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DO SLOW AND STEADY RESIDENTS WIN THE RACE? MODELING THE EFFECTS OF PEAK AND OVERALL RESIDENT PRODUCTIVITY IN THE EMERGENCY DEPARTMENT

Joshua W. Joseph, MD, MS,^{*†} Victor Novack, MD, PHD,[‡] Matthew L. Wong, MD, MPH,^{*†} Larry A. Nathanson, MD,^{*†} and Leon D. Sanchez, MD, MPH^{*†}

^{*}Department of Emergency Medicine, Beth Israel Deaconess Medical Center, Boston, Massachusetts, [†]Harvard Medical School, Boston, Massachusetts, and [‡]Clinical Research Center, Soroka University Medical Center and Faculty of Health Sciences, Ben-Gurion University of the Negev, Beer Sheva, Israel

Reprint Address: Joshua W. Joseph, MD, MS, Department of Emergency Medicine, Beth Israel Deaconess Medical Center, Rosenberg Building, Second Floor, One Deaconess Rd., Boston, MA 02215

Abstract—Background: Emergency medicine residents need to be staffed in a way that balances operational needs with their educational experience. Key to developing an optimal schedule is knowing a resident's expected productivity, a poorly understood metric. **Objective:** We sought to measure how a resident's busiest (peak) workload affects their overall productivity for the shift. **Methods:** We conducted a retrospective, observational study of resident productivity at an urban, tertiary care center with a 3-year Accreditation Council for Graduate Medical Education-approved emergency medicine training program, with 55,000 visits annually. We abstracted resident productivity data from a database of patient assignments from July 1, 2010 to June 20, 2015, utilizing a generalized estimation equation method to evaluate physician shifts. **Our primary outcome measure** was the total number of patients seen by a resident over a shift. **The secondary outcome** was the number of patients seen excluding those in the peak hour.

Results: A total of 14,361 shifts were evaluated. Multivariate analysis showed that the total number of patients seen was significantly associated with the number of patients seen during the peak hour, level of training, the timing of the shift, but most prominently, lower variance in patients seen per hour (coefficient of variation < 0.10). **Conclusions:** A resident's peak productivity can be a strong predictor of their overall productivity, but the substantial negative effect of variability favors a steadier pace. This suggests that resident staffing and patient assignments should generally be oriented toward a more consistent workload, an effect that should be further investigated with attending physicians. © 2017 Elsevier Inc. All rights reserved.

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INTRODUCTION

Emergency medicine residents provide medical care in academic emergency departments (EDs) and are supervised while developing and honing their clinical skills. ED leadership must develop a staffing plan that balances the operational needs of the department with the educational experience of the trainee and maintains a safe and efficient

environment. A key element to developing an optimal schedule is knowing the expected productivity of an emergency medicine resident, a metric that is variably defined and poorly understood. It has been defined variously in terms of the total volume of patients a resident sees over the course of a shift, the average number of patients seen per hour, or the number of relative value units (RVUs) generated by a resident during a shift (1–4). Regardless of the metric used, resident productivity has broad implications for both education and clinical operations.

Resident productivity serves as a close proxy for two important goals of emergency medicine resident education, namely excellent clinical efficiency and wide breadth of experience. Clinical efficiency is the ability to evaluate, treat, and disposition patients quickly and is an essential characteristic of emergency physicians, who must simultaneously treat multiple ill patients arriving in brief intervals. Similarly, more productive residents will see a larger volume of patients over the course of their residency, they will likely see a wider range of pathology, and thus have a greater breadth of experience to draw upon when treating the broad spectrum of patients seen in independent practice.

Administrators need to be able to predict resident productivity reliably so that they can staff residents and other providers appropriately to match demand and ensure efficient patient flow. Resident duty hours are fixed as a training program requirement, and it is difficult for programs to add residents, thus it is essential for both administrators and educators to know how residents can most effectively structure their shifts. There are also less overt constraints on residents' duty hours, as residents with supervisory responsibilities may be limited in their ability to see patients primarily, and other residents may need a reduced load in anticipation of conferences or didactics.

Despite the importance of this metric, there have been comparatively few studies on resident productivity in emergency medicine, and there aren't major recommendations or benchmarks of resident productivity from the main bodies governing emergency medicine resident education. Previous studies on emergency medicine resident productivity have been relatively small, and often have primarily examined productivity as a static number—the average number of patients per hour—in relation to residents' year of postgraduate training (1,5,6). Although a pair of previous studies has examined gradual decreases in overall productivity with increasing shift length, to date, no study has examined if there is an association between the variability of residents' hourly productivity and their overall productivity (7,8).

Understanding the relationship between residents' peak and overall productivity is important because variable productivity is inherent to emergency medicine. Patient arrival times and acuity in the ED do not progress

at a set rate, so there are often times during a shift when residents need to see patients at a much faster pace than they can sustain for the entirety of the shift. In this study, we sought to examine specifically whether there was a relationship between residents' peak hourly productivity (the highest number of patients per hour seen) and their overall productivity (the total number of patients seen over the course of a shift). As a secondary outcome measure, we examined the relationship between residents' peak productivity and their overall productivity when controlling for the patients seen during the peak hour.

METHODS

Study Design and Setting

This was a retrospective, observational study of resident productivity at an urban, tertiary care center with a 3-year Accreditation Council for Graduate Medical Education-approved emergency medicine training program, with 55,000 visits annually.

First-year residents in our ED are at liberty to pick up patients at their own pace, and patient assignments are logged by residents signing up for patients on a locally developed ED information system known as the "ED Dashboard." On slightly less than half of their shifts, second-year emergency medicine residents are automatically assigned additional patients who meet a set of "trigger" criteria, which include abnormal vital signs, trauma, or stroke risk, but otherwise pick up additional patients at their own pace (9). Third-year residents primarily have supervisory-only shifts, but see patients ad libitum on nonsupervisory shifts. Residents take patients in sign-out (patients whose disposition is contingent on the results of pending diagnostic testing) at the start of their shift.

Assessment

Every emergency medicine resident across all years of residency at our institution was enrolled in the study, during which they worked different 8- and 9-h shifts throughout the course of the day (7 AM–3 PM, 9 AM–5 PM, 2 PM–11 PM, 4 PM–1 AM, 10 PM–7 AM). We excluded shifts done by non-emergency medicine trainees ("off-service" residents) and those shifts performed by interns in a specific, low-acuity area that was phased out during the initial years of the study. We also excluded purely supervisory shifts done by third-year emergency medicine residents.

Methods and Measurements

We abstracted resident productivity data from a central database of patient assignments from July 1, 2010 to June 20, 2015. Identifying patient information (including

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