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The impact of the residency teaching model on the efficiency of the emergency department at an academic center

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ABSTRACT

The residency teaching model is often cited as a source of inefficiency in the healthcare system. We build a simulation model of an Emergency Department (ED) at a large urban academic hospital. Using historical data and a natural experiment involving residents in the ED, we show that residents in fact increase throughput and lower service and waiting times compared to not being there at all.

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1. Introduction

The rising cost of healthcare is of significant social and political concern in America today. According to the Center for Medicare and Medicaid services (CMS), in 2007, total healthcare spending in the USA was \$2.2 trillion. At \$7421 per person, this accounts for over 16% of the nation's GDP. By 2007, healthcare spending was more than three times what it had been in 1990 [16]. CMS expects that healthcare spending will keep increasing at 6% per year until 2018, at which point it will account for a fifth of the United States economy. While there are many components to these costs, hospitals contributed the largest amount, at 32% of all healthcare expenditures. Increasing hospital efficiency is one way to help slow the growth of healthcare spending. [7] reports that total healthcare spending increased to \$2.5 trillion or \$8047 per person, by 2009.

One potential source of inefficiency that we will study in this paper is the residency teaching model. After students graduate from medical school, they must complete three to seven years of additional training under a senior doctor, called an attending physician, to become board certified in a medical or surgical specialty. Residencies can be completed in any general or specialty field within medicine or surgery. Upon successful completion of residency and the specific medical boards for that specialty, a doctor is then considered a certified specialist. This level of training is required to

work as an attending physician in an academic center. While working as a resident, a new doctor will diagnose and treat patients under the supervision of an attending physician who oversees and teaches the residents, while providing clinical care. It is a common hypothesis that the presence of residents in a hospital setting hinders overall system efficiency [5]. Because attending physicians have to spend time teaching residents that could be spent treating patients directly, it has been suggested that residents slow down treatment and hinder efficiency.

We worked with the University of Maryland Medical Center (UMMC) to help determine the impact of their residency teaching model on efficiency in the Emergency Department (ED). We collected data and designed and implemented a simulation model of the ED. In Section 2, we review the relevant literature. In Section 3, we discuss our data and provide a detailed description of the simulation model. Validation of the model is given in Section 4. In Section 5, we discuss the results and implications. The conclusions are presented in Section 6.

2. Literature review

In this section, we discuss studies about the effects of residents on ED efficiency. The resident education model creates a dual role for attending physicians in the ED, because a resident's role includes both treating patients and learning medicine. Thus, the resident care model can affect patient throughput because of the additional time spent on instruction.

Recent research has found that residents do decrease efficiency in hospital settings. In one study, researchers aimed to review ED

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patient waiting times, time until an admission decision was made, and total ED length of stay during periods when residents were on strike versus times of normal resident staffing patterns [12]. They found that without residents, the ED had higher throughput and the length of stay was reduced. [17] examined the effect of adding residents to an ED at a community hospital. They found that there was a weak, positive correlation between ED patient length of stay and the presence of residents. [4] studied the efficiency of residents as they gained experience. They found that as residents become more experienced they increase their throughput. [21] observed the effects of a resident strike on quality and throughput in an ED at a large teaching hospital. They found that replacing residents with staff physicians led to an increase in throughput and in quality of care.

Other studies, however, have shown that residents have no negative effects on throughput or treatment times. [5] looked at the introduction of anesthesiology residents to surgical wards and expected to find decreased efficiency. However, they found no significant adverse economic or health effects. [20] studied the addition of residents to a trauma care center and concluded that residents improved efficiency while having no effect on the quality of care.

Methodologically, our paper relies on simulation modeling and queueing theory. These methods have been used extensively in the hospital operations management literature. [1,6,14,15] provide surveys of simulation models used in healthcare research. Simulation has a wide variety of applications in healthcare, such as modeling patient flow [2], optimizing resource allocation [18], and evaluating surgery scheduling strategies [3].

Queueing theory is another technique widely used in the hospital operations management literature. [8,10] provide surveys of applications of queueing theory to healthcare problems. For example, queueing theory has been used in the emergency department to determine appropriate staffing levels in order to reduce the proportion of patients who leave without being seen [11] and to assist in bed management planning [9].

3. Data and simulation model

We were motivated by the inconclusive literature to study whether residents help or hurt efficiency in the ED. At the UMMC, every Wednesday morning there was a seminar that the residents had to attend, so they were not present in the ED. Because of this, patients who were treated on Wednesday mornings were not seen by a resident, but only by attending physicians. This observation

(residents present vs. not) suggests a natural experiment to determine what effect removing residents would have during other parts of the week. We designed a simulation model to exploit this natural experiment. This research was reviewed and approved by the Institutional Review Board at the University of Maryland, Baltimore.

Because there are no changes in staffing levels in the ED on Wednesday mornings other than the presence or absence of residents, the differences in treatment times for similar patients can be attributed entirely to the presence or absence of residents. Typically, there are two attending physicians on duty and four or five residents in the ED. When the residents are present, they do almost all of the “hands-on” treatment of patients, while the attending physicians play a managerial/supervisory role. When the residents are present, they are simultaneously treating patients and receiving instruction from the attending physicians. The attending physicians oversee the care and teach the residents. Therefore, our simulation model assumes that when residents are present they treat every patient who arrives. When the residents are absent, due to the seminar, the attending physician’s role shifts from supervisory to active care-providing. As a consequence, they now spend their time treating patients, rather than supervising and teaching residents. The changes in treatment times that we see when residents are not present are a result of this shift. This assumption was motivated by conversations with ED physicians at the UMMC.

To attribute treatment time changes on Wednesday mornings to staffing levels, we must verify that Wednesday mornings are similar to the rest of the week in terms of arrival rates and patient severity. To do this, we compare the patients who arrive on Wednesday mornings (when residents are absent) to those who arrive at all other times of the week (when residents are present). Fig. 1 shows the historical arrival rates over the course of the week. There is a wide range of arrival rates for Wednesday mornings. In general, there are more arrivals than on weekend mornings and fewer than on Monday or Tuesday mornings. In addition, morning arrival rates are higher than overnight rates and lower than afternoon rates. So, Wednesday morning arrival rates are not atypical in any way. Furthermore, the patient population mirrors that of the rest of the week, in terms of severity and admission rate. We compared the two patient populations (those treated when residents were present and those treated when they were absent). We found that when residents were absent, 47%, 50%, and 3% of patients were of high, medium, and low severity, respectively, while those numbers were 45%, 51%, and 4% when residents were present. A Chi-Square test fails to reject ($p = .81$) the hypothesis

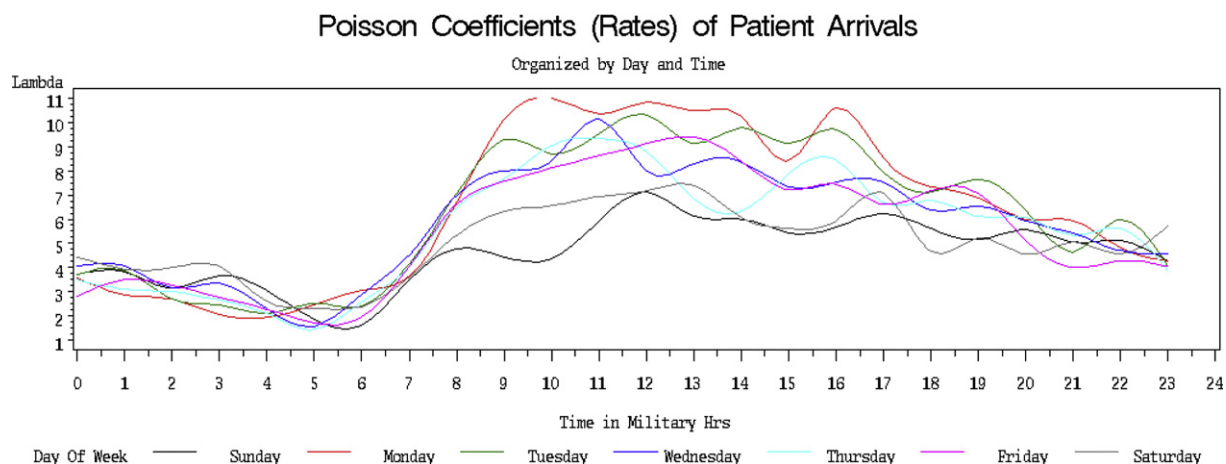


Fig. 1. Arrival rates by day of week.

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