A game theoretic model of the behavioural gaming that takes place at the EMS - ED interface

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Abstract

Operational Research (OR) techniques provide a toolkit of mathematical modelling approaches that are routinely used for problem solving in many sectors. Healthcare is considered to be one of such sectors where, in recent years, OR has found several applications.

Emergency departments (EDs) in hospitals are usually under pressure to achieve a target amount of time that describes the arrival of patients and the time it takes to receive treatment. For example in the UK this is often set as 95% of patients to be treated within 4 hours. There is empirical evidence to suggest that imposing targets in the ED results in gaming at the interface of care between the EMS and ED.

This study explores the impact that this effect may have on an ambulance's utilisation and their ability to respond to emergency calls. More specifically multiple scenarios are examined where an ambulance service needs to distribute patients between neighbouring hospitals. The interaction between the hospitals and the ambulance service is defined in a game theoretic framework where the ambulance service has to decide how many patients to distribute to each hospital in order to minimise the occurrence of this effect. The methodology involves the use of a queueing model for each hospital that is used to inform the decision process of the ambulance service so as to create a game for which the Nash Equilibria can be calculated. Numerous decisions are taken by both patients and staff alike that determine the level of workflow and the patient pathway.

This study aims to explore the use of a queueing theoretic model with two waiting spaces and use it to inform a game theoretic system that captures the emergent behaviour between the EMS and ED.