Hospital States:

Individuals can have six “hospital states”, which correspond to locations in the hospital and community. These hospital states determine when interventions such as quarantine lifting and testing occur, as well as the progression of the disease.

1. NOT_IN_HOSPITAL
2. WAITING
3. GENERAL
4. ICU
5. DISCHARGED
6. MORTUARY

The first state, “NOT_IN_HOSPITAL”, refers to individuals who have not yet been hospitalised. Individuals who transition to the “HOSPITALISED” disease state, which implies progressing to a severely symptomatic state, are assigned to the hospital with the fewest patients and added to a waiting list for a general ward.

At this point, if a patient can enter a general ward, they do so, and their hospital state is changed to “GENERAL”. Otherwise, their hospital state is set to “WAITING” and they remain in the general ward waiting list. “WAITING” in this context is used for patients who have not entered either a general

Table 1. Table showing the hospital states a patient transitions to when they progress to a particular disease state. In the case of hospitalised or critical patients, the outcomes are waited such that worse progression becomes more likely if they cannot transition to their required ward.

Disease State	**Required Ward/State**	**Better Progression Outcome**	**Worse Progression Outcome**
HOSPITALISED	GENERAL	RECOVERED	CRITICAL
CRITICAL	ICU	HOSPITALISED_RECOVERING	DEATH
HOSPITALISED_RECOVERING	GENERAL	RECOVERED	----------
RECOVERED	DISCHARGED	----------	----------
DEATH	MORTUARY	----------	----------

ward or a critical ward, and is used primarily to represent patients in hospitals with too much overflow. Upon reaching either the “GENERAL” or “WAITING” stage, quarantine is lifted and patients are tested.

Should a patient’s disease state transition to “CRITICAL” at this stage, then they are removed from either the general ward or the general ward waiting list added to a waiting list for the ICU. As before, if a patient can enter the ICU immediately, they do so immediately, and their hospital state is updated to “ICU”. Otherwise, their states remain as they currently are.

Once a patient has become critically ill, they can then begin to recover, in which case they are added to back to a waiting list for a general ward, and their hospital state is moved back to “GENERAL” if they transition back successfully. Otherwise, the patient dies and is moved to a “MORTUARY” state. Recovering patients have to spend at least sometime in the general ward before being DISCHARGED.

When a patient transitions to these severe disease states, the choice of which disease state they go to next is decided at the point where availability of ward beds is determined. This is based on the assumption that if a very ill person requires a specific level of care and they do not get it almost immediately, then progressing to a worse state is more likely, regardless of whether they get treated

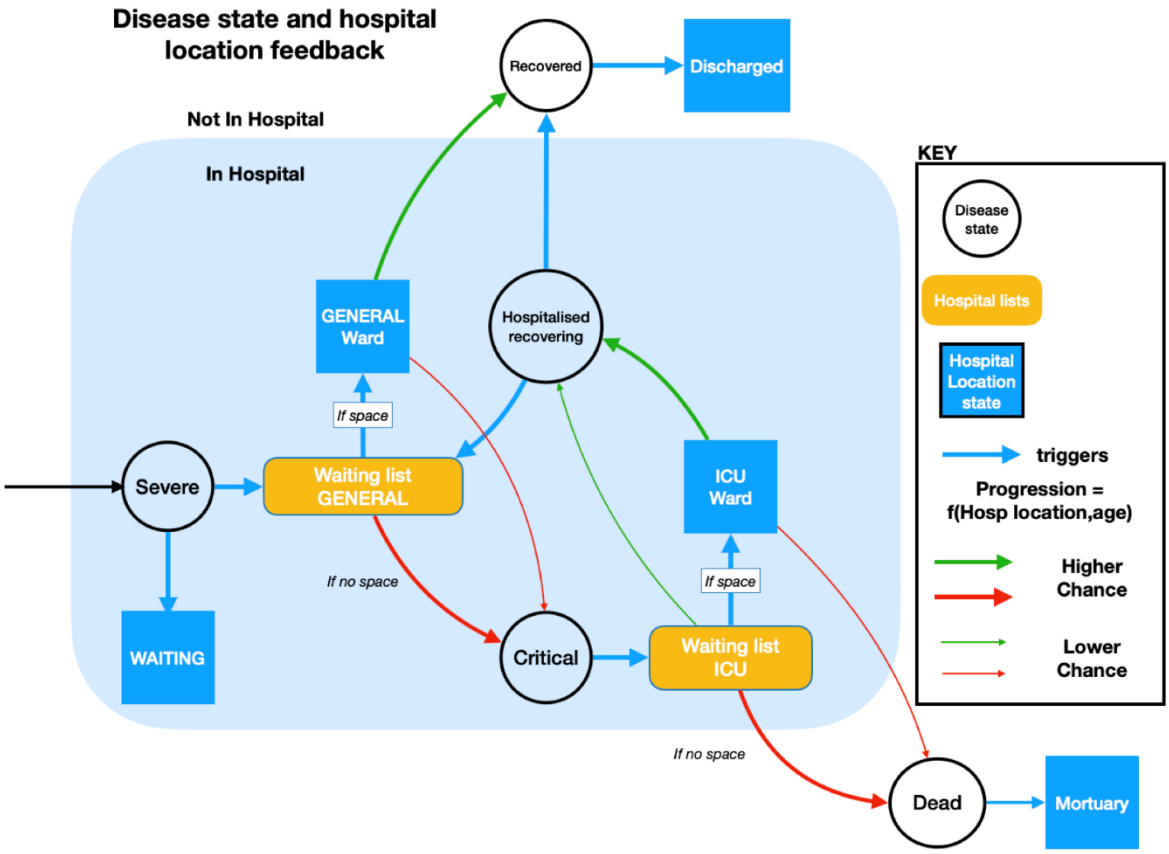

Figure 1. Diagram showing interlinking of disease states and hospital states in the simulation. As a person's disease progression advances, this triggers a change in their hospital state if they are able to move to their required ward (general if hospitalised or recovering, ICU if critical). If the wards are full, patients are added to a waiting list for that ward type and are moved in when space becomes available. However, failing to make it into a ward on the first attempt makes a progression to worse state more likely.

later. To emulate this, if a person cannot transition immediately to their required ward, the worse disease outcome becomes more likely. Otherwise, the probabilities for transitioning to either state remain as they were.

Ward Transitions and Waiting Lists:

As stated in the previous section, patients are added to waiting lists when attempting to enter either the general ward or ICU. These waiting lists are implemented as linked lists, with popping of patients being used to remove patients. The order of patients in the lists is therefore determined by the order in which they are added, which allows us to prioritise patients who have been in the list for longer by scheduling transitions for people earlier in the list. The only exception to this is when somebody in the either the general or ICU wards wishes to swap wards, in which case, they are added to the start of the list. This is to give patients who are already in the hospital priority when it comes to bed allocation. Furthermore, in instances where wards are full, newly recovering and newly critical patients can swap places.

Hospital Networks:

Infections in hospital occur at both a healthcare worker and a patient level, and are transmitted in a similar fashion to daily and work networks. All healthcare workers, who are separated into doctors and nurses, in a hospital are added to a work network (whilst being removed from the generic, age-stratified networks), which is static. Healthcare workers are assigned to individual wards, where they form random interactions with the patients in those wards. Healthcare workers remain in the same ward throughout the simulation (unless severely ill or in quarantine) and attempt to form a minimum number of required interactions with each patient. This means that a healthcare worker can form multiple connections with the same patient, representing a greater frequency of interactions with that patient. Doctors form a greater number of connections than nurses, but the strength of transmissions between doctors and patients is lower than for nurses, signifying the close contact and repeated interactions that a nurse typically has with a patient.