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Introduction

The Patient Protection and Affordable Care Act of 2010 included incentives for early adopters of electronic health record systems (EHRs).

Beginning in 2015, those incentives became penalties for those who did not implement EHRs, and penalties continue to increase yearly until at least 75% of healthcare professionals become "meaningful users" of EHRs.

Supportive evidence shows that adoption of EHRs can:

- reduce medical errors
- promote a sense of improved productivity, more efficient clinical processes and increased revenue for primary care physicians
- decrease emergency department visits and hospitalizations among diabetics

Opposing evidence shows that adoption of EHRs can:

- lead to decreased appointment availability persistently longer outpatient visits

For surgical specialties such as orthopedic surgery, fewer office visits may translate into fewer surgeries, and thus less revenue generated.

Hypothesis: adoption of an EHR will lead to a decrease in the number of outpatient visits per day and surgical cases per day for an orthopedic surgical practice.

Methods

Records from six orthopedic surgeons practicing in a Level 1 academic center were reviewed

For each surgeon, the number of outpatient visits per clinical office day and number of surgical cases per operative day were counted from four distinct, six-month time periods.

Time periods for data collection:

- 1) before adopting EHR in office setting
- 2) after adopting EHR in office setting
- 3) before adopting EHR in hospital setting
- 4) after adopting EHR in hospital setting

To control for the learning curve of adopting an EHR, data was not collected from the initial six months following implementation of the EHR in either setting

To control for any effect of seasonal variation on patient volume, data was collected from the same six-month time period pre and post EHR implementation in both settings

A paired-sample t-test was performed to determine if there was a significant difference in the number of outpatient visits per office day or surgical cases per operative day when comparing data from pre versus post EHR implementation

Results

Surgeon A		Before EHR	After EHR	Delta (%)
Office EHR	Office Visits/Day	37.91	41.24	8.8
	Surgical Cases/Day	3.41	4.43	30.1
Hospital EHR	Office Visits/Day	41.89	40.69	-2.9
	Surgical Cases/Day	4.53	5.08	12.1
Surgeon B		Before EHR	After EHR	Delta (%)
Office EHR	Office Visits/Day	37.17	38.54	3.7
	Surgical Cases/Day	3.62	4.29	18.7
Hospital EHR	Office Visits/Day	32.99	33.01	0.1
	Surgical Cases/Day	3.77	3.43	-9.0
Surgeon C		Before EHR	After EHR	Delta (%)
Office EHR	Office Visits/Day	30.50	31.07	1.9
	Surgical Cases/Day	1.51	2.15	42.1
Hospital EHR	Office Visits/Day	27.45	27.47	0.1
	Surgical Cases/Day	1.36	1.42	4.2
Surgeon D		Before EHR	After EHR	Delta (%)
Office EHR	Office Visits/Day	40.50	40.62	0.3
	Surgical Cases/Day	6.23	6.18	-0.7
Hospital EHR	Office Visits/Day	42.00	37.45	-10.8
	Surgical Cases/Day	6.33	6.39	1.0
Surgeon E		Before EHR	After EHR	Delta (%)
Office EHR	Office Visits/Day	23.95	27.72	15.8
	Surgical Cases/Day	1.58	1.95	23.4
Hospital EHR	Office Visits/Day	31.26	26.54	-15.1
	Surgical Cases/Day	1.78	1.81	2.1
Surgeon F		Before EHR	After EHR	Delta (%)
Office EHR	Office Visits/Day	31.74	32.44	2.2
	Surgical Cases/Day	2.89	2.81	-2.7
Hospital EHR	Office Visits/Day	20.32	30.5	50.1
	Surgical Cases/Day	1.23	1.58	28.4

Table 1 – Comparison of office visits per day and surgical cases per day before versus after implementing EHR systems in two different settings (office and hospital) for six surgeons.

Following Office-based EHR:

- All surgeons were able to see an increased number of patients per office day (range: 0.3% to 15.8%).
- Four physicians had an increase in surgical cases per operative day between 18.7% and 42.1%.
- The practice as a whole was able to see a significant increase in the number of outpatients per office day ($p = 0.047$) but no significant increase in surgical cases per operative day ($p = 0.060$) (Tables 1 and 2)

Following Hospital-based EHR:

- Five of the six surgeons had an increase in surgical cases per operative day between 1.0% and 28.4%.
- Half of surgeons had no change in number of patients seen per office day
- Two of six surgeons saw less patients per office day
- One surgeon was able to see an increased number of patients per office day (range: -15.1% to 50.1%).
- The practice as a whole was able to see a trending increase in the number of surgical cases per operative day ($p = 0.380$) but no significant increase in number of outpatients per office day ($p = 0.986$) (Tables 1 and 2)

		Mean %	Std Dev.	Std Error Mean	95% Confidence Interval		T	Df	Sig.(2-tailed)
					Lower	Upper			
Office EHR	Office visits (difference)	5.43	5.84	2.38	0.76	10.1	-2.62	5	0.047
	Surg. cases (difference)	18.5	17.5	7.15	4.46	32.5	-2.43	5	0.060
Hospital EHR	Office visits (difference)	3.57	23.6	9.64	-15.3	22.5	0.019	5	0.986
	Surg. cases (difference)	6.44	12.7	5.18	-3.71	16.6	2.015	5	0.380
Total Before to After EHR	Office visits (difference)	-2.1	10.4	4.63	-10.4	6.19	0.646	4	0.554
	Surg. cases (difference)	11.0	22.9	10.24	-7.33	29.3	2.131	4	0.350

Table 2 – Statistical changes in outpatient visits per day and surgical cases per day

Conclusions

Implementation of EHR in both the office and hospital setting leads to changes in office and OR surgical volumes, but this is surgeon specific.

Overall, with the implementation of EHR in both settings, the group, as a whole, did not see a significant change in office or OR surgical case volume.

The only significant change occurred with implementation of an office based EMR.