Optimizing Rapid Response Decisions to Improve Inpatient Care

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Abstract

Recognizing physical deterioration of inpatients in a general care setting is challenging due to the lack of a standard definition and irregular monitoring. Therefore, patients in the general ward are at increased risk of preventable failures, such as preventable death or ICU admissions, caused by delayed patient rescue interventions. Optimizing patient rescue decisions requires knowledge of the time spent in a health state in addition to the patient’s condition dynamics. We develop a semi-Markov Decision Process model to identify optimal strategies for Rapid Response Team (RRT) activation in order to minimize the time to stabilize a patient whose condition has deteriorated. Patient’s health condition evolves over time with the patient spending random amounts of time in each health state and moving stochastically between health states as assessed by vital sign measurements. This research incorporates the dynamic nature of the patient’s health status during their hospitalization from admission to the general floor through discharge from the general floor. Optimal policy obtained numerically has a control limit structure which enables the implementation of the optimal patient rescue strategies for real time decision support.

Keywords
Markov Decision Processes, optimization of inpatient care, decision analytical modeling.

1. Introduction

Hospitalized patients in a general care setting have a risk of experiencing an acute physiologic deterioration during their stay. Acute physiologic deterioration is defined as a clinical decline in physiological status which may lead to serious health problems such as cardiac arrest or even death [1]. Recognizing physical abnormalities early is essential to avoid delays in appropriate management and prevent worsening physiology.

Recognizing physical deterioration of patients in a general care setting is challenging. One reason is lack of a standard definition of physiological deterioration. Commonly, abnormal physical values occurring in the hours preceding an adverse event are associated with physiological instability, and considered as signs of physical deterioration [1]. Another reason is that patients in general ward are not observed as frequently as in intensive care units, and therefore are at increased risk of preventable failures due to delayed precautions to prevent adverse events, i.e. Failure to Rescue (FTR). Due to the irregular monitoring frequency they are at increased risk of preventable failures. Patient safety literature provides evidence that delay in recognition and resuscitation can lead to FTR [2].

Rapid recognition of physical deterioration is critical for rapid resuscitation to avoid preventable deaths. Hospitals implement medical emergency response teams, also called Rapid Response Teams (RRT) to support patient rescue decisions among other measures. RRT is a specialized team of clinicians who provide immediate on-site critical care service for physically deteriorating individuals who are being treated outside an intensive care unit [1-3]. In 2004, the Institute for Healthcare Improvement (IHI) encouraged American hospitals to implement emergency response teams to improve patients’ outcomes. Today, hospitals commonly have an established RRT to respond to physiological deterioration during hospitalization.