populations of some undesired compartments at the end of the investigation period were considered as the criterion for designing control inputs [4, 11–14]. However, in this study for the first time, the populations of two unaware susceptible and chronically infected classes during the entire treatment period are considered as the criterion and control inputs are designed in a way to track desired values instead of focusing on their final populations at the end of process.

The rest of this chapter is organized as follows. In Section 2, related research work will be explained. Description of the dynamic model and the proposed control scheme will be presented in Sections 3 and 4, respectively. The simulation results will be depicted and discussed in Section 5, and the concluding remarks will be mentioned in Section 6.

2. RELATED RESEARCH WORK

Previous related studies are presented in this section and are divided into three parts, including mathematical modeling, optimal control for HCV, and adaptive control strategies for different biological systems.

Several analytical analyses were conducted on the dynamic modeling of the HCV epidemic, which are described here. Martcheva and Castillo-Chavez [15] presented a simple mathematical model with three compartmental variables including susceptible, acutely infected, and chronically infected. They considered different epidemiological observations in the model. Yuan and Yang [8] added the exposed class to the previous model [15]. They considered that the susceptible individuals transmit to the exposed compartment in the case of having contact with the infected compartments. Zhang and Zhou [5] added a new term in the model of Yuan and Yang [8], which denotes the death rate due to the HCV. Hu and Sun [16] proposed another epidemiological model for the HCV with four classes in which the recovered compartment was taken into account for the first time. Naturally, the recovered people transmit to this class from the acutely infected and chronically infected compartments and become immune against this. Ainea et al. [17] extended the previous model [16] by adding the exposed class. Both these models [16, 17] considered the HCV disease-induced death rate for both acutely infected and chronically infected classes. Shen et al. [18] proposed a dynamical model with six classes including susceptible, exposed, acutely infected, chronically infected, treated, and recovered populations. They propounded treatment influence for the first time and classified treated people in a distinct class. Shi and Cui [19] improved the model in [18] and divided the treated class into two different classes by defining the treatment for chronic infection and aware reinfection.

Some researches have been conducted for optimal control of the HCV outbreak. Okosun [11] employed a SITV (susceptible, acutely infected, treated, and chronically infected) model for the HCV that was an extended form of the dynamics presented in [8]. This model [11] included the treatment compartment and considered movement for susceptible, treated, and acutely and chronically infected people among their compartments. Some time-dependent optimal control strategies are proposed, in order to control the HCV disease. A cost function is calculated for these strategies in order to evaluate the effectiveness of the control methods and select the most efficient one. Okosun and Makinde [12] employed a SEITV (susceptible, exposed, acutely infected, treated, and chronically infected) dynamical model for the HCV outbreak considering the screening rate and drug efficacy as control inputs for acutely and chronically infected populations and used the Pontryagin's principle to solve the optimal control problem. Another epidemiological model was investigated in [4] for the HCV outbreak in which the susceptible class was divided into aware and unaware classes. Moreover, they considered two control inputs including screening and treatment rates for the HCV epidemic model, which was determined by an optimal control law. In [4], the dynamics was formulated with the susceptibility reduction due to the publicity and the treatment process to identify the feasible effect of public concerns and treatment on the HCV. An optimal neurofuzzy strategy was also introduced in [13] in order to control the HCV epidemic. They [13] employed the mathematical model proposed in [12] as a deterministic model and utilized the genetic algorithm to obtain optimal control inputs.

As described, all of previous studies on the control of HCV epidemic were conducted on the optimal strategies. On the other hand, some other research works were performed on the adaptive control of different diseases as presented here. Moradi et al. [20] suggested a Lyapunov-based adaptive method to control three different hypothetical models of the cancer chemotherapy inside the human body and compared results among these models. In the next step of this research [21], a composite adaptive strategy has been developed for online identification of cancer parameters during the chemotherapy process. Boiroux et al. [22] employed a model predictive controller for the type 1 diabetes model and used an adaptive controller to balance the blood glucose. They determined the model parameters