

Using Computer Simulations to Improve Triage in a Mass-Casualty Event

February 24th, 2019



[Flexible Services and Manufacturing Journal](#)

June 2018, Volume 30, [Issue 1-2](#), pp 98-122 | [Cite as](#)

Markov decision process model for patient admission decision at an emergency department under a surge demand

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Article

First Online: 08 February 2017

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Abstract

We study an admission control problem for patients arriving at an emergency department in the aftermath of a mass casualty incident. A finite horizon Markov decision process (MDP) model is formulated to determine patient admission decisions. In particular, our model considers the time-dependent arrival of patients and time-dependent reward function. We also consider a policy restriction that immediate-patients should be admitted as long as there is available beds. The MDP model has a continuous state space, and we solve the model by using a state discretization technique and obtain numerical solutions. Structural properties of an optimal policy are reviewed, and the structures observed in the numerical solutions are explained accordingly. Experimental results with virtual patient arrival scenarios demonstrates the performance and advantage of optimal policies obtained from the MDP model.

Mass-Casualty Event



Oh no! The red line has derailed!

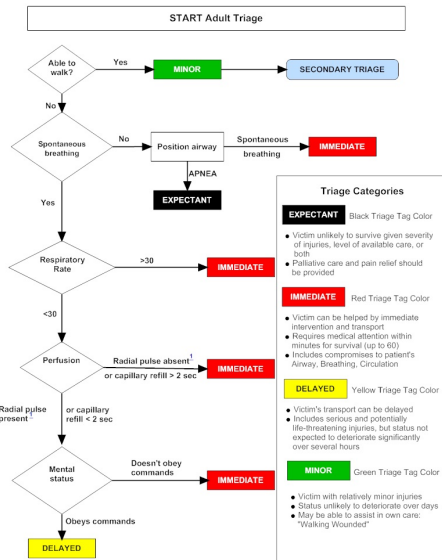


At the site of the crash



- **First-responders:** Triage patients based on injury severity
- **RED:** Patients in worst shape
- **YELLOW:** Patients whose care can be delayed
- **GREEN:** Patients with minor injuries

Simple Triage and Rapid Treatment (START)



Meanwhile, you must prepare the UChicago Trauma Unit



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- **Problem:** Not enough resources for all injured
- Expect around 30 patients but we only have the capacity to help 10!
- Any patients who cannot be seen here will need to be transported to the next closest unit which will take an additional 50 minutes!
- Who should be admit and who should we turn away?

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- First-Come-First-Serve
- Reserve beds for IMMEDIATE patients
- Reserve beds for DELAYED patients
- Research some for IMMEDIATE and some for DELAYED
- Other?

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 - How are these different for IMMEDIATE vs. DELAYED patients?
- Let's use computers to help us!

Humans are very predictable!

- Many of the things discussed above are random
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- Many of the things discussed above are random
- Why might we want to use a computer to generate random events rather than just doing it ourself?
 - Human's are very bad at being truly random
 - [Mindreader!](#)