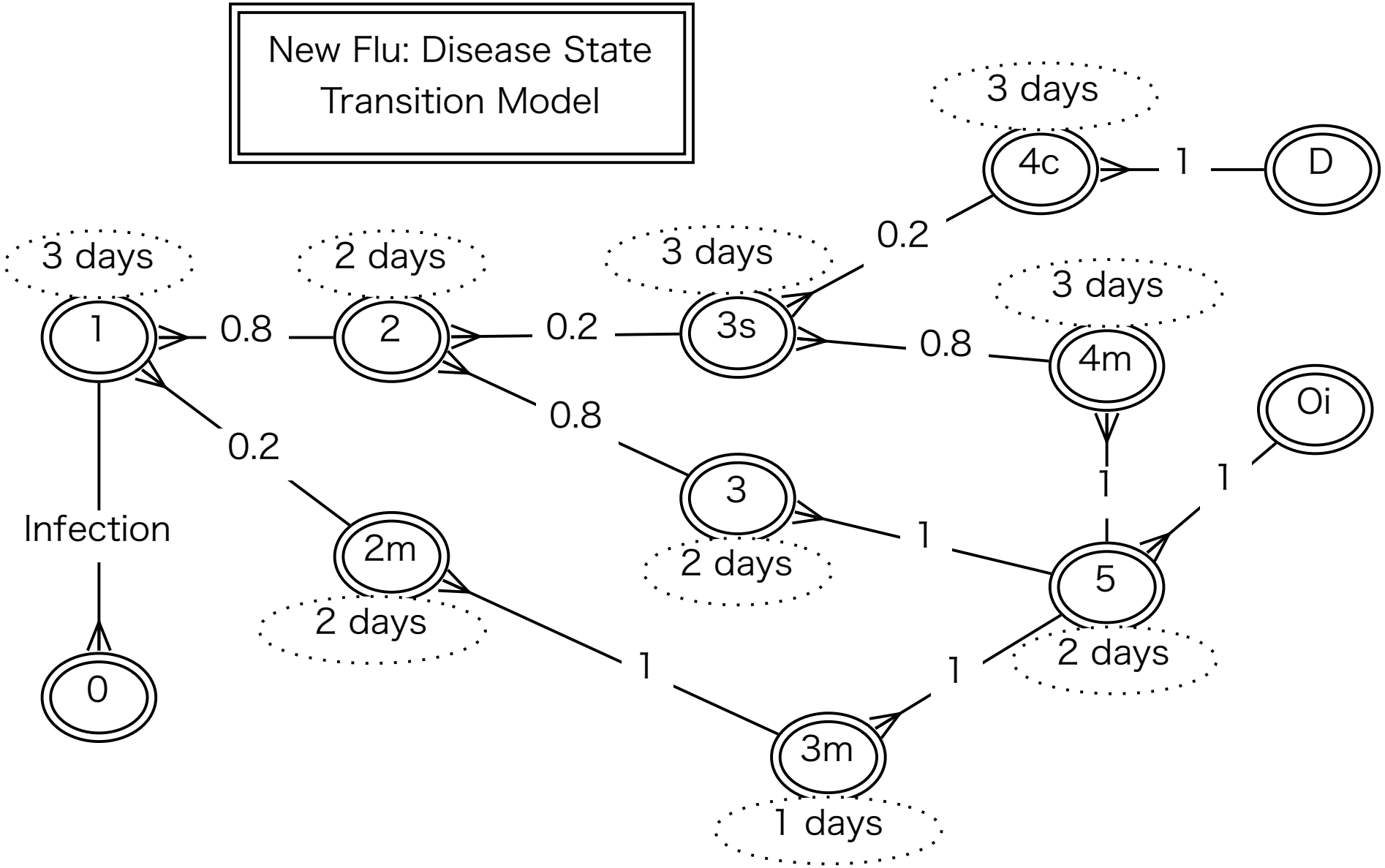
(3) The effect is slight even if there are high vaccine stocks, if the vaccination speed is slow.

(4) When middle-aged and elderly persons have immune deficiency, a vaccination strategy focused on young persons is very risky.

<summary>
If there are insufficient vaccine stocks,
1) despite employing a strategy that targets specific groups, if total vaccine stocks are below the virus eradication standard a disastrous spread of the infection occurs;
2) simulation results vary significantly depending on whether stock levels are below or above the eradication standard. This cannot be estimated accurately at this point;
3) The cases of targeting young generations can actually increase risk when middle-aged and elderly persons do not have antibodies.

Pandemic Protection Management against New Flu

Pathological transition model for influenza



Pathological Stage Transition Model of Influenza 1

Age	
b	baby
c	child
y	young
m	midle
o	old

In the disease stage model we introduce the transition probability model between stage.

Stage	Explanation	Period	Excretion	Scale
0i	Recovery with immunity		No	0
1	First Stage	2 days	little	0.2
2	Second Stage: high fever	2 days	large	0.6
2m	Second Mild Stage: slight fever	2 days	little+	0.4
3	Third Stage: feaver	2 days	large+	0.8
3m	Third Mild Stage: slight feaver	1 day	medium	0.5
3s	Third Severe Stage	3 days	large	0.6
3p	Third Pneumonia Stage	3 days	large	0.6
4c	Fourth Critical Stage	3 days	medium	0.5
4m	Fourth Mild Stage	3 days	medium	0.5
5	Fifth Recovery Stage	2 days	little	0.2
D	Death		No	0

Pathological Stage Transition Model of Influenza 2

Vaccination of Influenza

Vaccination of pneumonia

Treatment by Anti Virus Drug as Tamiflu

Age	Influ. Vacc.	Pneu. Vacc.	Disease Stage	Tran. Prob.	Disease Stage	Treat	Tran. Prob.	Disease Stage	Tran. Prob.	Disease Stage	Tran. Prob.	Disease Stage	tran. prob.	Disease Stage	Day	prob.	Prob. Sum.
b,y,c,m	No	No	1	0.8	2	-	0.8	3	1	5	1	0i			8	0.64	
b,y,c,m	No	No	1	0.8	2	-	0.2	3s	0.8	4m	1	5	1	0i	12	0.128	
b,y,c,m	No	No	1	0.8	2	-	0.2	3s	0.2	4c	1	D			10	0.032	0.8
b,y,c,m	No	No	1	0.8	2	Treat	0.5	3m	1	5	1	0i			7	0.4	
b,y,c,m	No	No	1	0.8	2	Treat	0.4	3	1	5	1	0i			8	0.32	
b,y,c,m	No	No	1	0.8	2	Treat	0.1	3s	0.8	4m	1	5	1	0i	12	0.064	
b,y,c,m	No	No	1	0.8	2	Treat	0.1	3s	0.2	4c	1	D			10	0.016	0.8
b,y,c,m	No	No	1	0.2	2m	-	1	3m	1	5	1	0i			7	0.2	0.2
o	No	No	1	0.9	2	-	0.6	3	1	5	1	0i			8	0.54	
o	No	No	1	0.9	2	-	0.4	3s	0.8	4m	1	5	1	0i	12	0.288	
o	No	No	1	0.9	2	-	0.4	3s	0.2	4c	1	D			10	0.072	0.9
o	No	No	1	0.9	2	Treat	0.4	3m	1	5	1	0i			7	0.36	
o	No	No	1	0.9	2	Treat	0.4	3	1	5	1	0i			8	0.36	
o	No	No	1	0.9	2	Treat	0.2	3s	0.8	4m	1	5	1	0i	12	0.144	
o	No	No	1	0.9	2	Treat	0.2	3s	0.2	4c	1	D			10	0.036	0.9
o	No	No	1	0.1	2m	-	1	3m	1	5	1	0i			7	0.1	0.1
b,y,c,m	Yes	No	1	0.5	2	-	0.8	3	1	5	1	0i			8	0.4	
b,y,c,m	Yes	No	1	0.5	2	-	0.2	3s	0.8	4m	1	5	1	0i	12	0.08	
b,y,c,m	Yes	No	1	0.5	2	-	0.2	3s	0.2	4c	1	D			10	0.02	0.5
b,y,c,m	Yes	No	1	0.5	2	Treat	0.5	3m	1	5	1	0i			7	0.25	
b,y,c,m	Yes	No	1	0.5	2	Treat	0.4	3	1	5	1	0i			8	0.2	
b,y,c,m	Yes	No	1	0.5	2	Treat	0.1	3s	0.8	4m	1	5	1	0i	12	0.04	
b,y,c,m	Yes	No	1	0.5	2	Treat	0.1	3s	0.2	4c	1	D			10	0.01	0.5
b,y,c,m	Yes	No	1	0.5	2m	-	1	3m	1	5	1	0i			7	0.5	0.5

Pathological Stage Transition Model of Influenza 3

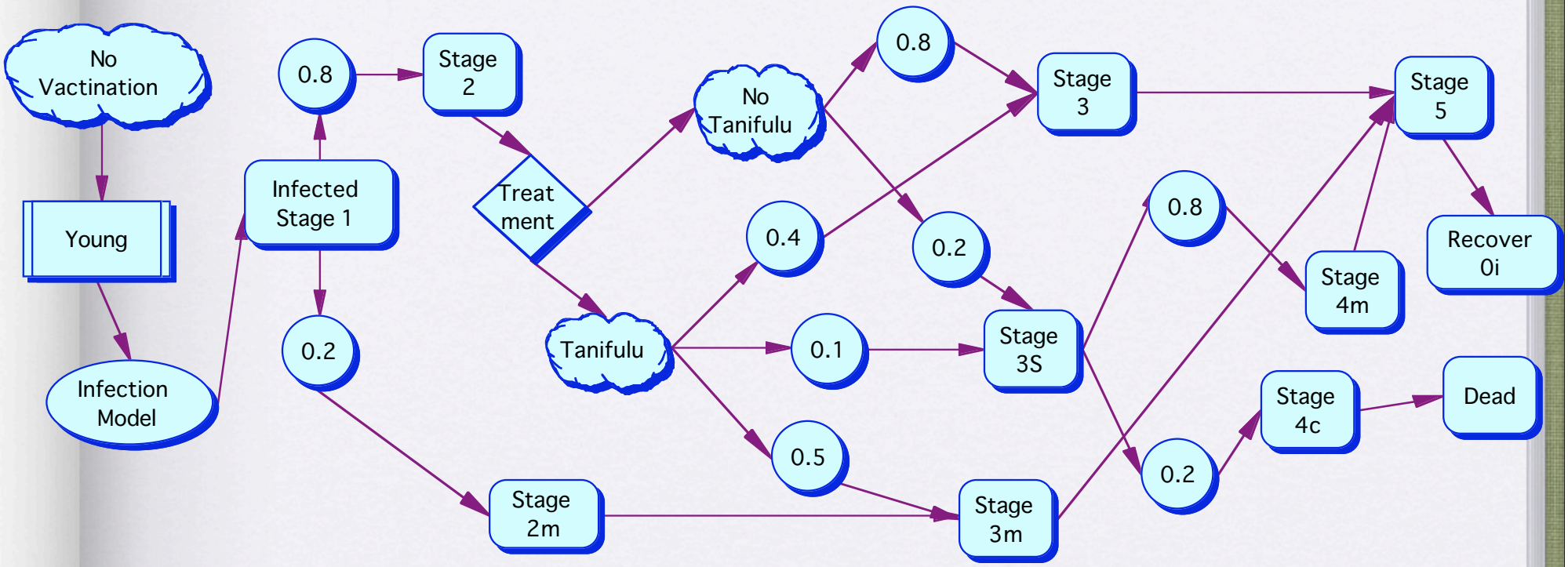
Vaccination of Influenza

Vaccination of pneumonia for old age

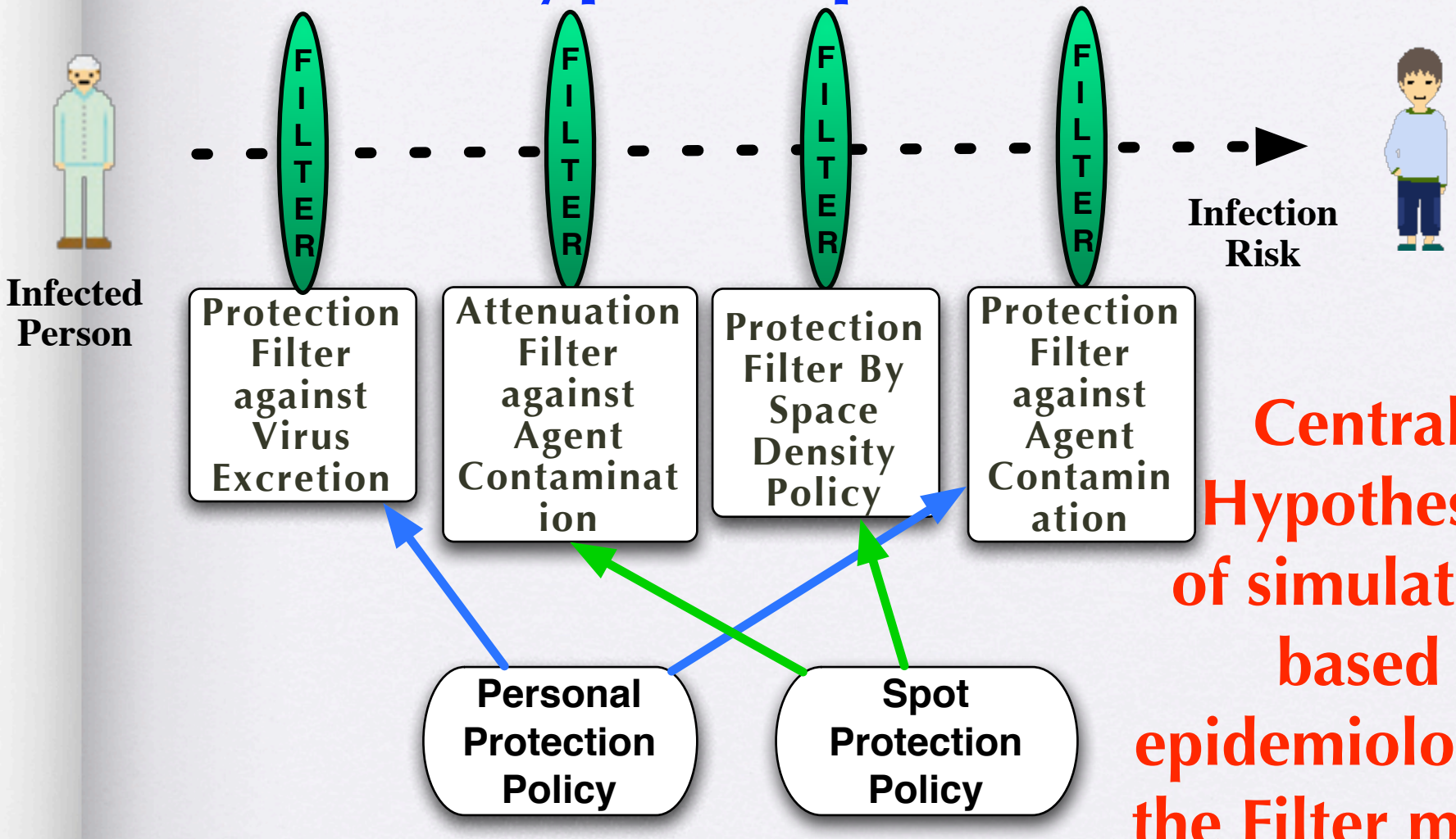
Treatment by Anti Virus Drug as Tamiflu

Age	Influ. Vacc.	Pneu. Vacc.	Disease Stage	Tran. Prob.	Disease Stage	Treat	Tran. Prob.	Disease Stage	Tran. Prob.	Disease Stage	Tran. Prob.	Disease Stage	tran. prob.	Disease Stage	Day	prob.	Prob. Sum.
o	Yes	No	1	0.5	2	-	0.6	3	1	5	1	0i			8	0.3	
o	Yes	No	1	0.5	2	-	0.4	3s	0.8	4m	1	5	1	0i	12	0.16	
o	Yes	No	1	0.5	2	-	0.4	3s	0.2	4c	1	D			10	0.04	0.5
o	Yes	No	1	0.5	2	Treat	0.4	3m	1	5	1	0i			7	0.2	
o	Yes	No	1	0.5	2	Treat	0.4	3	1	5	1	0i			8	0.2	
o	Yes	No	1	0.5	2	Treat	0.2	3s	0.8	4m	1	5	1	0i	12	0.08	
o	Yes	No	1	0.5	2	Treat	0.2	3s	0.2	4c	1	D			10	0.02	0.5
o	Yes	No	1	0.5	2m	-	1	3m	1	5	1	0i			7	0.5	0.5
o	No	Yes	1	0.9	2	-	0.8	3	1	5	1	0i			8	0.72	
o	No	Yes	1	0.9	2	-	0.2	3s	0.8	4m	1	5	1	0i	12	0.144	
o	No	Yes	1	0.9	2	-	0.2	3s	0.2	4c	1	D			10	0.036	0.9
o	No	Yes	1	0.9	2	Treat	0.7	3m	1	5	1	0i			7	0.63	
o	No	Yes	1	0.9	2	Treat	0.2	3	1	5	1	0i			8	0.18	
o	No	Yes	1	0.9	2	Treat	0.1	3s	0.8	4m	1	5	1	0i	12	0.072	
o	No	Yes	1	0.9	2	Treat	0.1	3s	0.2	4c	1	D			10	0.018	0.9
o	No	Yes	1	0.1	2m	-	1	3m	1	5	1	0i			7	0.1	0.1
o	Yes	Yes	1	0.5	2	-	0.8	3	1	5	1	0i			8	0.4	
o	Yes	Yes	1	0.5	2	-	0.2	3s	0.8	4m	1	5	1	0i	12	0.08	
o	Yes	Yes	1	0.5	2	-	0.2	3s	0.2	4c	1	D			10	0.02	0.5
o	Yes	Yes	1	0.5	2	Treat	0.7	3m	1	5	1	0i			7	0.35	
o	Yes	Yes	1	0.5	2	Treat	0.2	3	1	5	1	0i			8	0.1	
o	Yes	Yes	1	0.5	2	Treat	0.1	3s	0.8	4m	1	5	1	0i	12	0.04	
o	Yes	Yes	1	0.5	2	Treat	0.1	3s	0.2	4c	1	D			10	0.01	0.5
o	Yes	Yes	1	0.5	2m	-	1	3m	1	5	1	0i			7	0.5	0.5

Pathological Transition Model of Young Generation without Vaccination, with Treatment

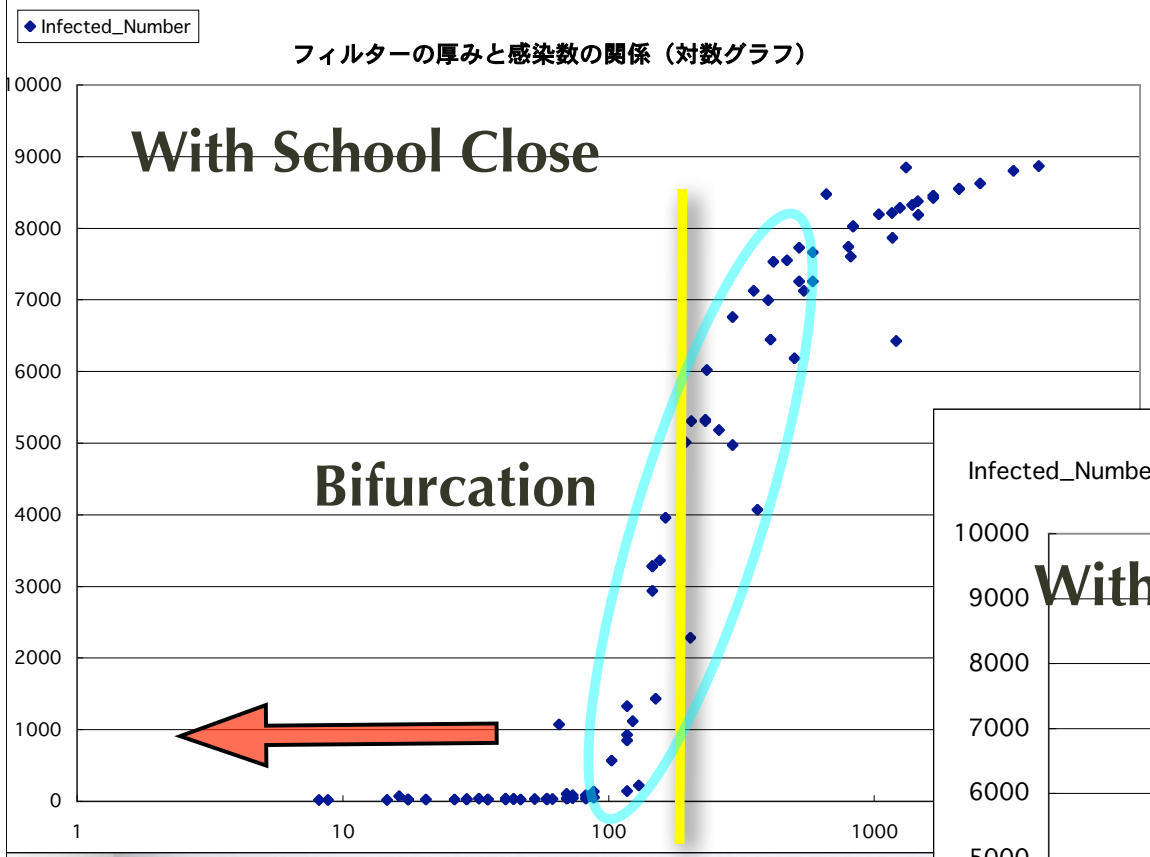


Social Infection Protection Policy is Characterized by the combination of different types of protection filters



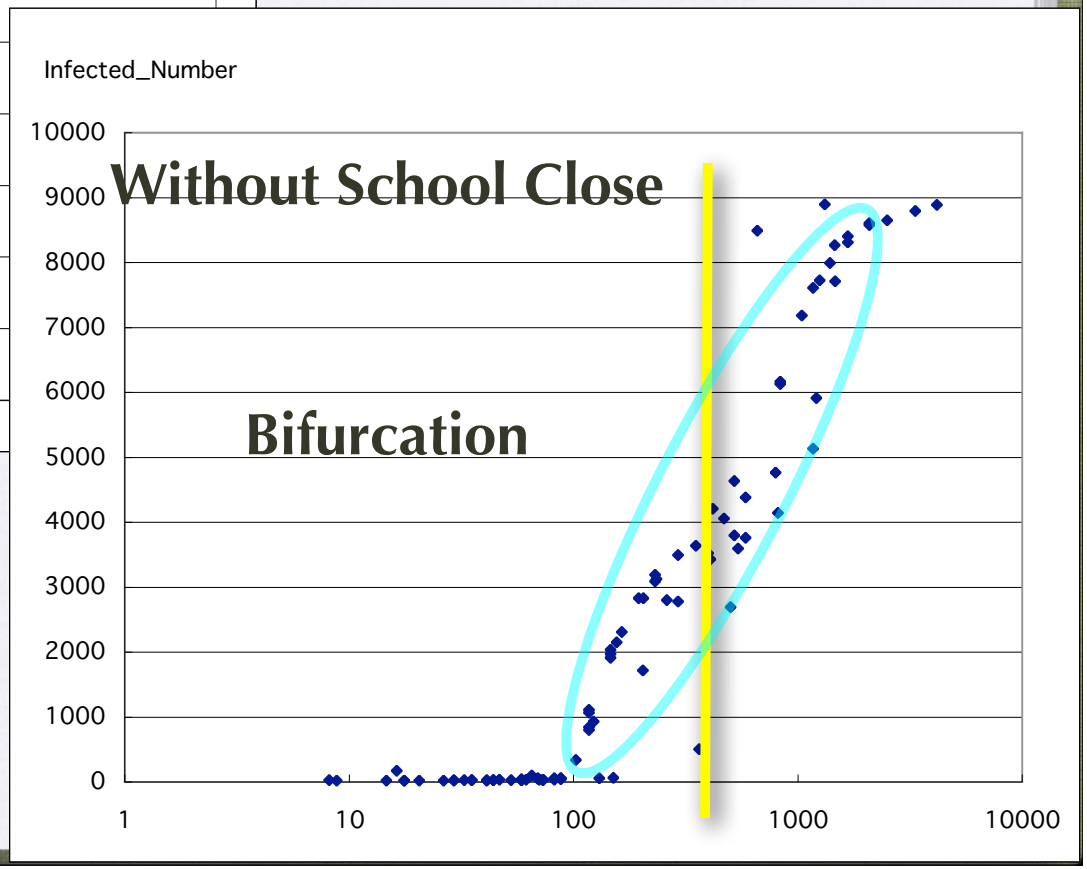
Central Hypothesis of simulation based epidemiology is the Filter model

Relationship between filter "thickness" and "number of infections" (log scale)



Even without vaccination, we can protect pandemic by the combination of several filters.

(1/2)*(1/2)*...=1/(2**n)



The lower the total filter value become, the higher the virus cut rate

Program & Project Management for Pandemic Protection by Social Filter Controlling Policy

Virus Excretion Control

Excretion
Protection Filter

From free commercial tissue

to free commercial mask

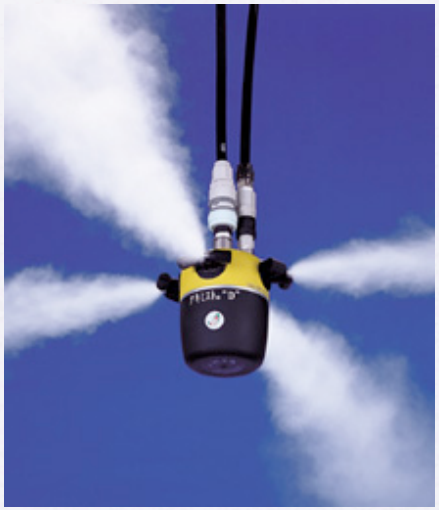
http://
www.planettown.co.jp/

Spot Attenuation Filter by Sterilization

STERILIZATION
BY
ULTRAVIOLET LIGHT

UGVI METHOD
DEPENDING ON
WHO, CDC GUIDELINE

ATTENUATION CONTROL BY HUMIDITY

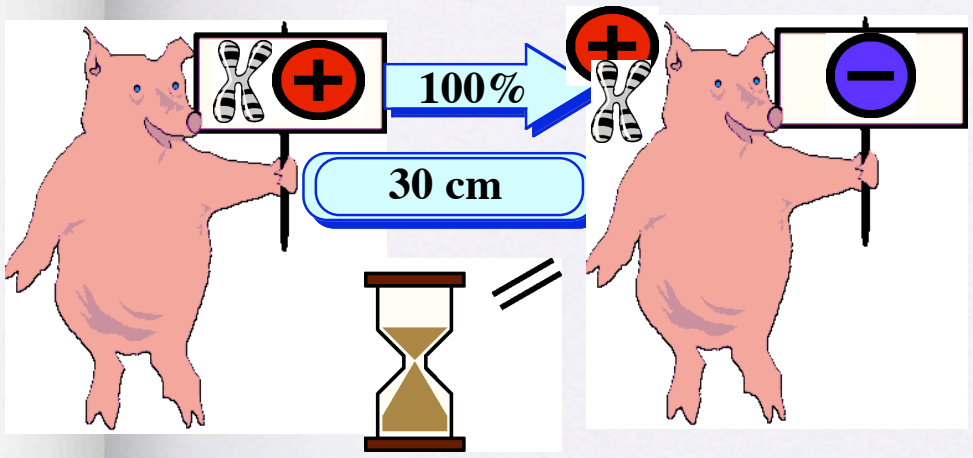


Spot Attenuation Filter by Environmental humidity control

humidifier

Experimental Data for Virtual Space Density Control Policy

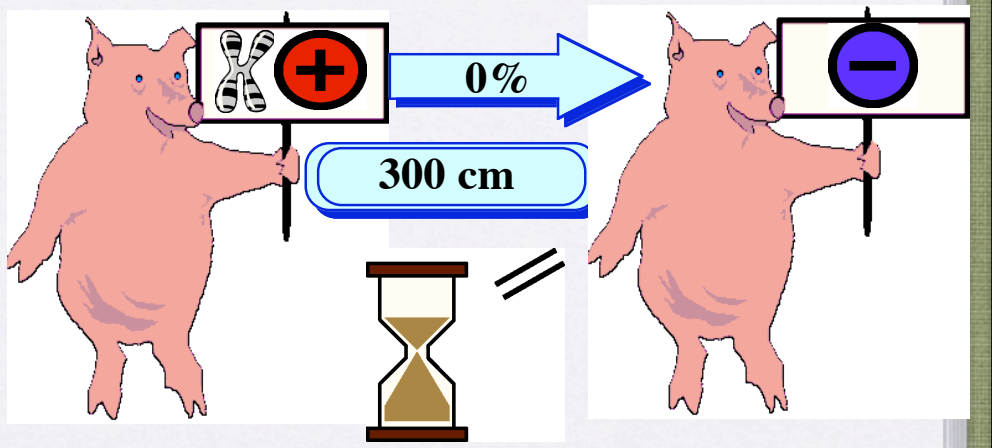
Infection Risk 100%



3 Hours

Experimental Data by Pigs

Infection Risk 0%

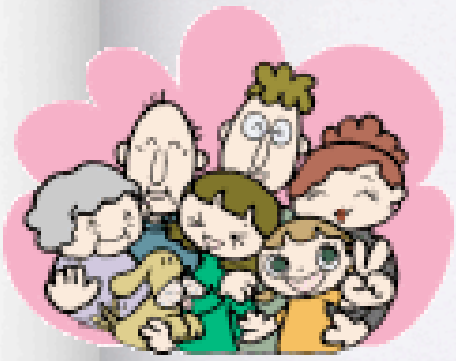


3 Hours

Experimental Data

Torremorell M, Pijoan C, Janni K, Walker R, Joo HS., Airborne transmission of Actinobacillus pleuropneumoniae and porcine reproductive and respiratory syndrome virus in nursery pigs, Am J Vet Res. 1997 Aug;58(8):pp. 828-832

Virtual Density Control at Family



Agent Contamination Protection Filter: by Spacial Density Control

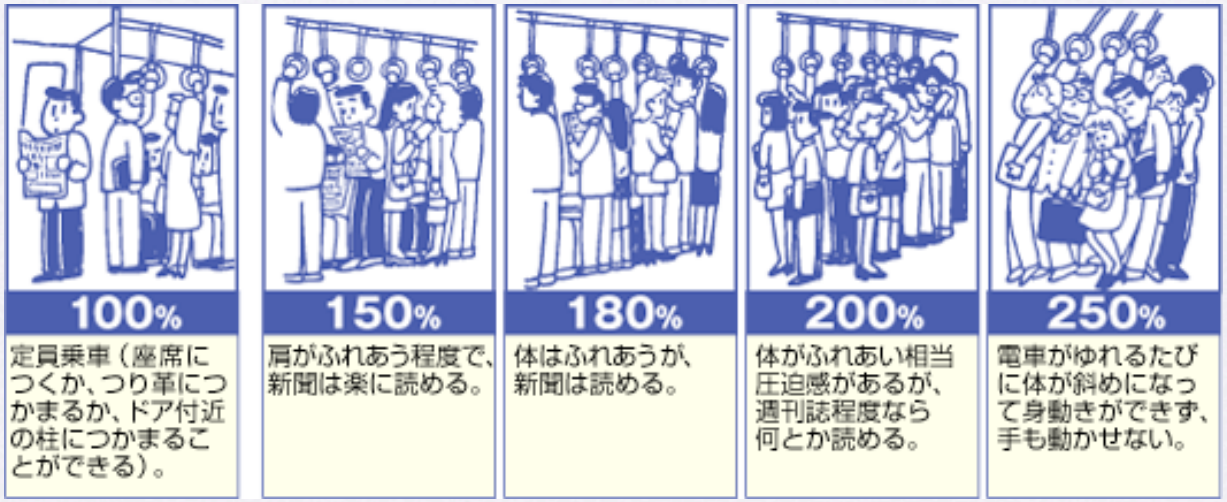
Virtual Density Control at School

混雑した教室で授業を受ける生徒たち

http://www.mofa.go.jp/mofaj/world/kuni/ethiop_1.html

Virtual Density Control on Traffic

Flex Time Work



http://www.mlit.go.jp/kisha/kisha02/01/011024_.html

http://www.seibu-group.co.jp/kawara/special/sp97.html

N95 Mask for personal Protection

N95 Mask Vending Machine
at station or public area

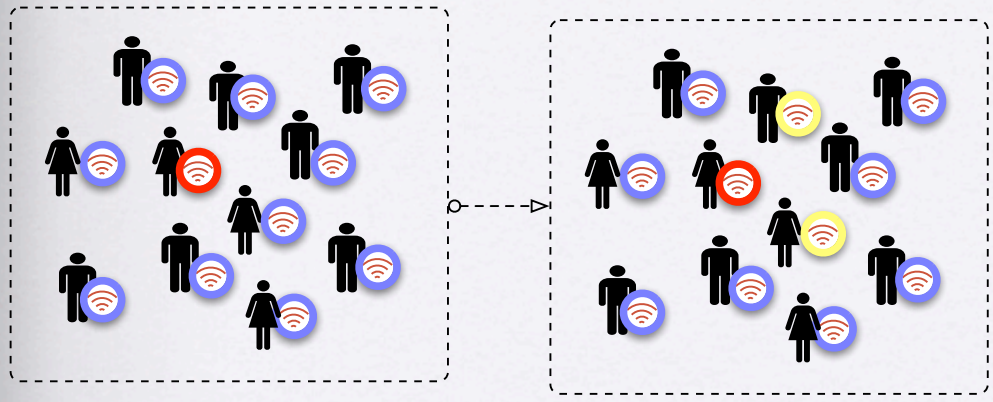
N95 Mask 200 Yen

Agent Contamination Protection
Filter by N95 Mask

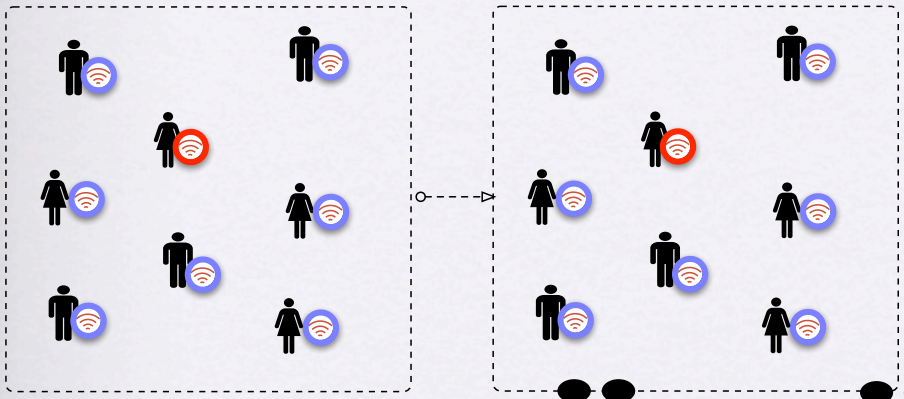
Personal Protection by gargle and washing hands

Agent Attenuation
Filter by Sterilization

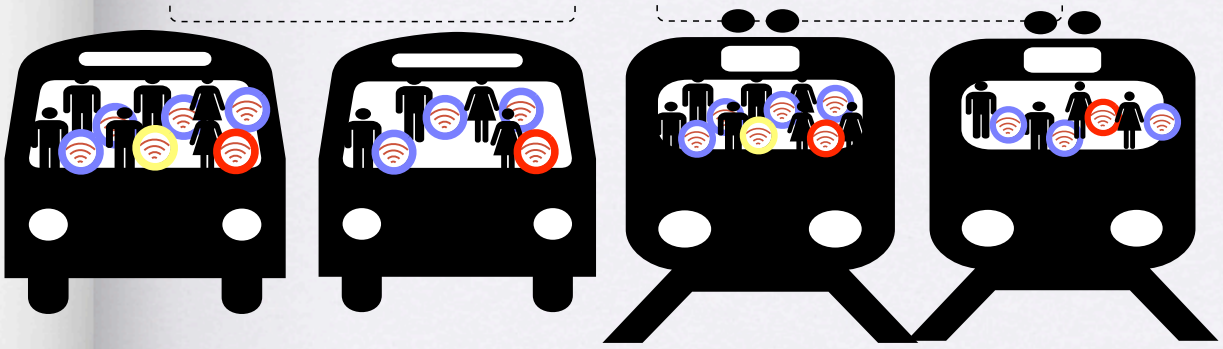
Measurement of Virtual Density by peer to peer wireless cards



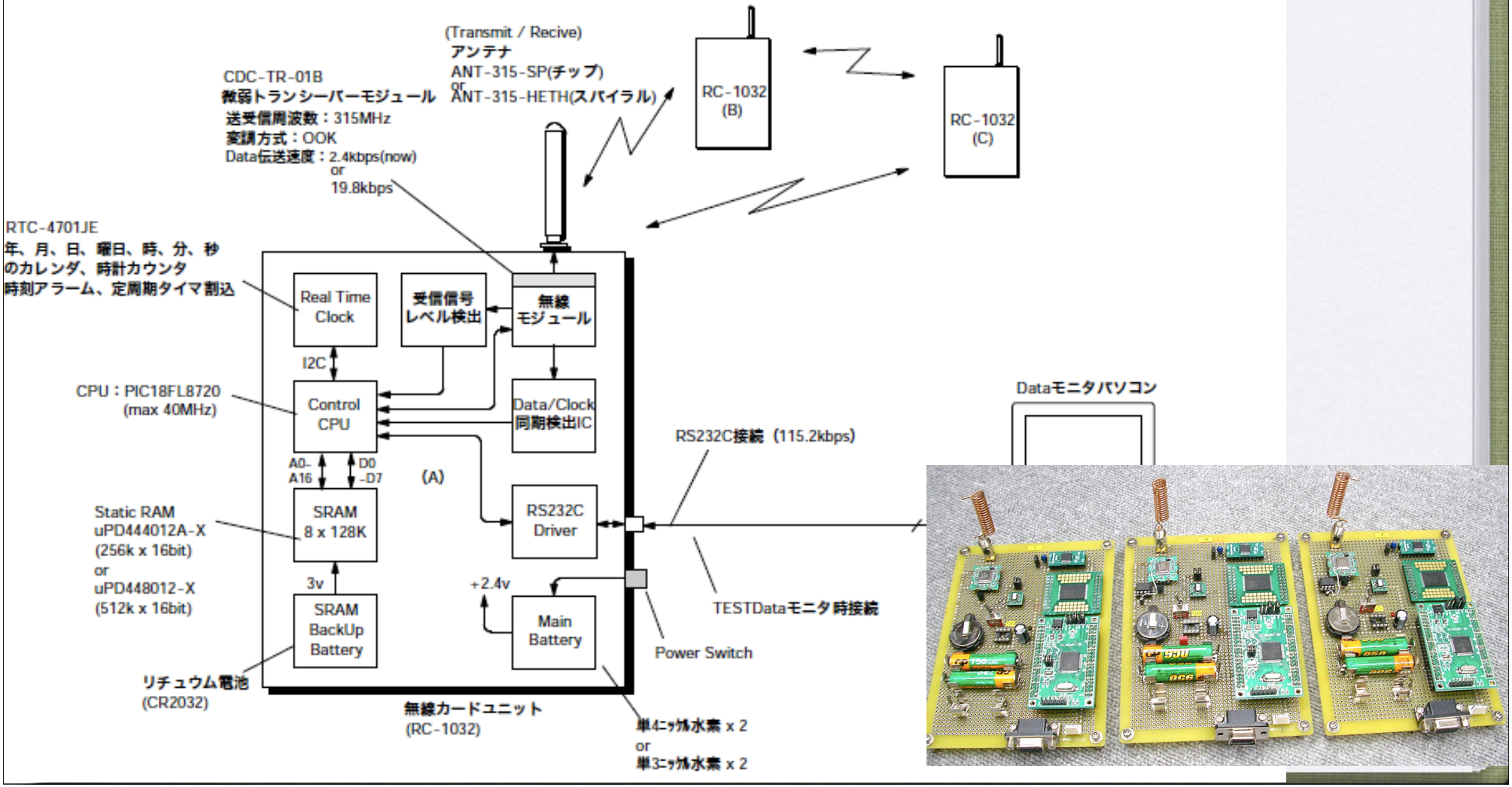
High Density &
High Risk Case



Low Density &
Low Risk Case



We are now developing the wireless card: Welcome the collaboration and funding the research & development!



Program & Project Design for Pandemic Protection

- **We have to design the Social Protection Program for the target organizations.**

Target Cases	Purpose of Control	Measures for Project
School, Traffic,e.t.c.	Excretion Control	Free Mask at Public Space
Home, School, e.t.c.	Attenuation Control	Spread of Humidifier
Hospital, e.t.c.	Attenuation Control	Sterilization & Humidification
School, Office, e.t.c.	Virtual Space Density Control	Sheet Distance Arrangement
Hospital	Virtual Space Density Control	Bed Distance Arrangement
Family	Virtual Space Density Control	Activity Pattern of Family
Traffic	Virtual Space Density Control	Staggered Working, Gate Control
Traffic, Hospital, e.t.c.	Personal Protection Control	N95 Mask Vending Machine
School, Home, e.t.c.	Attenuation Control	Sterilization

Thank You for Your Attention