

Empirical Analysis of the Effect Residents Have on Treatment Times in an Emergency Department

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Overview

Broad Healthcare Landscape

- Health Care Reform Bill, 2010
- Americans spent \$2.3 trillion on health care in 2007
- Hospitals are one of the least efficient sectors



University of Maryland Medical Center (UMMC)

UMMC

700 beds
1,182 doctors
742 residents

UMMC ED

55 beds
20% admission rate
46,000 patients/year



Residency Model

Medical School

- Four years
- Classes, clinical rotations

Residency

- First year: Internship, general medicine
- Next 3-7 years: Specialty
- Designed for teaching

Attending Physician

- Private practice or hospital

Research Question

What effects do residents have on the efficiency of the emergency department?

- Longer or shorter patient treatment times?

Residents are in the hospital to learn but also treat patients

One conjecture is that the teaching of residents takes time away from patient care and negatively impacts efficiency

Resident Seminars

- Residents absent every Wednesday morning for a seminar
- No replacement workers hired
- Wednesday mornings provide a representative sample of all emergency department activity
 - Wide range of arrival rates
 - All types of patients and severities
 - Congestion levels vary as well

Data

- Data was provided on 7395 patients
- Information on severity score, number of lab and radiology tests needed, arrival time, treatment time, congestion of the waiting room, and whether or not the patient was admitted to the hospital was given for each patient
- Resident presence was determined based on the time the patient was first treated

Regression Analysis

- Regressed treatment time on patient and treatment characteristics: Resident absence increases treatment times by almost 8%.

Variable	Coefficient	Std. Error	t-value	p-value
(Intercept)	5.002	0.020	247.475	<.001
NoRes	0.075	0.034	2.242	0.025
Line	0.010	0.002	5.455	<.001
Admit	0.088	0.015	5.819	<.001
NumLab	0.032	0.001	35.847	<.001
Labs	0.335	0.018	18.716	<.001
NumRad	0.057	0.004	13.509	<.001
Rad	0.148	0.016	9.376	<.001
Weekend	-0.044	0.013	-3.311	<.001
Sev1	-0.148	0.096	-1.544	0.123
sev2	0.048	0.017	2.730	0.006
sev3	0.031	0.015	2.080	0.038
sev4	-0.178	0.032	-5.511	<.001
sev5	-0.543	0.090	-6.001	<.001

(Adjusted R2 = .5355, N = 7935)

High Severity vs Low Severity

- Residents might play different roles when treating different types of patients
- Ran regressions on high and low severity patients separately.
- Residents have a strong effect on lowering treatment times when treating high severity patients, but no noticeable effect when treating low severity patients

High Severity Results

Variable	Coefficient	Std. Error	t-value	p-value
(Intercept)	5.027	0.020	245.581	<.001
NoRes	0.073	0.034	2.138	0.033
Line	0.009	0.002	4.784	<.001
Admit	0.090	0.015	5.955	<.001
Numlab	0.032	0.001	35.832	<.001
Labs	0.316	0.018	17.242	<.001
Numrad	0.056	0.004	13.331	<.001
Rad	0.143	0.016	8.881	<.001
Weekend	-0.055	0.014	-4.010	<.001
sev1	-0.146	0.095	-1.528	0.126
sev2	0.049	0.017	2.828	0.005
sev3	0.029	0.015	1.987	0.047

(Adjusted R2 = .5133, N = 7549)

Low Severity Results

Variable	Coefficient	Std. Error	t-value	p-value
(Intercept)	4.234	0.104	40.558	<.001
NoRes	0.110	0.189	0.581	0.562
Line	0.041	0.011	3.711	<.001
Admit	0.010	0.127	0.081	0.935
Numlab	0.035	0.007	4.899	<.001
Labs	0.553	0.087	6.324	<.001
Numrad	0.133	0.037	3.610	<.001
Rad	0.144	0.093	1.559	0.120
Weekend	0.135	0.062	2.183	0.030
sev4	0.281	0.099	2.834	0.005

(Adjusted R2 = .5737, N = 341)

Morning Patients

- One possible source of endogeneity is that residents are only absent for patients treated in the morning
- We restrict the data to only those patients who began treatment between 7 am and 1 pm (the time of the seminars on Wednesday)
- Our results still hold

Morning Results

Variable	Coefficient	Std. Error	t-value	p-value
(Intercept)	4.630	0.055	84.908	<.001
NoRes	0.068	0.034	2.008	0.045
Line	0.023	0.006	3.792	<.001
Admit	0.146	0.031	4.669	<.001
Numlab	0.030	0.002	15.628	<.001
Labs	0.328	0.038	8.750	<.001
Numrad	0.054	0.009	5.901	<.001
Rad	0.188	0.033	5.763	<.001
High	0.345	0.054	6.359	<.001

(Adjusted $R^2 = .5712$, $N = 1768$)

Survival Analysis

- Instead of measuring treatment times, we can measure discharge rate
- We compare discharge rate on Wednesday mornings to the discharge rate on other weekdays
- A higher discharge rate would imply that residents help to increase throughput

Survival Analysis Results

Variable	Coefficient	Standard Error	z	Pr(> z)
Numlab	0.0037	0.0055	0.6680	0.5044
Numrad	-0.0358	0.0254	-1.4090	0.1587
NoRes	-0.2505	0.0860	-2.9140	0.0036
Sev1	0.6403	0.4540	1.4100	0.1585
Sev2	-0.0447	0.1023	-0.4370	0.6622
Sev3	-0.1140	0.0836	-1.3640	0.1725
Sev4	-0.0320	0.1932	-0.1660	0.8685
Sev5	0.6317	0.5864	1.0770	0.2814
Line	0.0327	0.0104	3.1310	0.0017
Labs	-0.6133	0.1067	-5.7490	0.0000
Rad	-0.2198	0.0905	-2.4290	0.0152

Conclusion

- Contrary to our original intuition, we have shown that residents speed up the treatment of patients in the emergency department
- This effect is especially strong when treating high severity patients
- We recommend that when possible, residents treat high severity patients