Boarding patients are patients that require admission to the hospital after being treated in the emergency department (ED) but are stranded in the ED because of a lack of beds in the hospital wards. This ‘inpatient boarding’ phenomenon is considered to be a big problem in many EDs all over the world and has been associated with increased ambulance diversions, worse patient outcomes, frustration among medical staff, higher patient length of stay, loss of revenue, and higher mortality rates.

The queueing network we are considering, models the ED as a semi-open queueing network with a limited number of beds and physicians. Patients may have to visit the physician more than once and boarding patients impact the treatment process by occupying beds while they wait for admission, preventing newly arriving patients from entering the ED. We analyse and solve our queueing network in an exact numerical way using a Markov-Modulated Fluid Queue (MMFQ). The advantage of the MMFQ over the standard QBD approach for exact analysis, is that service levels (the probability that the waiting time to obtain a bed is smaller than a certain threshold) are obtained more efficiently. We observe that boarding patients can put a lot of pressure on the ED when the number of beds is limited and investigate policies aimed at reducing the number of boarding patients.