5. RESULTS AND DISCUSSION

For the effectiveness evaluation of the proposed method, some simulations are presented in this section. Note that computer simulations have proven to be useful for evaluating the spreading behavior of infectious diseases [28]. In the present study, the simulation process is performed in the Simulink-Matlab environment. The parameters' values of the HCV epidemic model (1) are listed in Table 2.

A small society with a total population of 1310 people at the beginning of the investigation is used. The following desired scenarios are considered for the reduction of unaware susceptible individuals (S_{u_d}) and the treatment of chronically infected people (C_d):

$$S_{u_d} = (S_{u_0} - S_{u_f})\exp(-a_1 t) + S_{u_f} \quad (20)$$

$$C_d = (C_0 - C_f)\exp(-a_2 t) + C_f \quad (21)$$

where a_1 and a_2 are the desired population reduction rates. S_{u_0} and S_{u_f} are the initial and final (steady-state) populations of the unaware susceptible class, respectively. C_0 and C_f are the initial and final (steady-state) populations of the chronically infected compartment, respectively.

The presented reduction and treatment scenarios (20), (21) are employed in these simulations as the desired decreasing behavior of the HCV epidemic control. However, other continuously decreasing fashion can be used as desired scenarios without loss of generality. The values of parameters in the desired HCV population reduction scenarios (20), (21) are listed in Table 3. These scenarios for unaware susceptible and chronically infected compartments are shown in Fig. 3.

TABLE 2
Values of the HCV Parameters in Its Mathematical Model (1) [4].

Parameter	Value
b	0.012
μ	0.006
β	0.15
K_1	0.5
K_2	0.2
α	0.1
γ	4
q	0.2
ξ	0.8
p	0.5
θ	0.001

TABLE 3
Values of Parameters in the Desired HCV Population Reduction Scenarios (20), (21).

Parameter	Value
S_{u_0}	1000
C_0	100
S_{u_f}	0
C_f	0
a_1	0.4
a_2	0.2

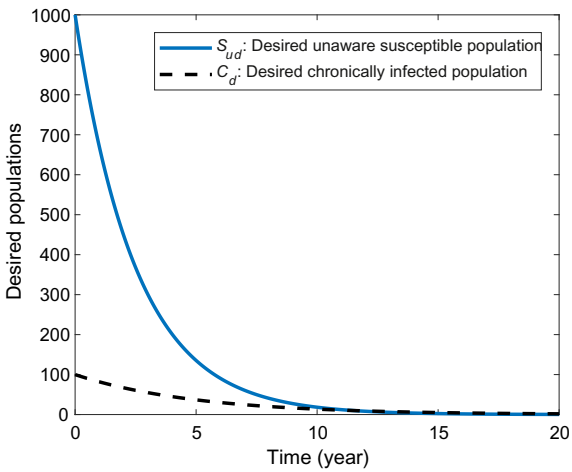

FIG. 3 Desired scenarios for the reduction of unaware susceptible and chronically infected compartments in the HCV epidemic.

In the absence of control inputs, the HCV infection will extend in the society based on Eq. (1). Accordingly, the treated population will decrease and reach zero exponentially due to the lack of treatment process. In that case (no control input), unaware and aware susceptible individuals will get the hepatitis C virus in contact with the infected people in I and C compartments and will join the acutely infected class (I). Since there is no treatment for acutely infected individuals (as seen in Eq. 1), the HCV disease will progress and reach the chronic stage. Thus, the population of the chronically infected compartment (C) will increase and the populations of all other compartments will decrease. Fig. 4 depicts the above-mentioned points about the HCV outbreak in the case of no control input.