Section 3:
Controlling Covido-19
## while the vaccine is not developed yet

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Introduction

- The last two sections spread of Covido-19 was discussed under three different scenarios.

- The best scenario was to start strict social distancing and self-protecting in mandatory contacts.

- It was also shown that until the vaccine of the disease is not developed after controlling the first wave of the disease the next waves start although with lower peaks.

- It seems that waves of the disease continue until or susceptible get infected.

- This section develops and discuss policy in addition to social distancing and self-protection to control the disease even more than scenario 1.

- This section examines a policy from the beginning or in the middle of the first wave.

- The policy is testing and screening all who are not symptomatic patients and quratininie the infected asymptomatic persons until they recover.

Major Stock and Flow Structure with Testing
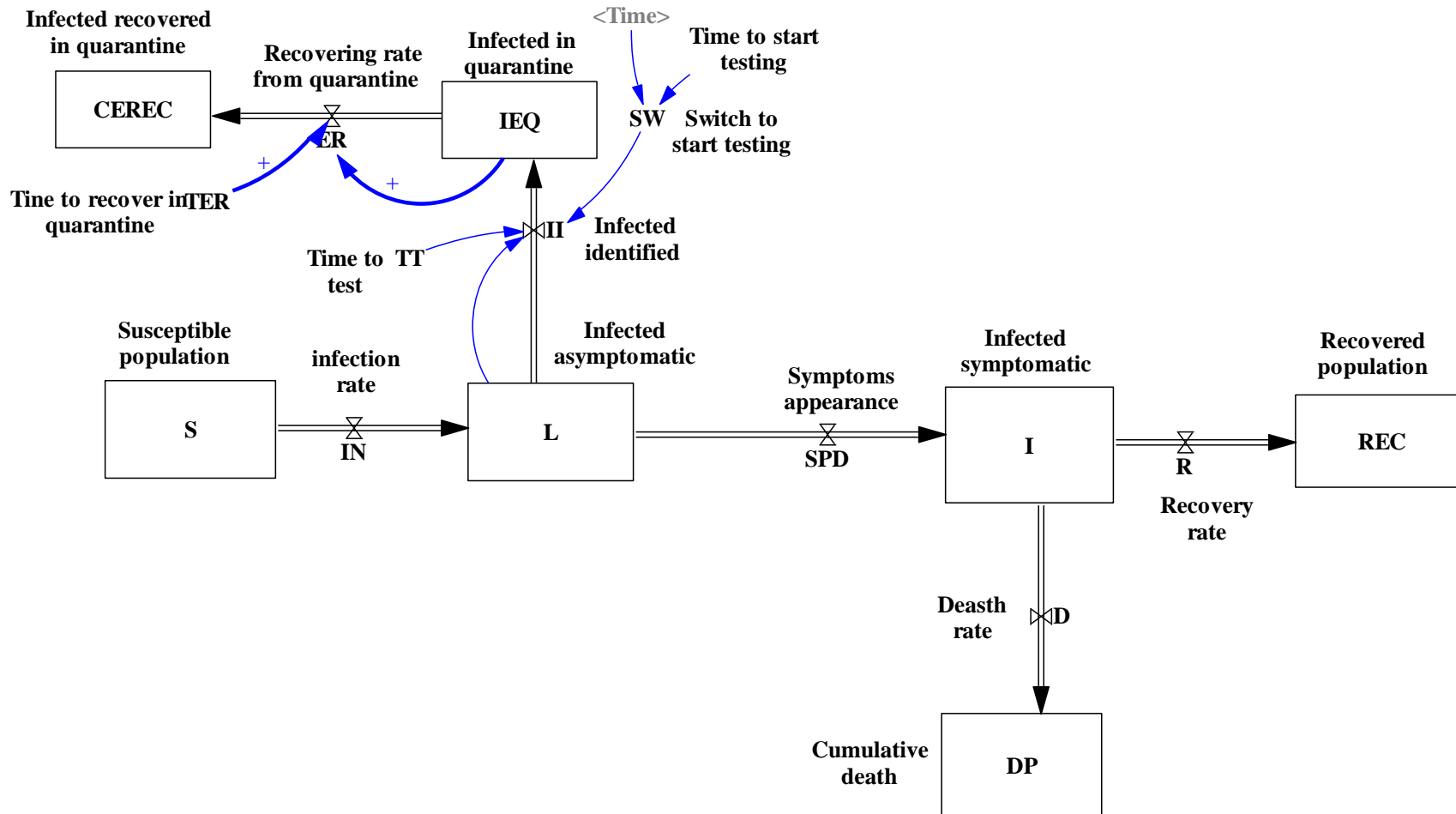
This figure shows the changes in the basic structure of the model for implementing the new policy. Two stocks and two flows are added. One stock represents asymptomatic patients that have been tested and put in quarantine (IEQ). The other stock presents infected recovered in quarantine (CEREC). One rate is infected identified through testing that flows from infected asymptomatic to infected in quarantine. The other is recovering rate from quarantine that presents the flow of those who recover and move to "infected recovered in quarantine. Next slide show the equations for the two new rates.

Equations of the two new rates

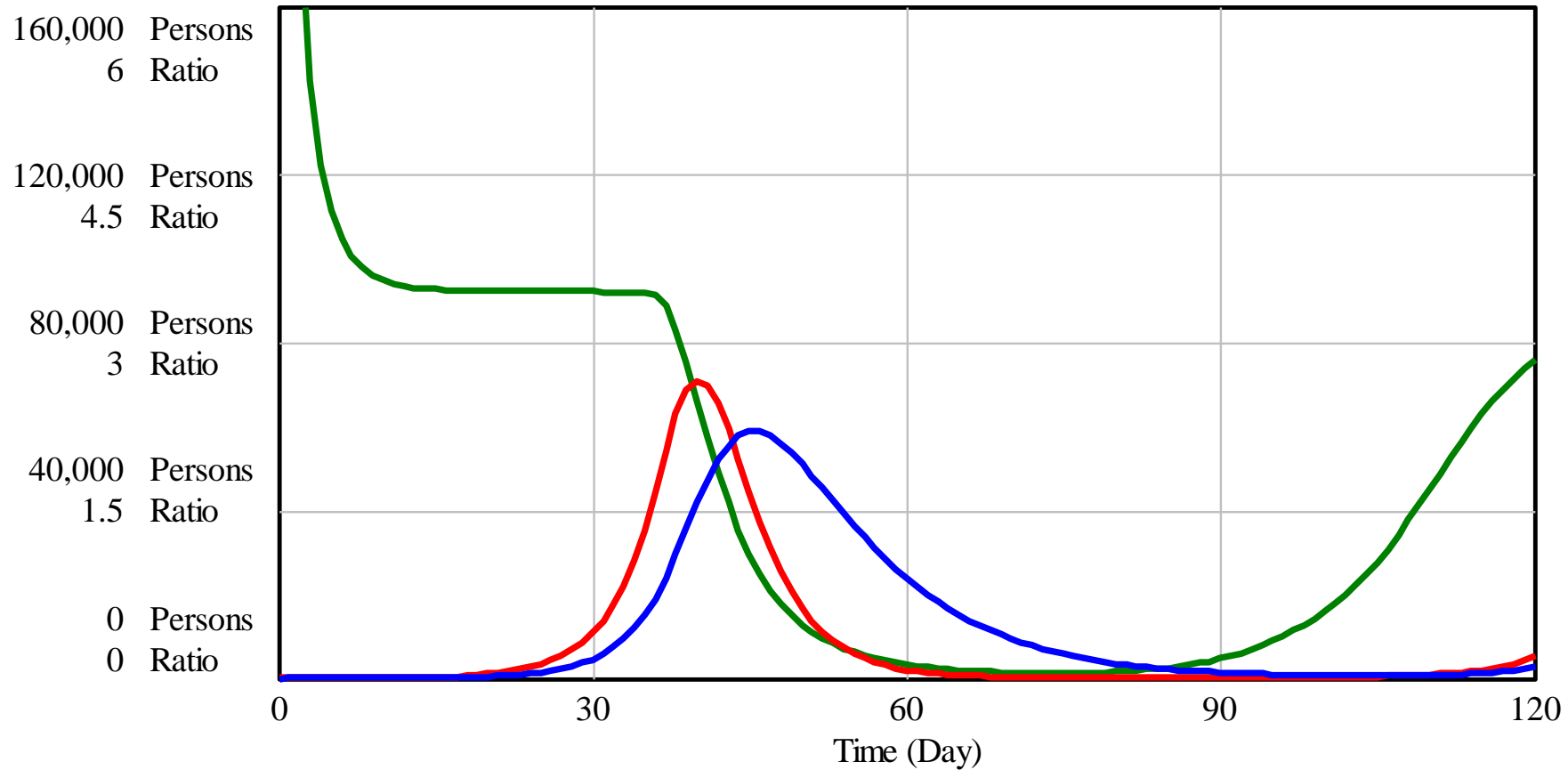|	
EL=SW*L/TT	Infected in quarantine
L	Infected asymptomatic
TT	Time to test
SW	Switch to start testing
SW=IF THEN ELSE(Time<Time to start testing,0,0)	Switch to start testing
Time to start testing	Time to switch on testing
ER=IEQ/TER	Recovering rate from quarantine
IEQ	Infected in quarantine
TER	Tine to recover in quarantine

- Time to test represents the average time between sequential tests for corona that each individual who is not yet a symptomatic patient will take. Those persons include both susceptible and infected asymptomatic who do show any symptoms.

- In the following simulations it assumed that each individual takes a test every 10 days.

- Time to recover in quarantine is assumed to be 14 days.

- The rest of assumptions and parameters are the same as in scenarios.

Scenario 1 with testing

- The first scenario is simulated with testing all non symptomatic patients from the beginning.

- Time between sequential testing of each individual is assumed 10 days.

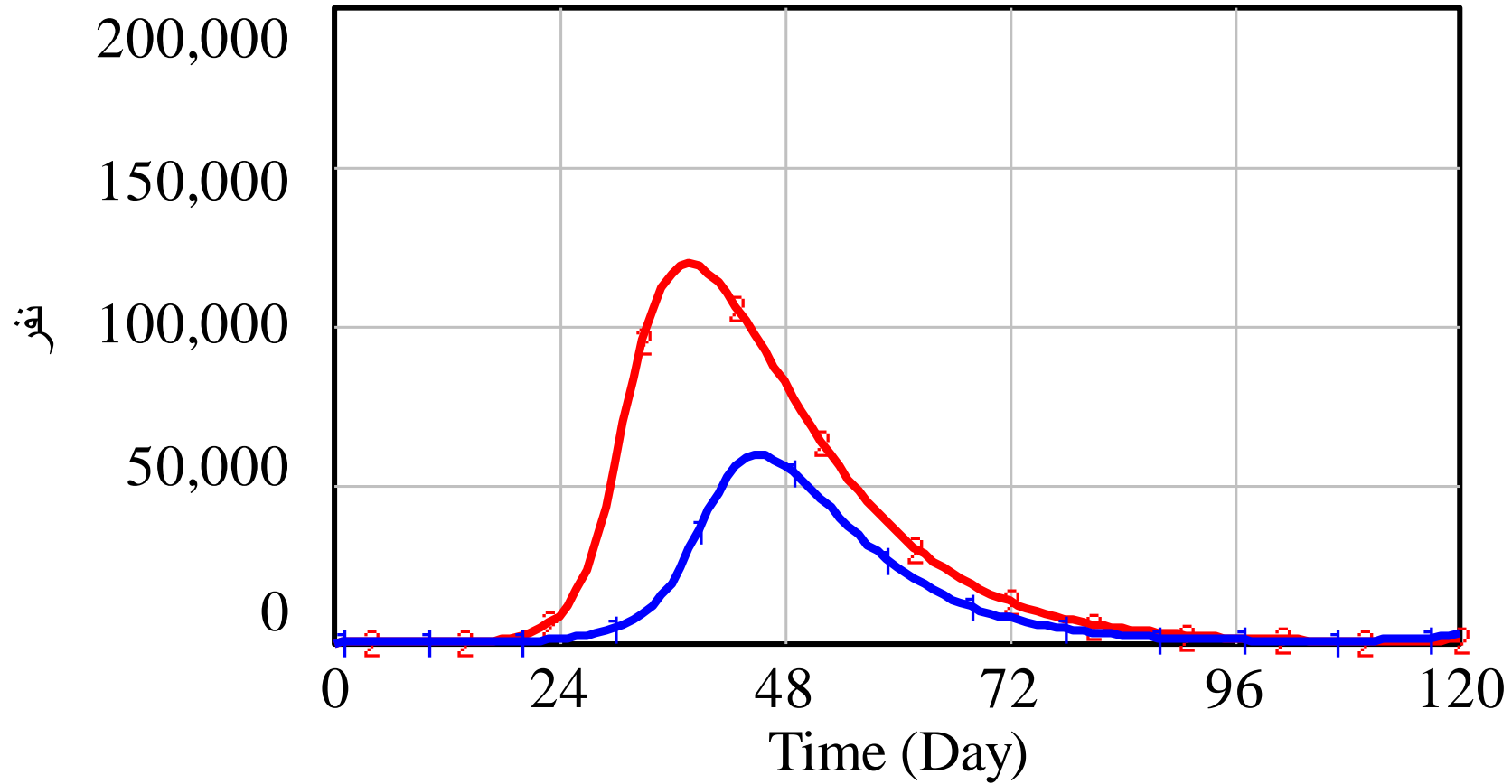سناریو 1 با تست شناسایی زودهنگام : تعداد بیماران

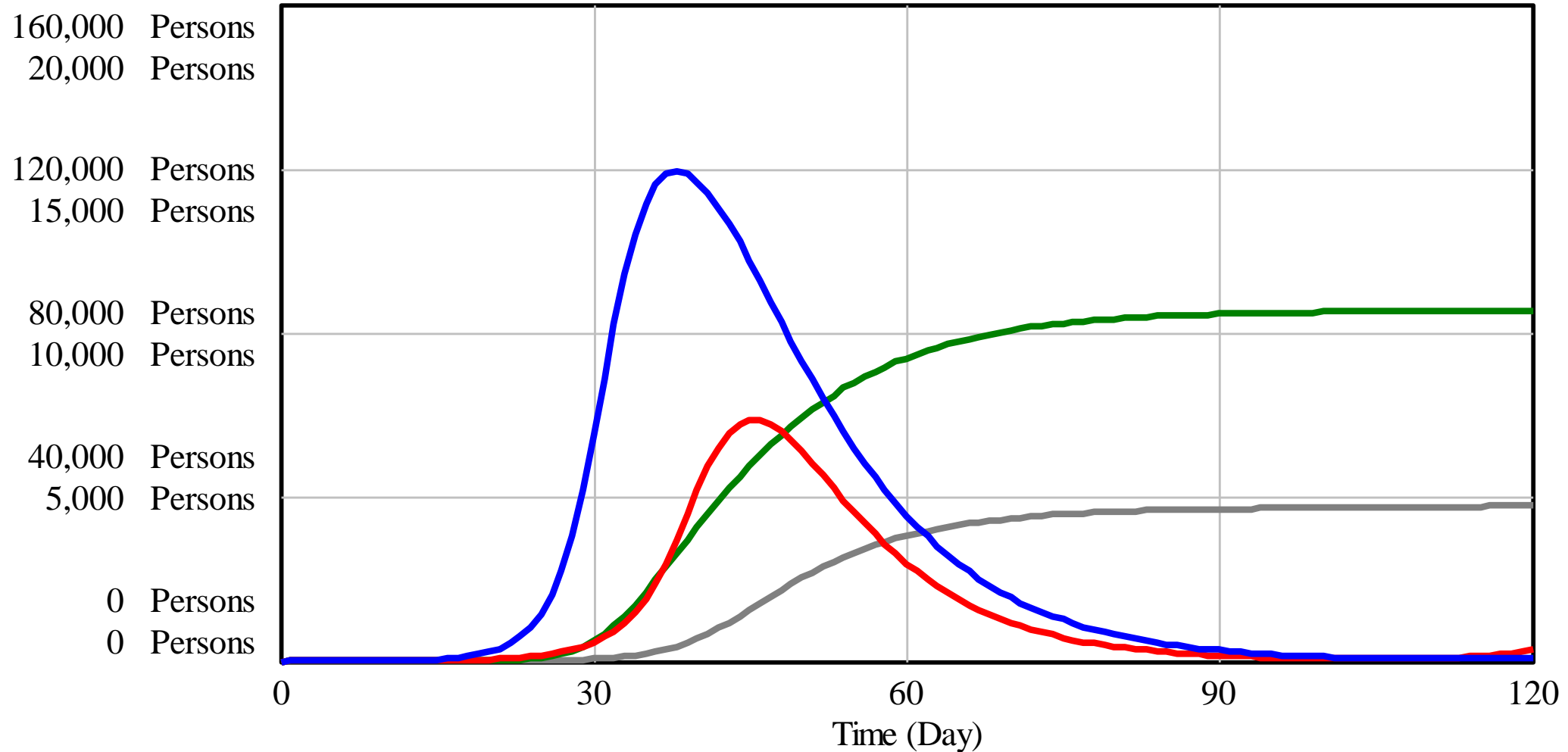Number of infected patients in scenario 1 with testing to separate asymptomatic patients

سناریو 1: مقایسه تعداد افراد بیمار با علائم بیماری با و بدون تست شناسایی زودهنگام و قرنطینه اولیه
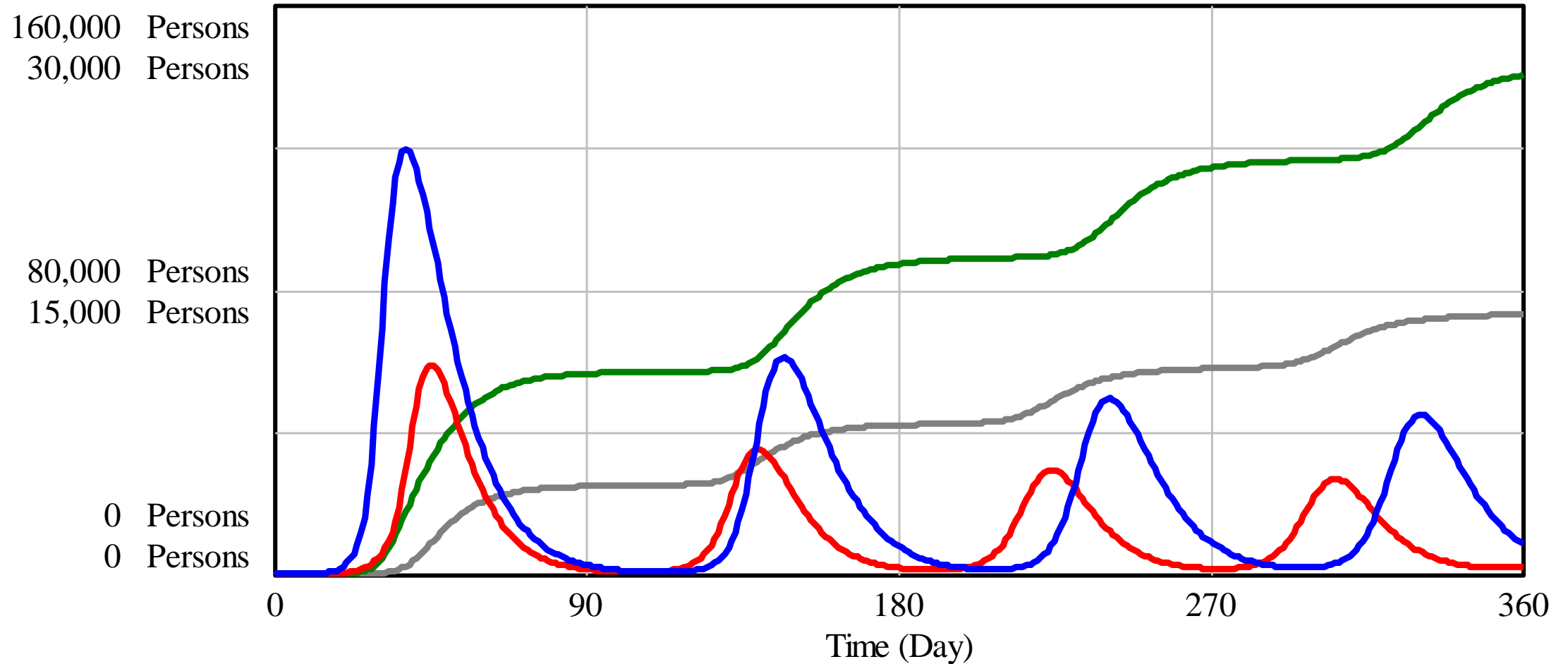
مقایسه تعداد بیماران در سناریو 1 با تست و بدون تست

Number of infected patients in scenario 1 with testing to separate asymptomatic patients

Infected symptomatic without testing	Persons
Infected symptomatic with testing	Persons
Cumulative deaths without testing	Persons
Cumulative deaths with testing	Persons

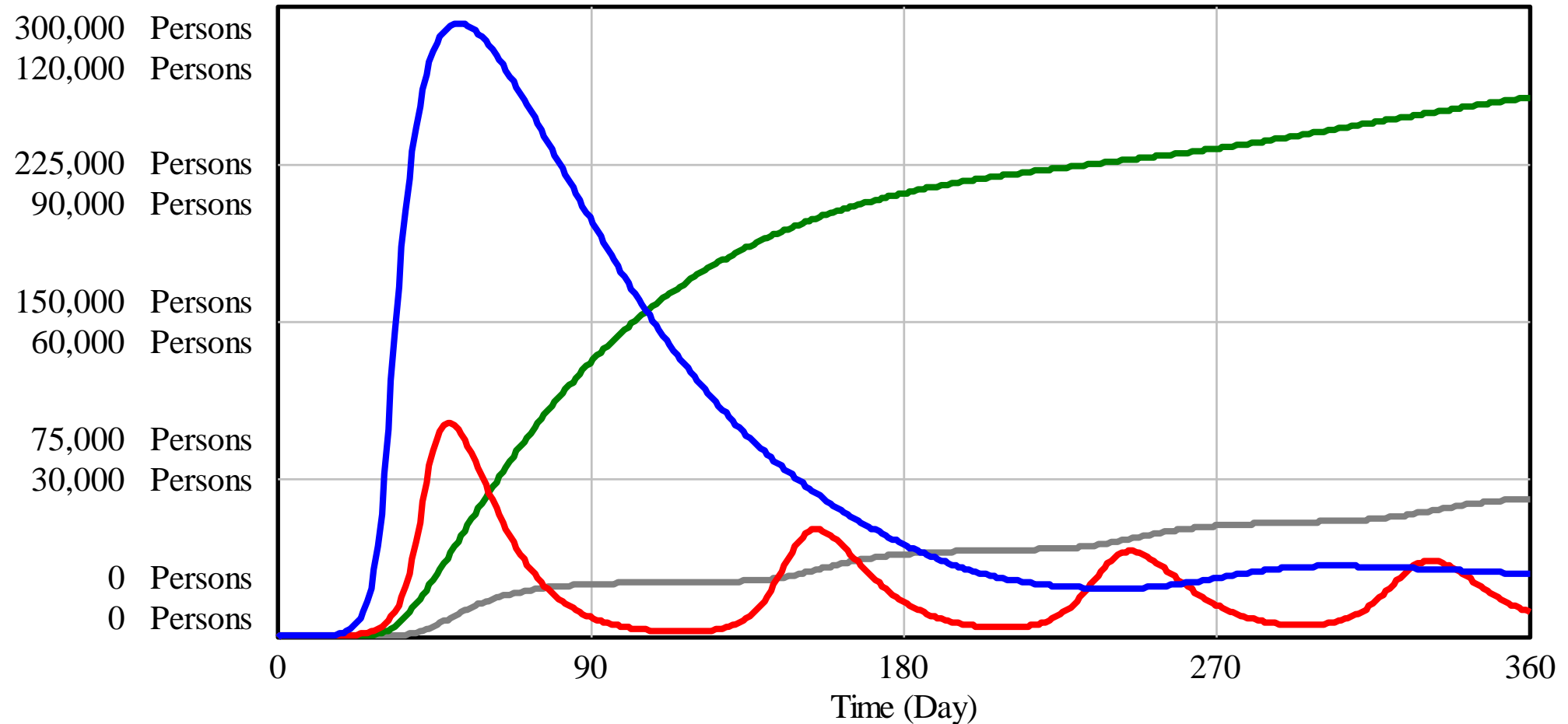Comparing waves of number of infected patients in scenario 1 with and without testing

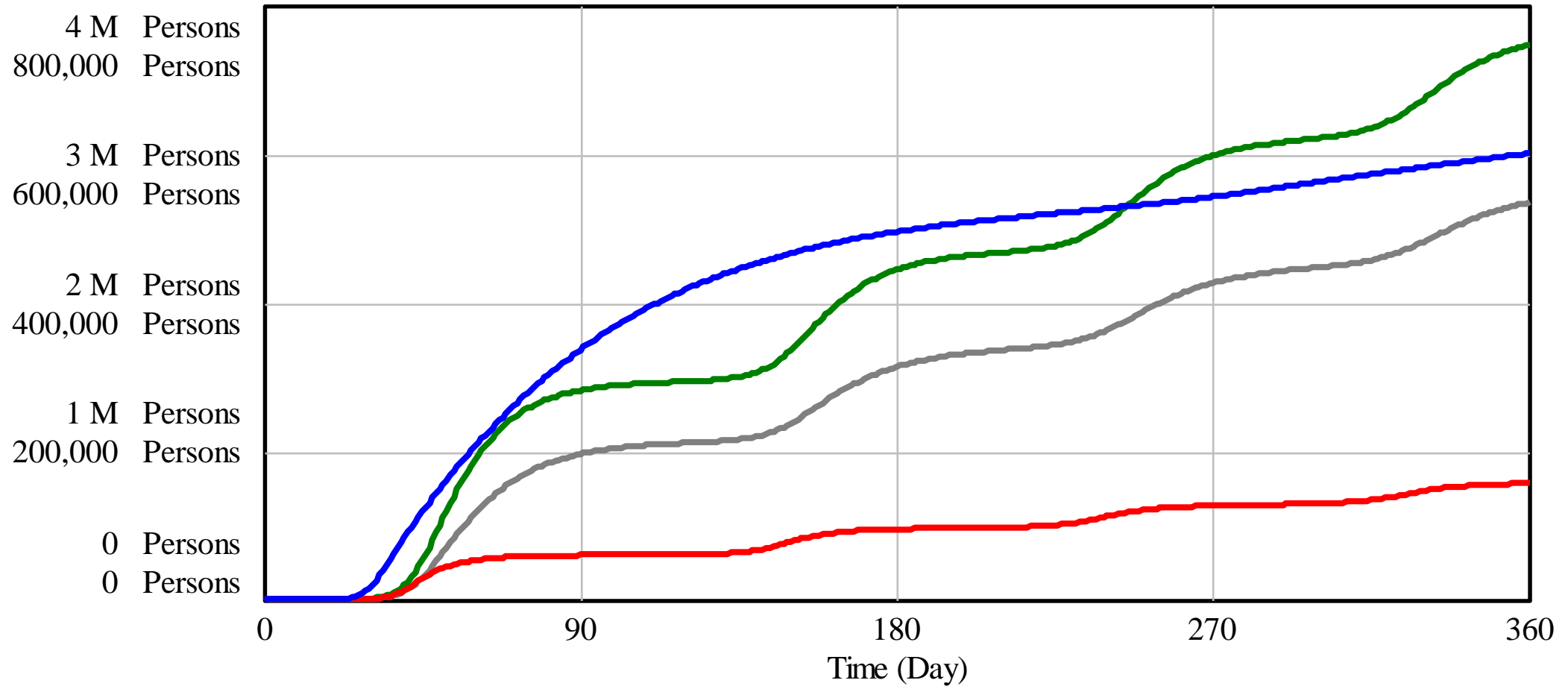|	
Infected symptomatic without testing	Persons
Infected symptomatic with testing	Persons
Cumulative deaths without testing	Persons
Cumulative deaths with testing	Persons

Scenario 2 with testing

- The second scenario is simulated with testing all non symptomatic patients from the beginning.

- Time between sequential testing of each individual is assumed 10 days.

Number of infected patients in scenario 2 with testing to separate asymptomatic patients

Infected symptomatic without testing	Persons
Infected asymptomatic with testing	Persons
Cumulative deaths without testing	Persons
Cumulative deaths with testing	Persons

Number of infected patients in scenario 2 with testing to separate asymptomatic patients
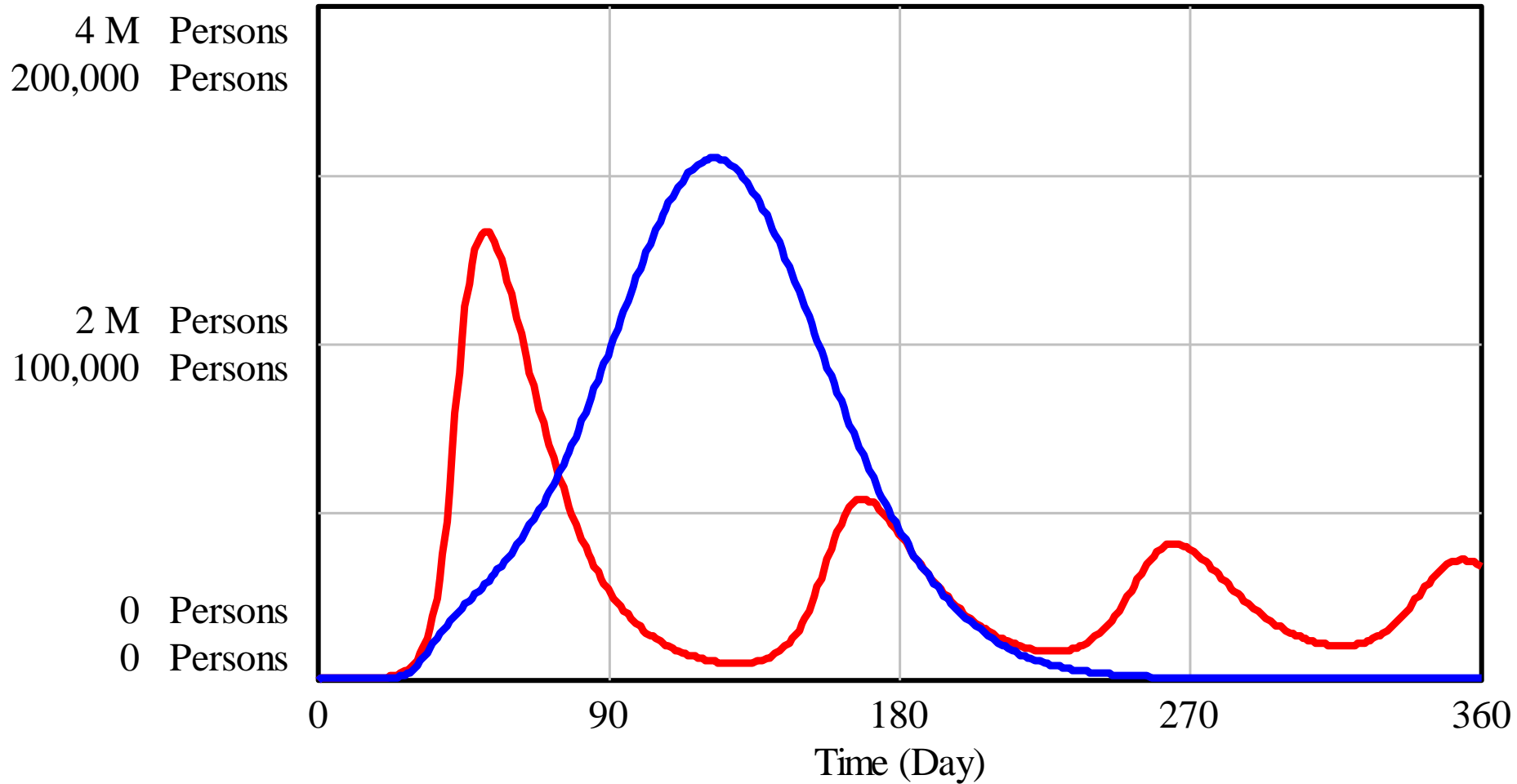
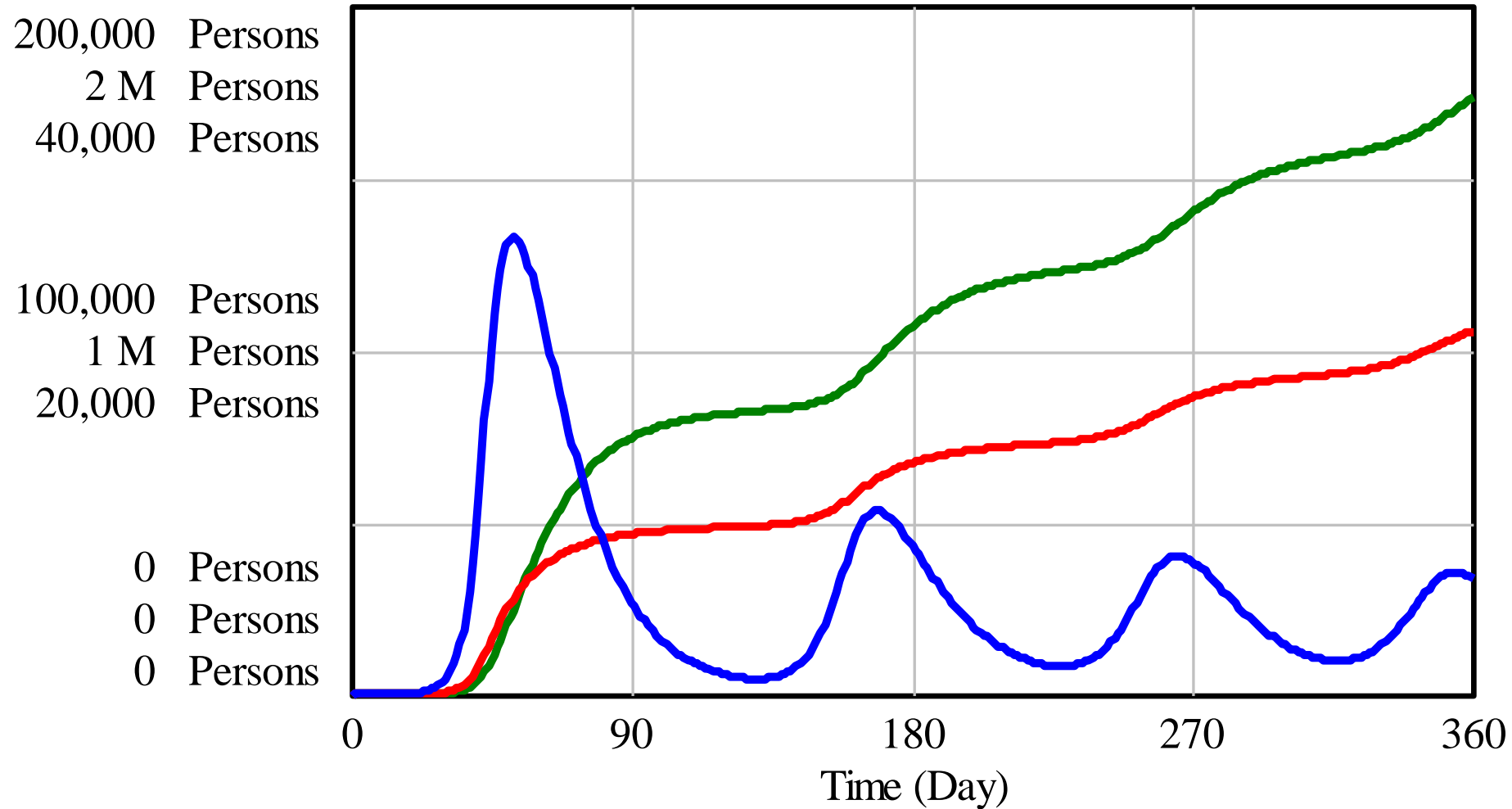|	
Cumulative deaths without testing in scenario 2	Persons
Cumulative deaths with testing in scenario 2	Persons
Cumulative recovered with testing in scenario 2	Persons
Cumulative recovered in quarantine with testing in scenario 2	Persons

Scenario 3 with testing

- The third scenario is simulated with testing all non symptomatic patients from the beginning.

- Time between sequential testing of each individual is assumed 10 days.

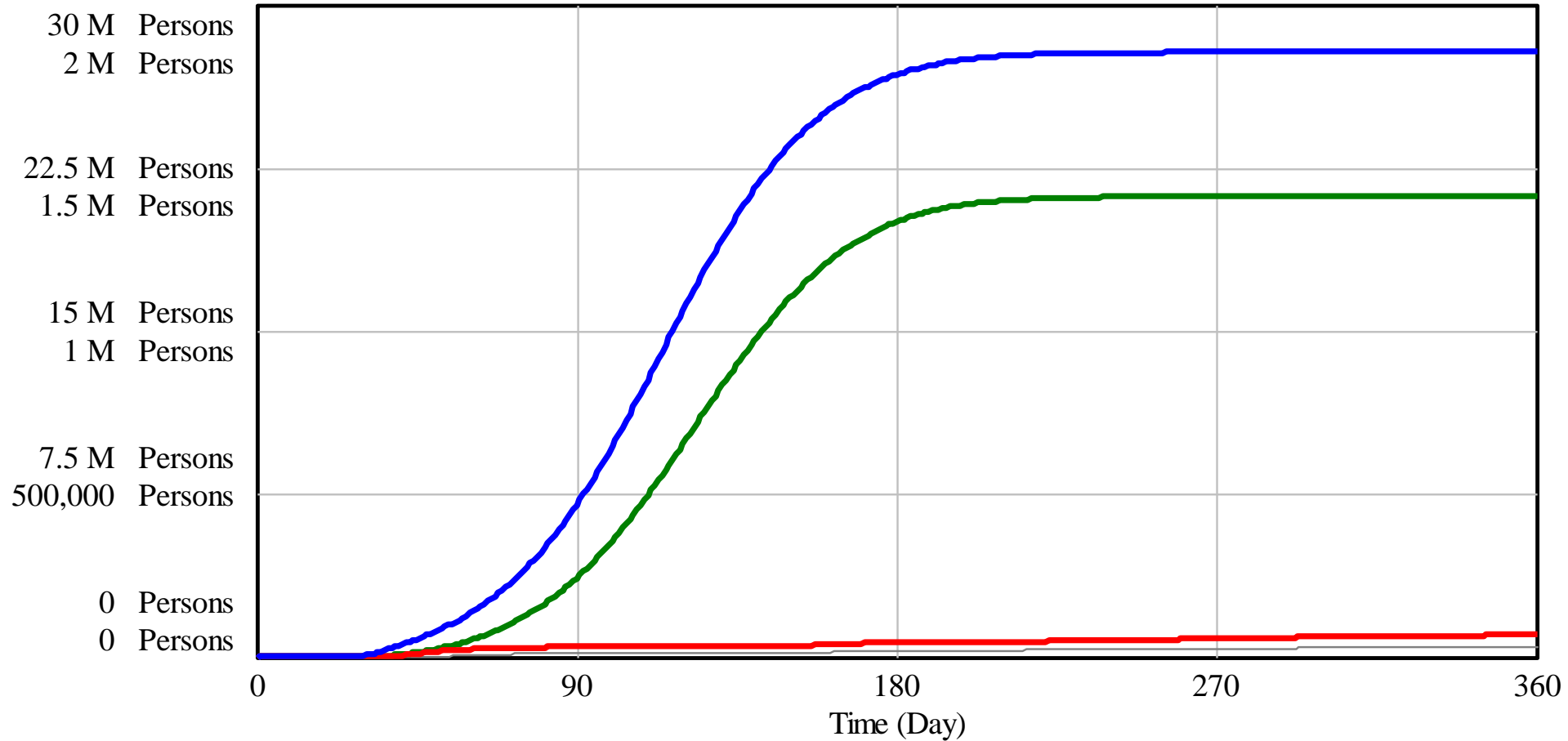Number of symptomatic patients in scenario 3 with and without testing

Infected symptomatic without testing in scenario 3	Persons
Infected symptomatic with testing in scenario 3	Persons

Cumulative deaths in scenario 3 with and without testing

200,000	Persons			
2 M	Persons			
40,000	Persons			
100,000	Persons			
1 M	Persons			
20,000	Persons			
0	Persons			
0	Persons			
0	Persons			

Time (Day)

0   90   180   270   360

symptomatic patients without testing in scenario 3 ——————— Persons
Cumulative smptomatic patients with testing in scenario 3 ——————— Persons
Cumulative deaths with testing in scenario 3 ——————— Persons

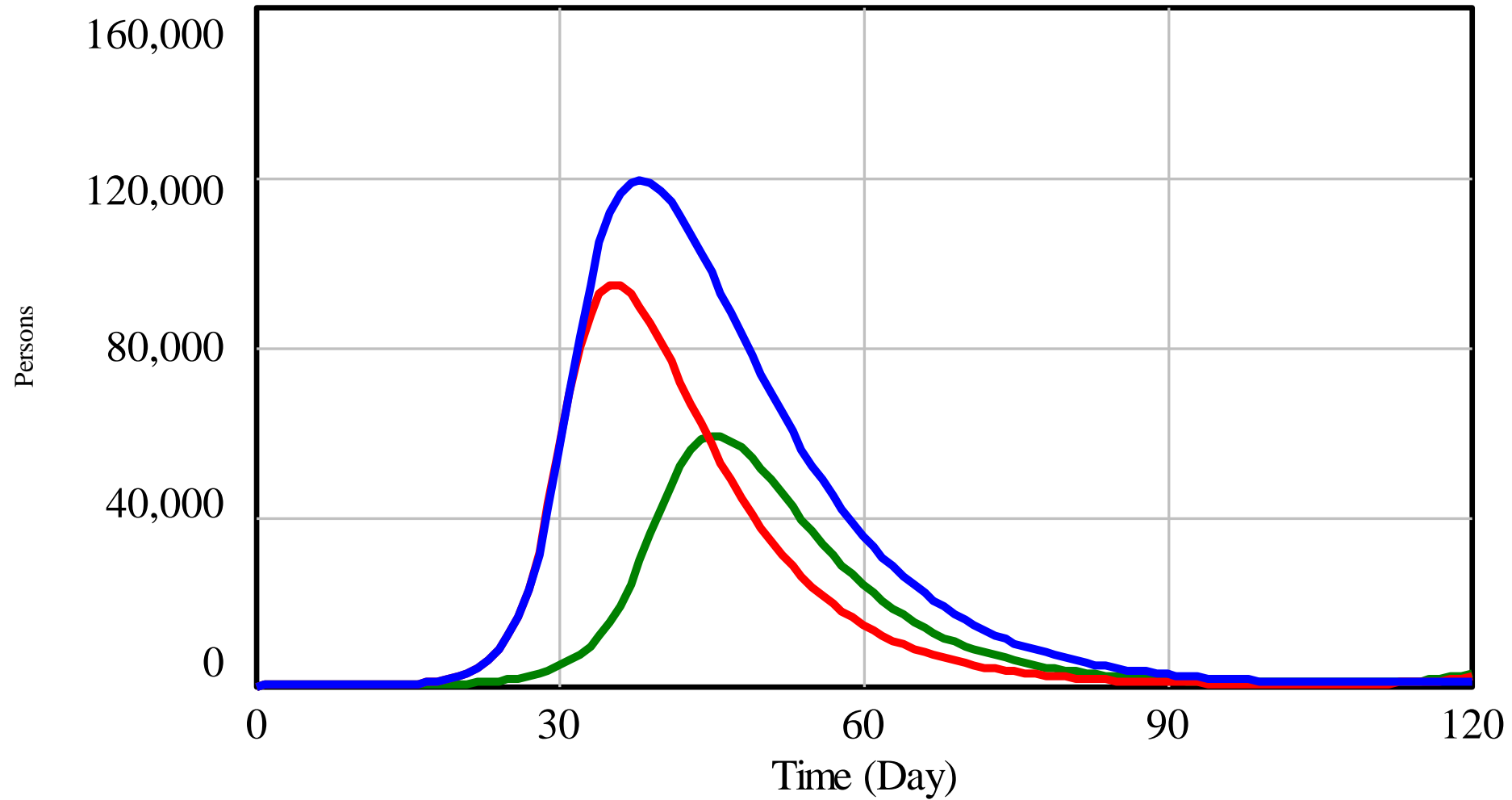# Comparing cumulative deaths and symptomatic patients in scenario 3 with and without testing

30 M Persons	
2 M Persons	
22.5 M Persons	
1.5 M Persons	
15 M Persons	
1 M Persons	
7.5 M Persons	
500,000 Persons	
0 Persons	
0 Persons	

Time (Day)

Cumulative symptomatic patients without testing in scenario 3 ——————————— Persons
Cumulative symptomatic patients with testing in scenario 3 ——————————— Persons
Cumulative deaths without testing in scenario 3 ——————————— Persons
Cumulative deaths with testing in scenario 3 ——————————— Persons

# The impact of testing 30 days after the beginning of the pandemic

- In this section it is assumed that the testing start not from the beginning of that corona virus spreads but 30 days after the beginning.

- The results show that even starting the testing after day 30 could be very helpful in reducing mortality and the number of symptomatic patients in all three scenarios.

- To simulate the model, in each scenario Time to start testing is set equal 30. In the previous simulation the time was set equal a very large number such that testing did not start during the simulations.

Number of infected patients in scenario 1

Infected symptomatic in scenario 1 without testing
Infected symptomatic in scenario 1 with testing from day 30
Infected symptomatic in scenario 1 with testing from beginning
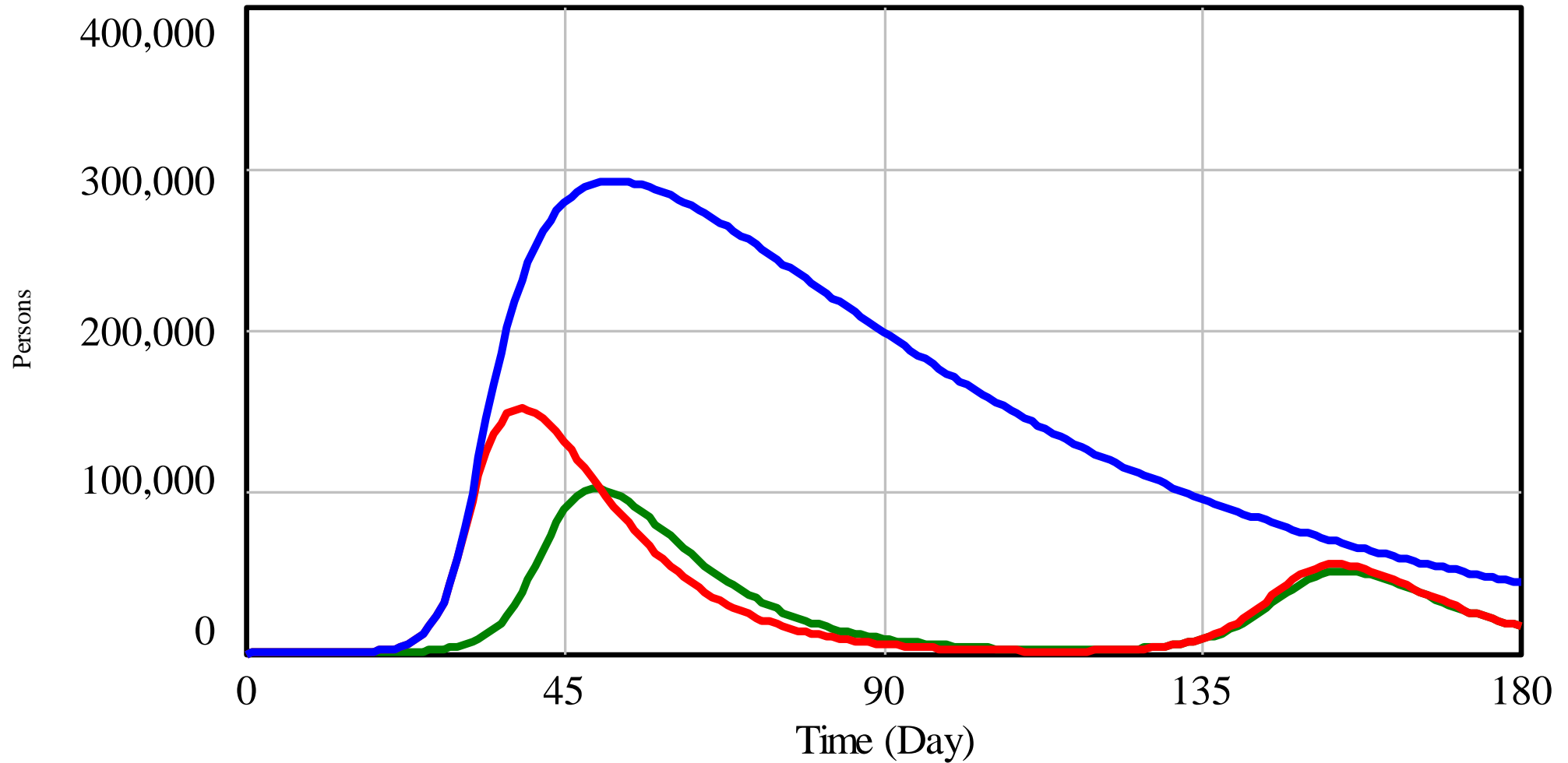
Cumulative death in scenario 1 with and without testing
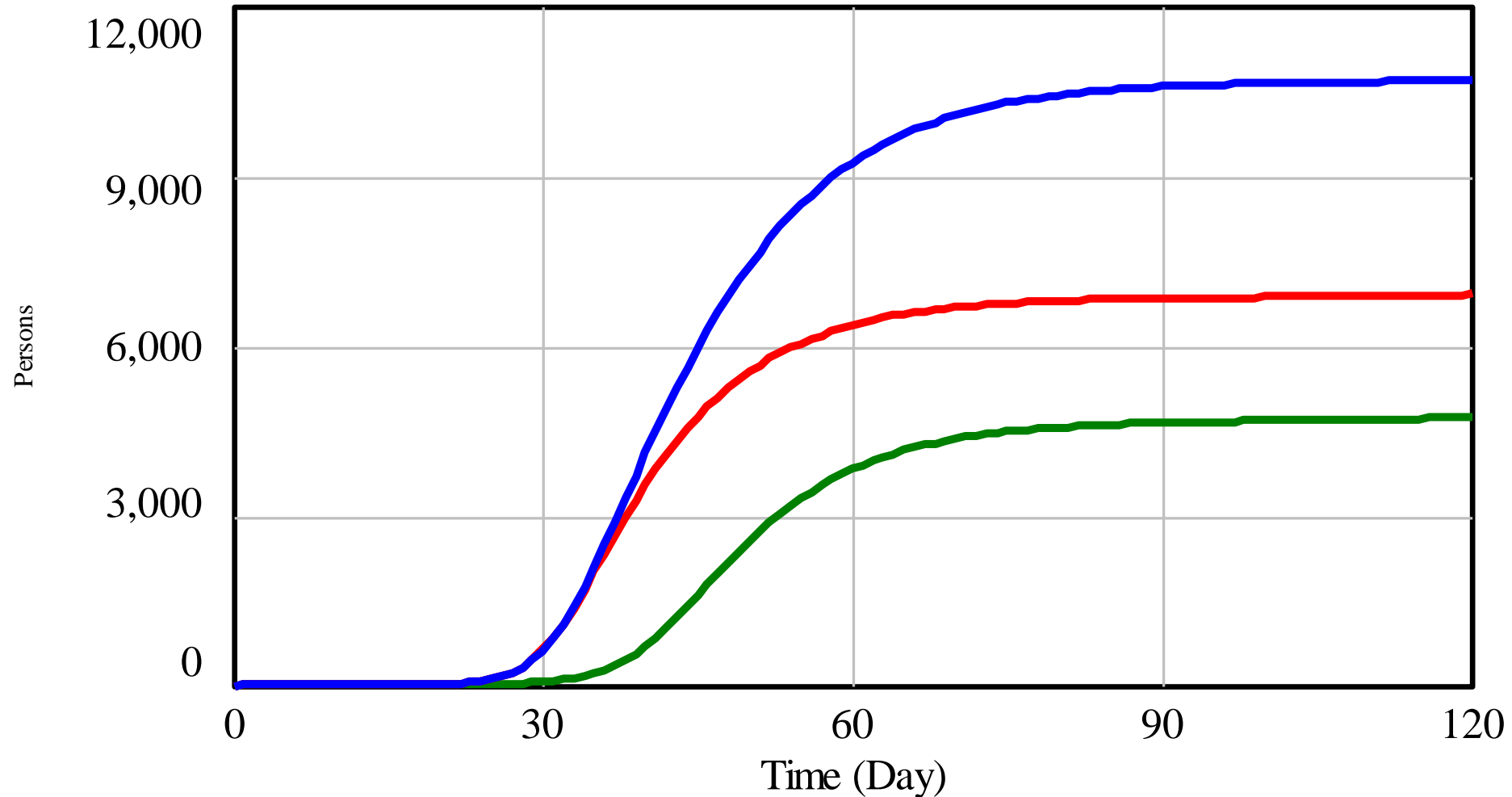
cumulative deaths in scenario 1 without testing
cumulative deaths in scenario 1 with testing from day 30
cumulative deaths in scenario 1 with testing from beginning

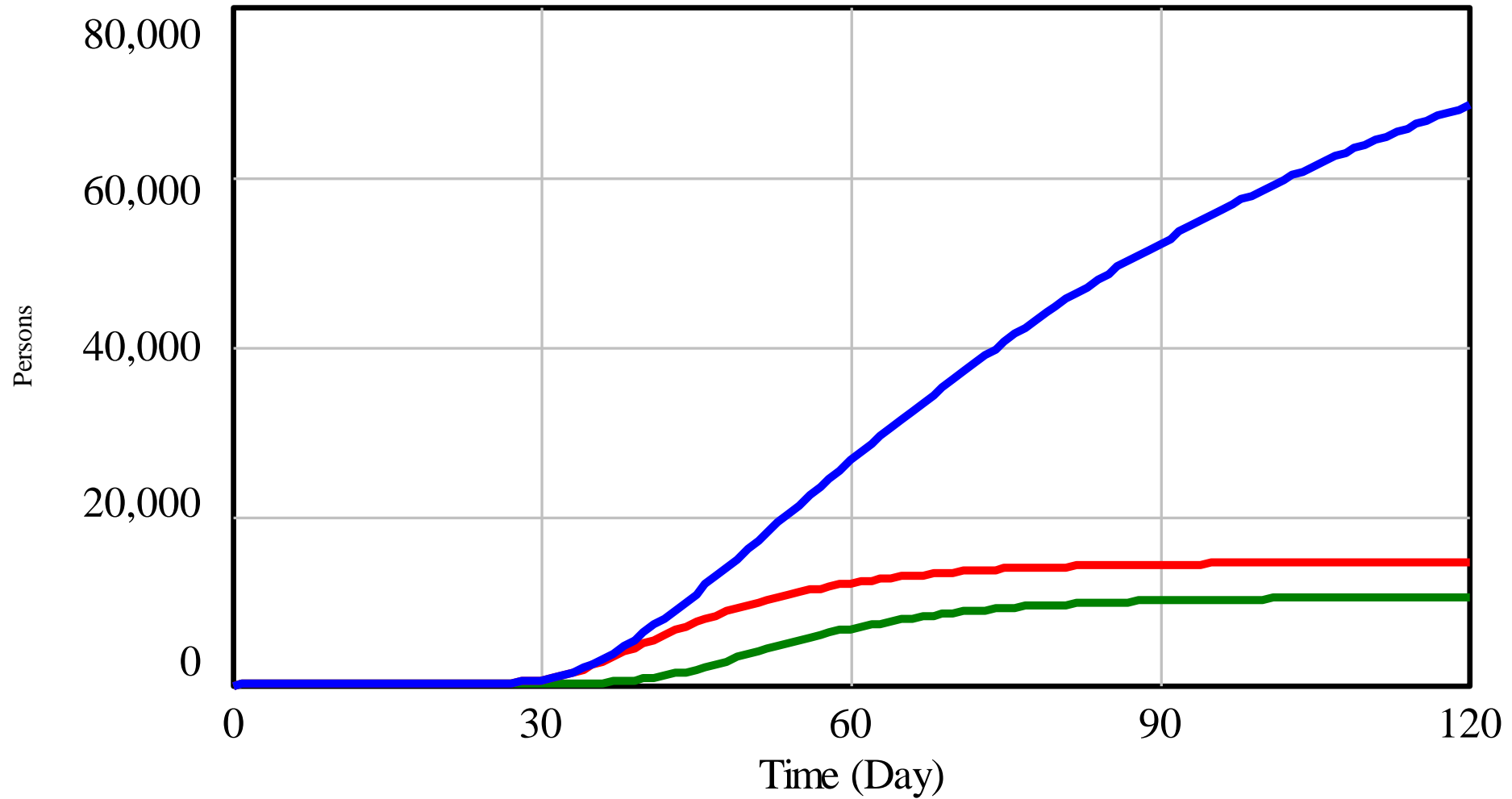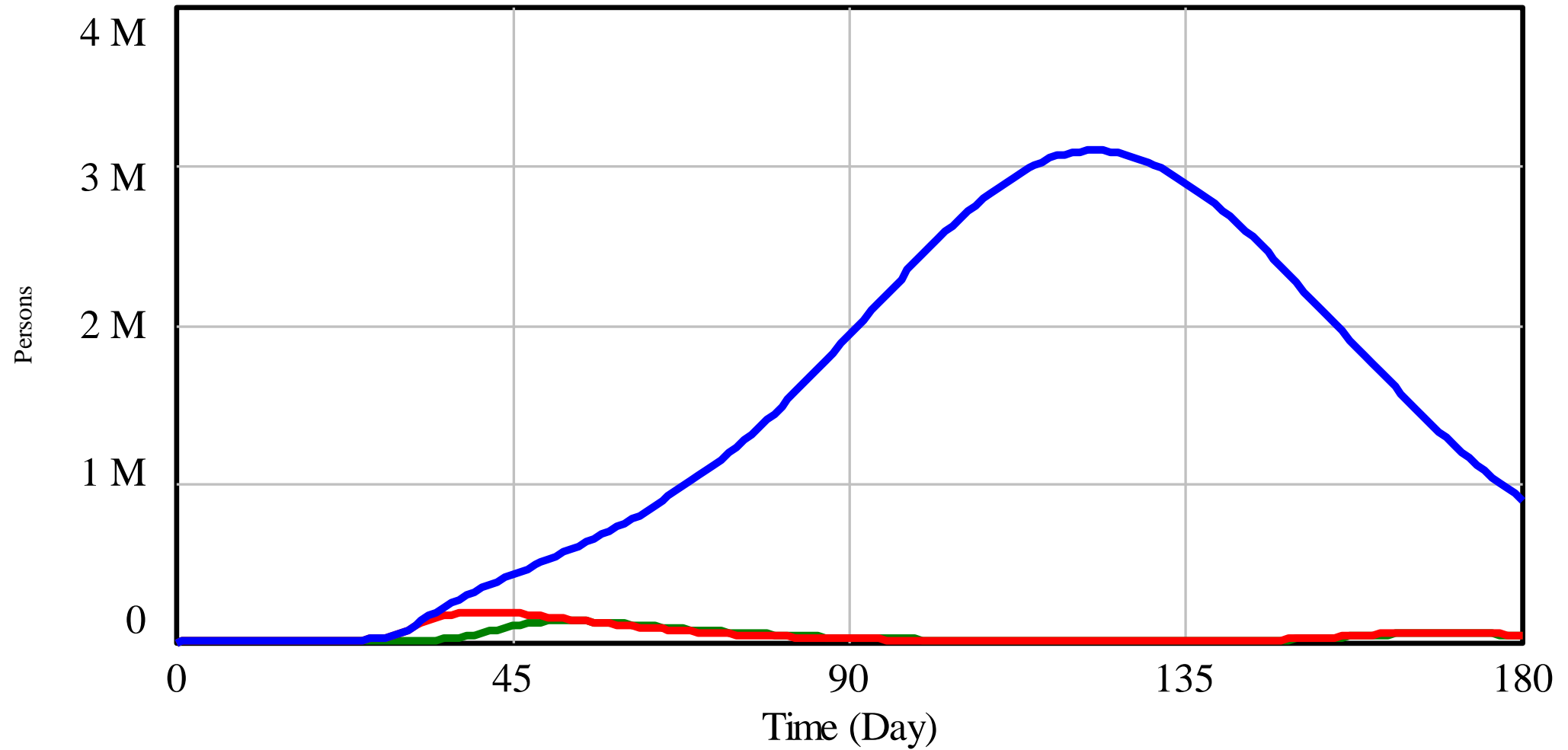Comparing symptomatic patients in scenario 2 with and without testing

Symptomatic patients in scenario 2 without testing
Symptomatic patients in scenario 2 with testing from day 30
Symptomatic patients in scenario 2 with testing from beginning

Cumulative death in scenario 2 with and without testing

cumulative deaths in scenario 2 without testing

cumulative deaths in scenario 2 with testing from day 30

cumulative deaths in scenario 2 with testing from beginning

Comparing symptomatic patients in scenario 3 with and without testing
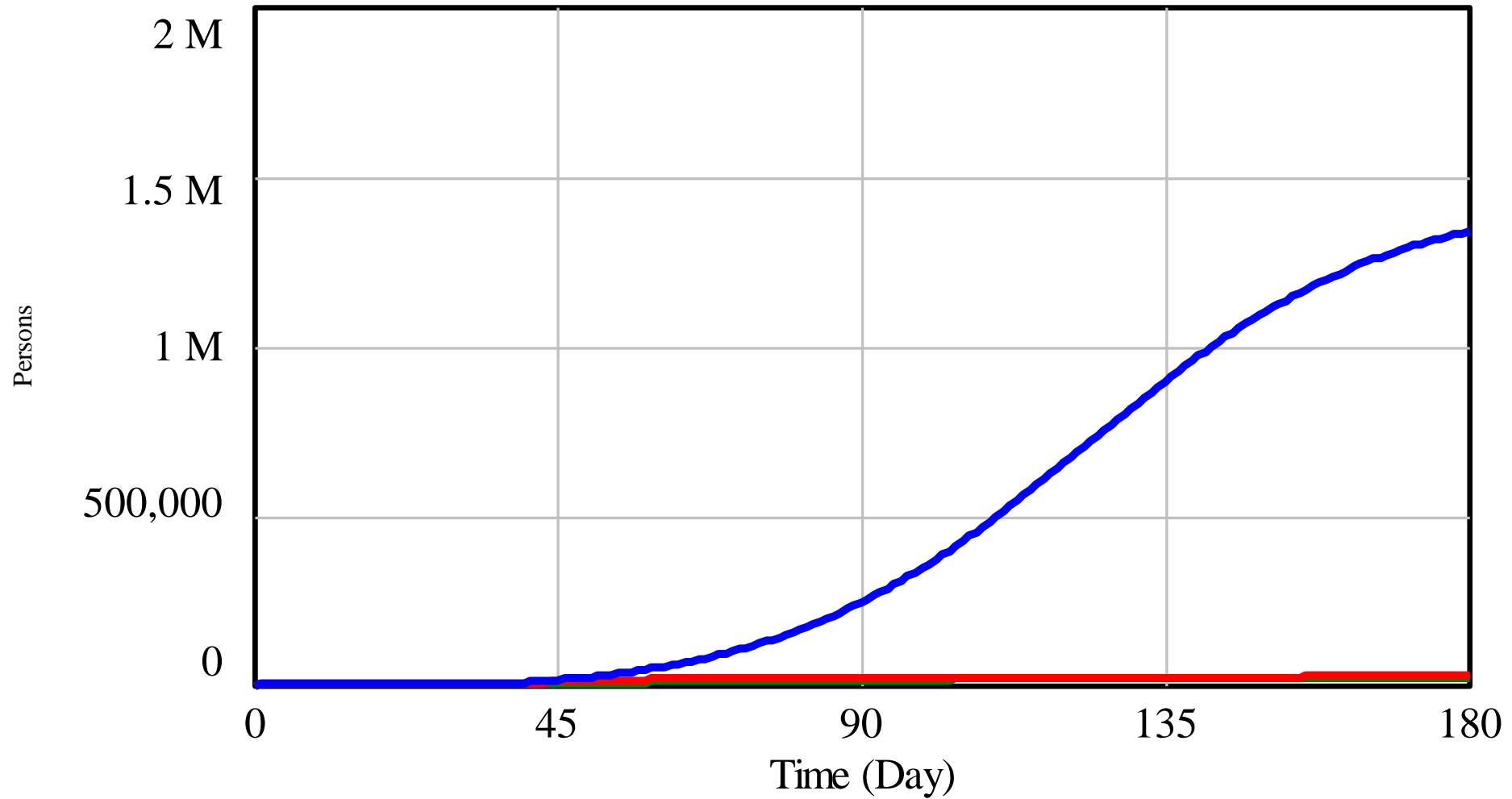
Symptomatic patients in scenario 2 without testing
Symptomatic patients in scenario 2 with testing from day 30
Symptomatic patients in scenario 2 with testing from beginning

Cumulative death in scenario 3 with and without testing


cumulative deaths in scenario 3 without testing
cumulative deaths in scenario 3 with testing from day 30
cumulative deaths in scenario 3 with testing from beginning

# Sensitivity of sequential testing

- Testing and separating asymptomatic patients and putting them in quarantine was shown as an important and effective policy.

- In order to examine the sensitivity of the behavior of the model with respect to time distance between tests, in this section " Time to test" or TT is set 3 instead of 10. That means we assume that each person get a test every three days instead of 10 days.

- The results are shown in the following slides.

Number of infected patients in scenario 1 with 10 days and 3 days testing
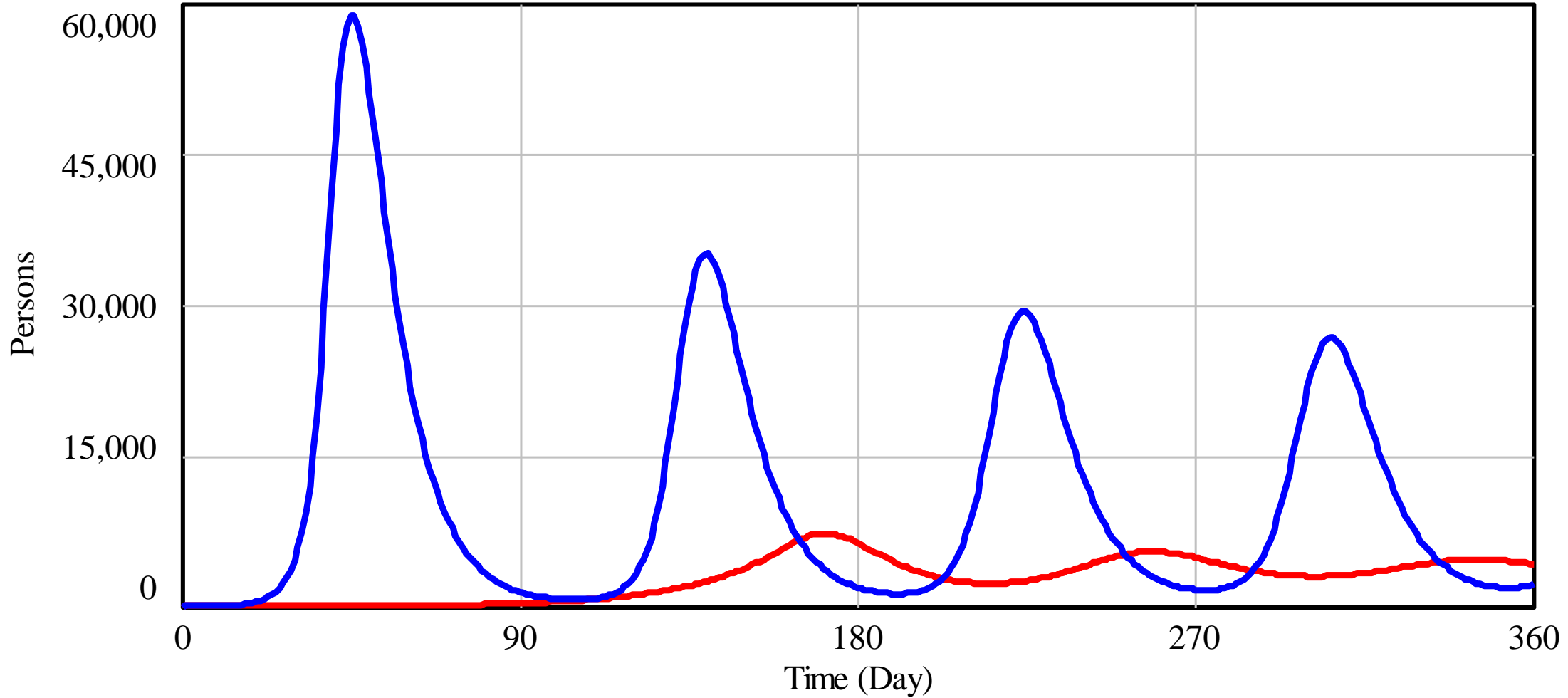
Infected symptomatic with 10 days tesing
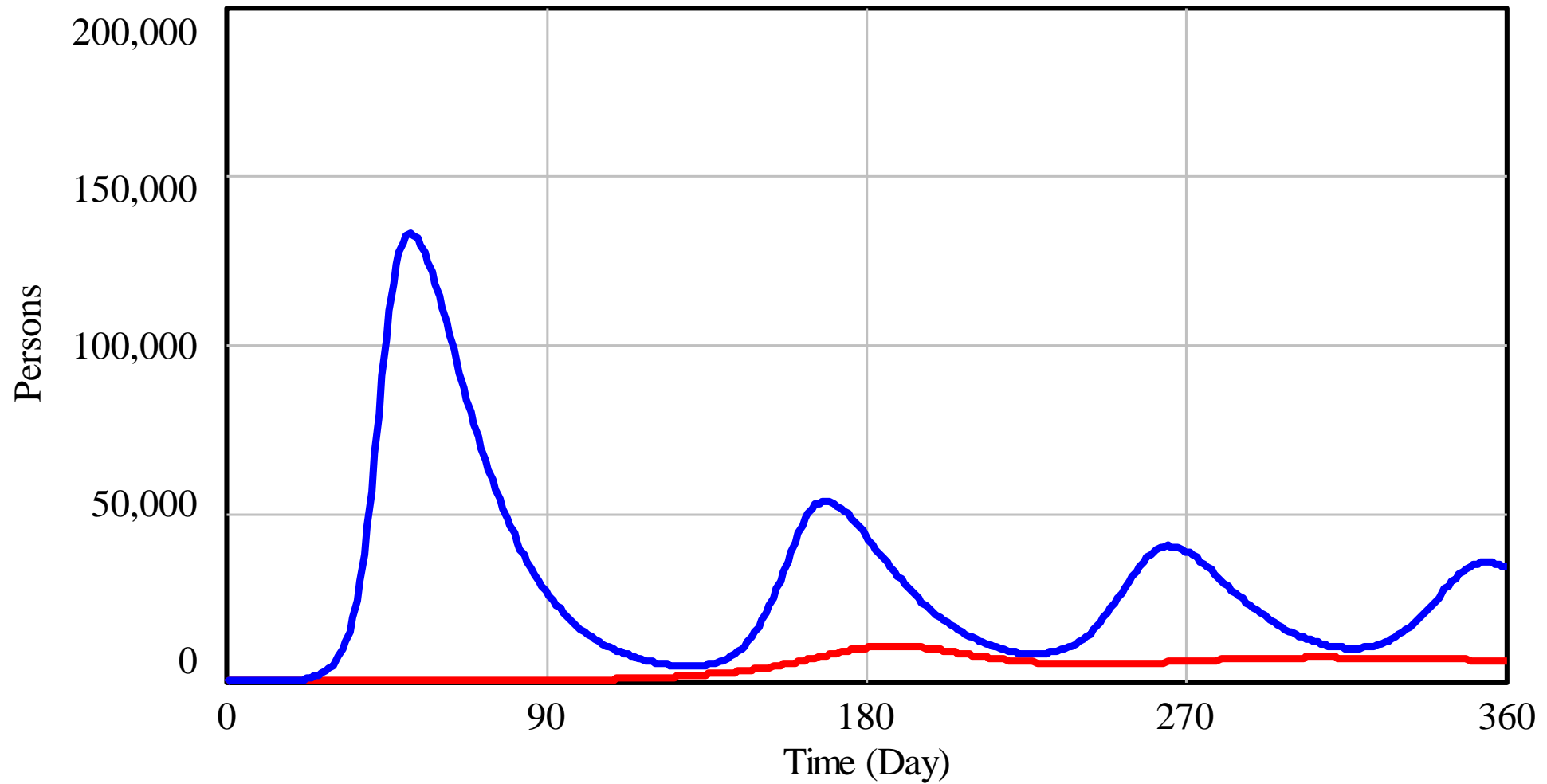
Infected symptomatic with 3 days testing

Number of infected patients in scenario 2 with 10 days and 3 days testing
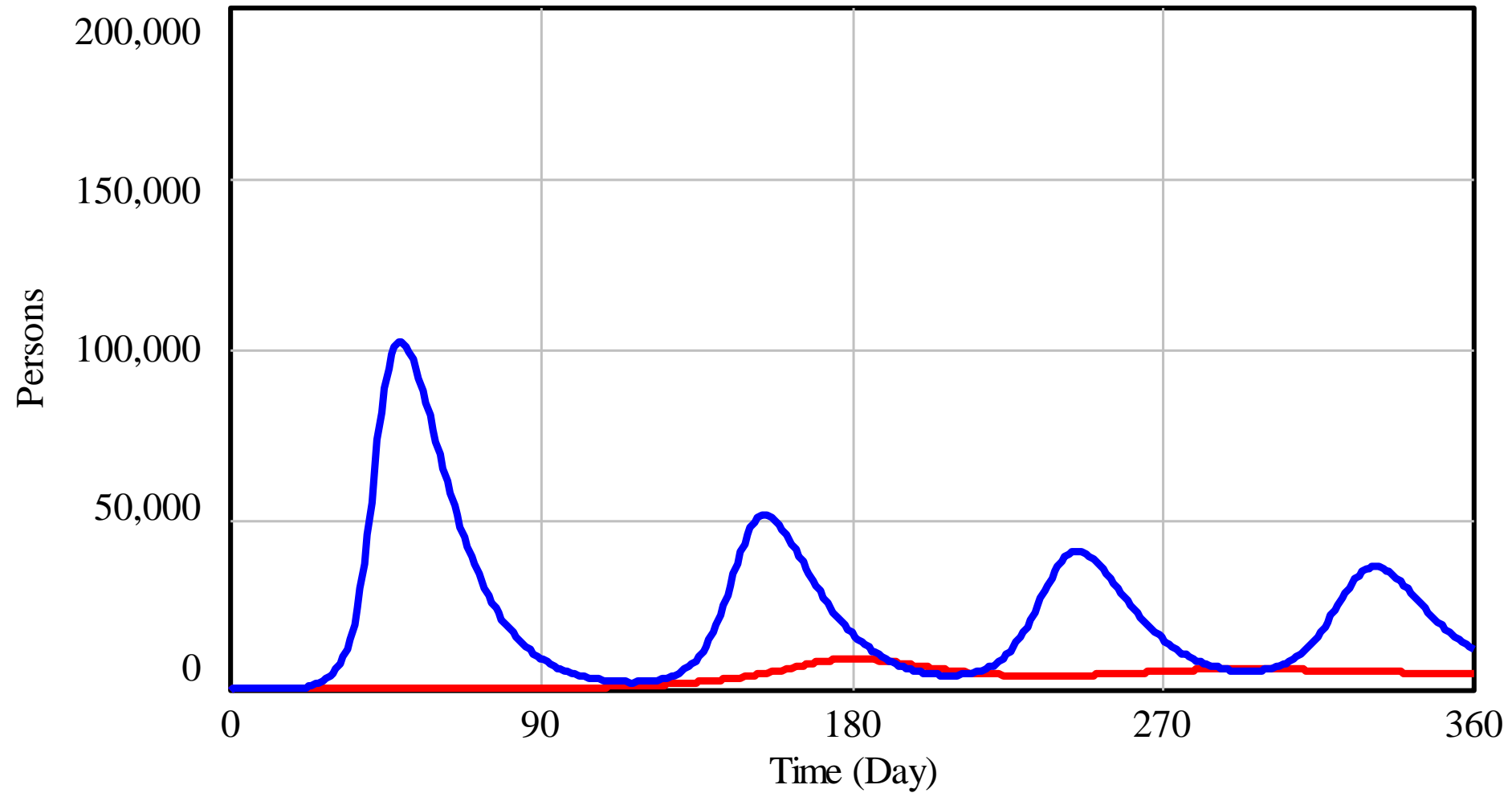
Infected symptomatic with 10 days tesing
Infected symptomatic with 3 days testing

Number of infected patients in scenario 3 with 10 days and 3 days testing

Infected symptomatic with 10 days tesing
Infected symptomatic with 3 days testing

Thanks