

Fig. 2.1. Patient flow in the hospital COVID unit under the admission control policy

## 2.2 DES MODEL CONCEPTUALIZATION :

A DES model based on the general patient flow in hospital COVID units was developed using commercial simulation software, Arena®. The scope of the system and the patient flow is described as follows. Patients arriving at the hospital will be triaged first. Mild patients will be directly discharged after administering the treatment, which is out of the scope of this study. Severe patients, based on their level of severity will be admitted to an ICU (critical condition) or a ward (non-critical, e.g., do not need ventilators). In the model, type 1 (high risk) patients have a higher chance to be admitted to an ICU with a rate of 35%, and that of type 2 (low risk) patients is only 23%. Patients in wards, depending on their types being 1 or 2, will stay an average of 6.80 days with a standard deviation of 4.48 days, i.e., 6.80 (4.48) days, or 4.00 (2.40) days, and will be discharged. Patients in ICUs with critical conditions (stage 1) will be stabilized and transferred to a ward (stage 2). The total length of stay for ICU patients are 13.30 (8.37) and 12.90 (8.09) days with their average time in the ICU as 9.30 (5.86) and 8.90 (5.58) days, for type 1 and type 2 patients, respectively. When the ICU is full or exceeding its surge capacity (typically 20% more than the normal bed allocation), new arrivals have to be rejected. These patients might be transferred to another hospital or sent home. Here we consider an admission control policy: when the ICU bed occupancy is below the normal bed allocation, all new arrivals

will be admitted. When the ICU bed occupancy is above the normal bed allocation but below the surge capacity, only high-risk patients are admitted. The goal is to make room for a future critical condition patient. We denote this as a type-dependent admission control policy, and the corresponding patient flow is illustrated in Fig 1. Besides, as shown in Fig 2, we consider the early step-down of a patient from the ICU to make room for an incoming critical condition patient. If a new arrival is of type 1 and the ICU is at its surge capacity, then, we will search for a current ICU patient who is of type 2 and has stayed for the number of days which is more than the mean number of mechanical ventilation usage days in ICUs [19]. If there exists a patient that qualifies both criteria, he or she will be stepped down to a ward. This is denoted as an early step-down policy. If a patient is rejected or stepped down due to capacity constraints, their health outcome will be affected. Generally, ICU refusal or delay of ICU care would result in a higher death rate .

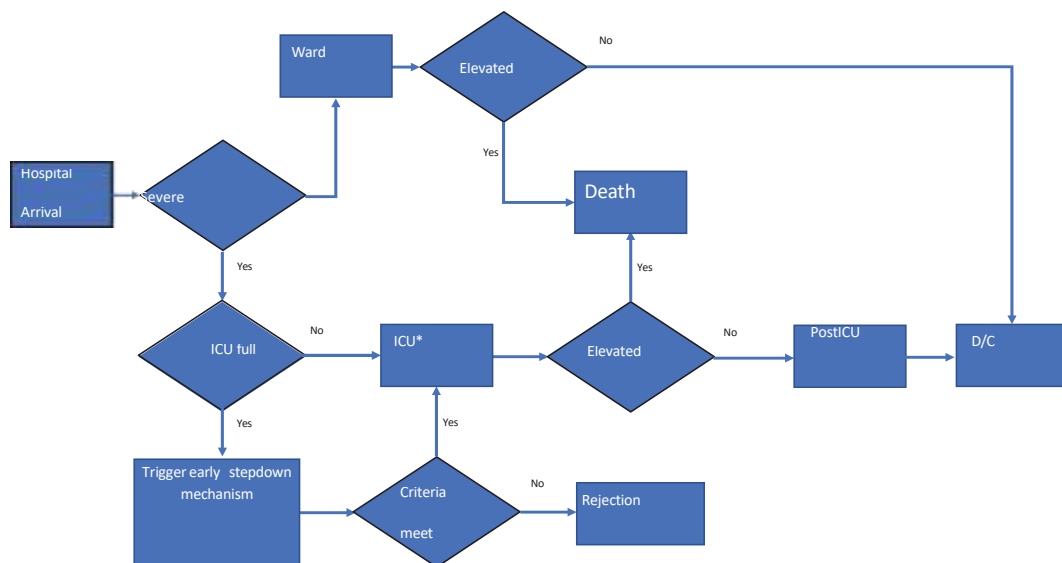


Fig. 2.2 Patient flow in the hospital COVID unit under the early step-down policy

## COVID BED SLOT BOOKING SYSTEM