Mixing Electronic and Non-Electronic Health Records Limits Physician Productivity - The Arizona Experience

Willaim G Johnson[1*], Richard J Butler[2] and Gevork Harootunian[3]

[1] Department of BioMedical Informatics, Arizona State University, Arizona, USA

[2] Department of Economics, Brigham Young University, Utah, USA

[3] Center for Health Information and Reseearch, Arizona State University, Arizona, USA

Abstract

Objective: Estimate the effects of electronic health records (EHRs) on physician productivity in day-to-day practice by including the combinations of EHRs with non-electronic records that typify current practice.

Study Design: Cross section of 7,725 physicians representing 70% of physicians who provided patient care in 2012-2014 in Arizona. The sample was divided into office based (OFB) and non-office based (NOFB) physicians.

Methods: Information from licensing applications was combined with a survey of the uses of electronic and non-electronic health records. Productivity was measured as patient visits per hour in a typical work week. The effects of EHRs on productivity were estimated from a regression model that compared users to non-users and an model that included combinations of electronic, paper and scanned records. The results are compared to the physicians' rankings of the effect of each combination of records on staff and physician productivity.

Results: The productivity of OFB physicians is increased by the use of e-prescribing (+17.4%, p<0.001) and intervention reminders (+5.7%, p=0.03). There are no significant effects of the different mixes of health records.

Among NOFB physicians, e-prescribing is the only contributor to productivity (+7.7%, p=0.069).

Physicians rank EHR-only as more productive than any combinations of EHRs with non-electronic records.

Conclusion: The potential productivity of EHRs is severly limited by the typical practice of combining EHRs with non-electronic records. Reducing the number of different types of records used in a practice will increase the positive effects of EHRs on productivity. One requirement for such reductions is an increased availability of health information exchanges.

Keywords

Electronic health record; Physician; Productivity

Correspondence to:

William G Johnson
Department of BioMedical Informatics, Arizona State University, Scottsdale, Arizona, USA.
E-mail: William.G.Johnson@asu.edu

EJBI 2018; 14(4):12-19
Received: September 22, 2018
Accepted: May 10, 2018
Published: May 17, 2018

1 Introduction

This study analyzes the effects of mixing electronic health records (EHRs) with non-electronic records on physician productity using data on 7,725 physicians in Arizona during 2012-2014. Office based physicians in the United States increased their use of EHRs from 18% in 2001 to 78% in 2013 [1]. In Arizona, EHR use, by office based and non-office based physicians, increased from 45% in 2007-2009 to 81% in 2012- 2014 [2]. The predicted improvements in productivity from EHR use have not, however, been realized [3, 4, 5, 6].

The predictions failed to adequately adjust for the substantial lag between adoption of an EHR by a medical practice and reliance on EHRs as the only form of medical record. Eighty-three percent of Arizona physicians with EHRs and 80% of physicians nationally, combined EHRs with paper and/or scanned records [2, 7].

The shortage of health information exchanges (HIEs) over which EHRs can be exchanged also limits the effectiveness of EHRs. Avoiding duplicative tests and adverse events, for example, requires sharing among providers, but only 14% of office based physicians in the U.S. exchange

information electronically with other health care organizations [8, 9]. In Arizona, for example, 36% of physicians engaged in e-prescribing; 26% electronically exchanged patient summaries; 28% exchanged electronic lab orders and 10% of physicians exchanged intervention reminders [2].

Early discussions of EHRs implicitly assumed that HIEs would grow apace with the adoption of EHRs but many HIEs closed when government or philanthropic subsidies ended and the future of many active HIEs is uncertain [10, 11, 12, 13, 14, 15, 16].

In 2012, the Arizona statewide HIE (The Network) served only 37 participants, mostly hospitals [2]. The inability to transfer EHRs electronically requires scanning or downloading medical records to paper to be faxed or emailed [7]. Each transaction reduces physician and staff productivity in the sending and receiving organizations.

The use of multiple types of records reduces physician and staff productivity relative to using a paper or electronic record alone. Comparisons of EHR users to non-users obscure differences in productivity among physicians that reflect differences in reliance on mutliple types of medical records. The resulting estimates, on average, are likely to understate the true productivity of EHRs alone.

We estimate a multivariate model linking physician productity to EHRs, comparing users to non-users and then compare the estimates to a model that includes EHRs combined with non-electronic records. Results are also presented on the shortage of HIEs.

Physicians' rankings of the productivity effects of EHRs and the combinations of EHRs with paper and scanned records are compared to the estimates from the multivariate models. Statistically significant contributions to productivity from EHRs are only found in the model with record combinations included. Examples of the positive effects of EHRs include increases in productivity from e-prescribing which combines EHR use with networks for electronic exchanges. Physicians' perceptions strongly suggest that EHRs increase their productivity.

2 Background

2.2 Literature Search

Research on physician productivity and EHRs includes large national survey studies of office-based physicians and analyses of 1-50 primary care practices, often within a single State. We scanned Goggle Scholar and PubMed using the terms *electronic medical record*, *electronic health records* and *physician produductivity* through the year 2017. We found studies relating to the effects of EHRs on physician productivity, but none that considered the effects of combining electronic and non-electronic records.

Bae J and Encionosa WE [17] authored a very comprehensive study of the impact of EHRs on the workload of primary care physicians (PCPs). The outcome variables were *patient face time per visit* and *weekly patient visits*. The nationally representative sample includes 1,470 PCPs during 2006-2009. The quintile regression models include 46 independent variables including demographics, health insurance, patients' health, practice characteristics and geography for anextensive representation of potential influences on productivity.

The results show that EHR use increases productivity among older PCPs but reduces productivity among younger PCPs. It also shows that physicians using EHRs increased face time per patient. The model does not, however, include information on the extent to which EHRs were used in combination with paper records.

Fleming et al. [18] researched 26 primary care practices, totaling approximately 450 physicians, in Texas for the years 2006-2008 [18]. Information was provided on both the workflow and financial outcomes of EHR use. Physician productivity was measured by work RVU per physician and, of particular interest to this study, visits per patient full time equivalent (FTE). Productivity decreased when EHRs were first adopted and gradually recovered but did not return to pre-adoption levels for a net decrease in productivity. No information was provided on the extent to which EHRs were combined with non-electronic records.

Adler-Milstein J et al. surveyed 49 community practices in Massachusetts during 2005-07 [19]. The study compares costs and revenues associated with the adoption of EHRs. Savings are defined as increased patient visits per hour, reduction in dictations and the elimination of paper records. The study mentions that nearly one-half of the practices used paper records with their EHRs but does not analyze the effect on productivity.

Adler-Milstein J et al. surveyed 42 small primary care practices using Athena Health software in several States in 2006-2009 [20]. The software included an EHR and a billing system. Productivity was measured in Relative Value Units (RVUs) per workday. One interesting result was an analysis of the effects of the delegation of tasks to non-physician staff. Increased use of EHRs and increased delegation of tasks increased RVU production but not the number of monthly appointments. The increases in productivity were restricted to larger (4+physicians) practices while both EHR use and delegation reduced productivity in smaller practices.

Furukawa MF provides a comprehensive study of the effect of EHR use on services provided per 20 minutes of a patient visit, using national data on 2,625 physicians and a sample of patients [21]. The services include: examinations,

health education, laboratory tests, radiology procedures, non-medication treatments and medications. The probability that a service was provided and the number of services provided are estimated. EHR use increased the probability that laboratory tests were ordered but reduced the number ordered. The changes in labortory tests were the only significant impact of EHR use. Most germane to our results, EHRs did not affect the duration of physician visits. No information was provided on mixes of electronic and non-electronic records.

Cheriff AD et al. compare average monthly patient visits to 203 physicians in a physician group who adopted EHRs versus "non-adopters"[22]. Average monthly patient visits increased but the intensity of visits (RVUs) declined. One problem is the definition of "non-adopters." A proficiency score combining closed office appointments and lag times was calculated and a threshold value selected to distinguish between proficient and non-proficient EMR users. The "non-adopters" were EHR users who failed to achieve a threshold value for increased patient visits relative to pre-adoption. Patient visits to "non-proficient EMR users" were unchanged. The results are, therefore, more a comparison of proficient and non-proficient users than between users and non-users of EHRs.

3 The Model

Lacking a well established theoretical model of the effect of EHRs on physician productivity we follow previous studies by specifying an empirical model incorporating determinants of physician productivity that were identified in previous research.

We measure patient visits per hour in a "typical work week", defined by physician's survey responses. We regressed the log of (visits/hour) on EHR use in a base model with the treatment variable being "any EHR use (1,0)". An alternative model includes record types ranging from *paper-only* and *EHR-only* to combinations of EHRs with non-electronic records. The measures of physician utilization of EHR functions include: patient summaries; e-prescribing, lab results and reminders for interventions.. The control variables include practice type, specialty, practice size, and physician characteristics.

The base model is specified as:

$$\ln\left(\frac{P}{hr}\right)_i = \beta_0 + \beta_1 EHR_i + \beta_2\, practice_i + \beta_3 specialty_i + \beta_4 X_i + \beta_5 experience_i + \beta_6 urban_i + \beta_7 size_i + \varepsilon_i$$

where: $\ln\left(\frac{P}{hr}\right)$ is the logarithm of patients treated/ hour in a typical week, as reported by physician *i*'s survey responses.

EHR: *an electronic version of a patient's medical history, including progress notes, problems, medications and other information used in treatment.* A 1, 0 variable, indicating if a physician uses an EHR.

Practice Type: Binary variables for office based physicians: *solo practice; group practice; private outpatient practice and other* (omitted); for non-office based physicians: *community health center, state hospital; hospital combined practice; federal hospital and hospital/medical school group practice* (omitted).

Specialty: Binaries from the licensing data.

Primary Care: Family care, general practice, geriatrics, or internal medicine.

Pediatric Specialties: Pediatricians or physicians practicing a pediatric subspecialty.

Surgical Specialties: Surgeons or any surgical subspecialty.

Hospital Based Specialties include critical care medicine, emergency medicine, hospitalist medicine, infectious disease, neonatology, respiratory care, transport medicine, intensive care medicine, pathology, nuclear medicine and rehab and occupational medicine (excluded by National Ambulatory Medical Care Survey (NAMCS) from office based data).

Medical Specialties, all others.

X*:* Binaries for *Doctor of Medicine* (MD), *male.*

Experience: In years, measured as: *Survey Date – Graduation Date.*

Urban*:* Binaries for *Maricopa and Pima counties*, the urbanized counties in Arizona.

Size*:* Binaries for number of physicians in practice; 2-5 physicians, 6-50; 51-94, 95+ (omitted).

The alternative model adds medical record combinations and a measure of the extent to which physicians use EHR functions.

EHR Combinations: seven mutually exclusive binary variables: *Paper files only; EHR only; Scanned Images Only; Paper+Scanned Images Only; EHR+Paper only; EHR+Scanned Images Only; Paper+Scanned Images+EHR* (omitted).

Three ***Functions*** variables are defined as: (EHR (1, 0) * Function Used (1, 0)) for whether physicians with EHRs used: *Patient Care Summaries*; *E-prescribing*; *Lab Results* and *Reminders for Interventions*. *Quality metrics* and public health reports are omitted.

Both models are estimated for OFB and NOFB physicians.

4 The Data

Arizona State University (ASU) has partnered with the allopathic (Arizona Board of Medicine) and osteopathic (Arizona Board of Osteopathic Examiners) licensing boards to track all physicians with Arizona licenses since the 1990s [2]. ASU adds voluntary surveys to license renewals and merges survey responses with each physician's licensing data. Licenses are renewed every two years so the 2012-2014 cohort of eligible subjects included all physicians with Arizona licenses.

In 2012-2014, 14,013 or 84% of the 16,620 physicians practicing in AZ, responded to the survey. We excluded 1,056 retired or semi-retired physicians; 2,017 physicians who did not provide patient care and 3,215 physicians with incompleted answers. The analysis data set includes 7,726 physicians.

5 Results

5.1 Descriptive Data

Figure 1 compares the types of health records used between 2007-2009 and 2012-2014. Paper records were the only record used by 46% of Arizona physicians in 2007-2009. Reliance on paper alone declined to 11% by 2012-14 but sole reliance on EHRs hardly changed (13.4% to 14%). Instead, more than two-thirds of physicians combined EHRs with paper and/or scanned records. Utilization of *EHRs+scanned records* increased from 12% to 33% and *EHR+paper+scanned* increased from 12% to 31% [2].

The persistence of paper reflects the lagged transition from paper to EHRs while the growth in scanned records is evidence of the limited opportunities for electronic record exchanges.

The National Ambulatory Medical Care Survey (NAMCS) of office based (OFB) physicians excludes government practices and certain specialties [23]. We applied these criteria as closely as possible to create the samples of OFB and non-office based (NOFB) physicians described in Table 1.

Office based physicians are more experienced (23 years vs. 20 years); more likely to be male and to be in smaller practices than NOFB physicians. They are much less likely to have EHRs (74% vs. 91%), relying more heavily on paper records alone (19% vs. 3%). Among physicians with EHRs, OFB physicians are less likely to use available EHR functions, with the largest difference being the use of lab orders (50% vs. 74%).

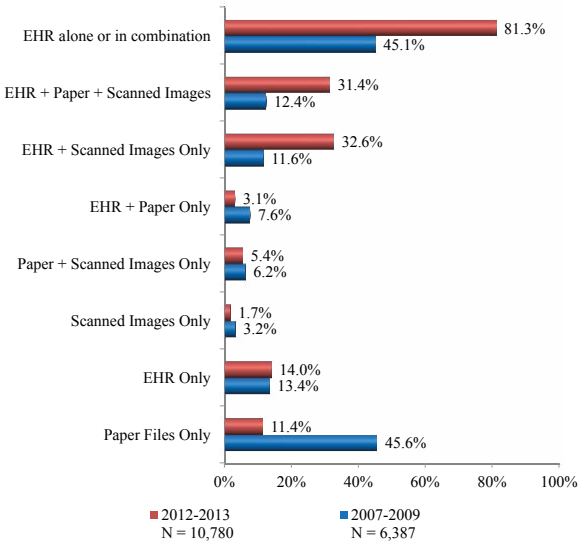

Figure 1: Methods of storing medical records by renewal period. Source: AMB, ABOE Survey Data, 2007-2009; 2012-2014. Respondents who did not identify a method of storing medical records (missing): 390 for 2007-2009 and 2,177 for 2012-2014. *Data on "EHR alone or in combination" is not mutually exclusive from otEHR categories.

The differences between OFB and NOFB physicians represent different stages in the transition from paper to EHRs. NOFB physicians have nearly ended sole reliance on paper but the transition to EHRs is not complete. More than one-third of them combine *EHRs+paper+scanned* records and a slightly larger percentage use *EHRs+ scanned* records. The *EHR +scanned* record combination may be the last stage in the transition to reliance on EHRs alone, awaiting the expansion of HIEs.

5.2 Multivariate Estimates

We next compare estimates from the model that simply compares EHR users to non-users to results that better represent day- to- day practice by including combinations of EHRs with non-electronic records. The coefficients in Table 2 represent percentage changes for unit increases in the independent variables because outcomes are expressed in logarithms.

Among OFB physicians, pediatricians see 25% more patients per hour and surgeons see 49% fewer patients than other specialists. MDs see 10% fewer patients per hour than Doctors of Osteopathic Medicine (DOs). Productivity increases with practice size relative to solo practice but marginal returns decline from 19% (2-5 physicians) to 15% (6-50) and 13% (51-94).

The comparison of users to non users of EHRs (the base model) shows no significant effects of EHRs on productivity but significant effects are found in the model that includes combinations of EHRs with non-electronic records and the use of EHR functions.

The coefficients on the use of EHR functions represent the effects of a physician using a function compared to either not having an EHR or having an EHR but not using the function. Because the functions variables are correlated with the prevalence of EHR use, the higher the utilization of EHRs, the less likely that estimates for functional use will be statistically significant even though they affect productivity.

The productivity of OFB physicians, where the effect of *EHR-only* is not significant, is increased by the use of e-prescribing (+17.4%) and intervention reminders (+5.7%). Among NOFB physicians, where nearly everyone has an EHR and the overall effect of *EHR-only* is statistically significant (+6.9%). The use of e-prescribing increases productivity by +7.7%. The success of e-prescribing for both groups of physicians results in part from the well established electronic

Table 1: Means and standard deviations for full model specifications.

	Office Based Physicians Mean (SD)	Non-Office Based Physicians Mean (SD)
Dependent Variable:		
ln(pat/hr)	0.559 (0.624)	0.235 (0.686)
Independent Variables:		
Any HER	0.736 (0.441)	0.910 (0.081)
Patient summary	0.555 (0.496)	0.644 (0.478)
Intervention reminder	0.198 (0.398)	0.304 (0.460)
Lab reports	0.502 (0.500)	0.738 (0.439)
E-prescribing	0.558 (0.496)	0.613 (0.487)
Paper only	0.189 (0.392)	0.028 (0.167)
EHR only	0.125 (0.331)	0.153 (0.360)
Scan only	0.012 (0.109)	0.012 (0.112)
Paper + scan	0.052 (0.222)	0.034 (0.183)
EHR + paper	0.034 (0.182)	0.027 (0.162)
EHR + scan	0.314 (0.464)	0.389 (0.487)
Solo practice	0.340 (0.473)	
Group practice	0.578 (0.493)	
Private outpatient practice	0.074 (0.262)	
Community health center practice		0.164 (0.370)
State hospital		0.039 (0.195)
Hospital combo practice		0.385 (0.486)
Federal hospital		0.130 (0.336)
Primary care specialty	0.410 (0.492)	0.463 (0.498)
Medical specialty	0.286 (0.452)	0.215 (0.411)
Pediatric specialty	0.093 (0.290)	0.123 (0.328)
Surgical specialty	0.123 (0.328)	0.079 (0.270)
MD	0.860 (0.346)	0.860 (0.346)
Male	0.725 (0.446)	0.642 (0.479)
Physician experience	23.222 (11.167)	19.813 (11.500)
Maricopa County	0.666 (0.471)	0.583 (0.493)
Pima County	0.155 (0.362)	0.187 (0.390)
Practice size: 2 to 5	0.288 (0.453)	0.107 (0.309)
Practice size: 6 to 50	0.252 (0.434)	0.399 (0.489)
Practice size: 51 to 94	0.030 (0.173)	0.097 (0.297)
Sample size	4,583	2,982

Table 2: Physician productivity and EHR.

	Office Based EHR 1,0 Model		Office Based EHR Combo		Non-Office Based EHR 1,0 Model		Non-Office Based EHR Combo	
	Coeff	Signif	Coeff	Signif	Coeff	Signif	Coeff	Signif
Intercept	0.079	0.49	-0.558	0.34	0.618	P<0.001	0.329	P<0.001
Any EHR	0.005	0.79			-0.039	0.34		
Patient summary			-0.007	0.8			0.053	0.2
Intervention reminder			0.057	0.03			0.026	0.49
Lab reports			-0.018	0.51			-0.037	0.45
E-prescribing			0.174	P<0.001			0.077	0.07
Paper only			0.15	P<0.001			0.031	0.81
EHR only			-0.025	0.41			0.137	0.01
Scan only			-0.023	0.79			-0.021	0.89
Paper + scan			0.016	0.74			0.261	0.01

EHR + paper			-0.026	0.6			-0.07	0.55
EHR + scan			0.013	0.58			0.057	0.12
Solo practice	0.457	P<0.001	1.022	0.08				
Group practice	0.589	P<0.001	0.992	0.09				
Private outpatient practice	0.519	P<0.001	1.052	0.07				
Community health center practice					0.283	P<0.001	0.23	P<0.001
State hospital					0.007	0.9	0.919	0.08
Hospital combo practice					0.046	0.14	0.292	0.26
Federal hospital					-0.069	0.1		
Primary care specialty	0.062	0.06	-0.004	0.91	-0.16	P<0.001	-0.221	P<0.001
Medical specialty	0.046	0.18	-0.017	0.65	-0.457	P<0.001	-0.461	P<0.001
Pediatric specialty	0.303	P<0.001	0.245	P<0.001	-0.224	P<0.001	-0.207	0
Surgical specialty	-0.432	P<0.001	-0.487	P<0.001	-0.699	P<0.001	-0.807	P<0.001
MD	-0.082	0.001	-0.067	0.01	-0.133	P<0.001	-0.109	0.02
Male	0.035	0.08	0.053	0.01	-0.007	0.77	-0.045	0.19
Physician experience	-0.001	0.03	-0.002	0.01	0.001	0.16	0.001	0.39
Maricopa County	0.01	0.65	0.005	0.83	-0.076	0.01	0.001	0.98
Pima County	0.039	0.2	0.047	0.14	-0.061	0.1	-0.023	0.45
Practice size: 2 to 5			0.194	P<0.001			0.164	0.01
Practice size: 6 to 50			0.149	P<0.001			0.238	P<0.001
Practice size: 51 to 94			0.13	0.05			0.248	P<0.001
R-square	0.1091		0.1357		0.1126		0.1903	
Sample size	4,641		4,100		3,026		1,626	
F: functions			13.53	P<0.001			2.21	0.07
F: records			4.61	P<0.001			2.56	0.02
F: practice type	23.74	P<0.001	1.73	0.16	18.05	P<0.001	12.1	P<0.001
F: specialty type	86.65	P<0.001	6.65	P<0.001	34.53	P<0.001	13.86	P<0.001
F: practice size			76.07	P<0.001			31.76	P<0.001

Notes: F tests ("F:") at the bottom of the page (probability significance levels) are for the joint significance of, respectively: functional uses of EHR, types of records used in practice (omitted: EHR+scan+paper), practice type (omitted: all otEHR office based), practice specialization (omitted: hospitalists), and practice size (omitted: 95+). Inclusion of practice size not only reduced sample size, but these variables were highly collinear with the otEHR variables in the analysis (VIFs exceeding 1000 with practice sizes). Federal hospital practice was too collinear to be included in the far right specification.

networks of retail chain pharmacies.

Among OFB physicians, *paper-only records* (19% of physicians) increase productivity by 15%. None of the combinations of records significantly contribute to productivity. The use of *paper +scanned* records by 3.4% of NOFB physicians increases productivity by 26.1%. Use of *EHR-only* increases productivity by +13.7% for 15.3% of the physicians. More than 60% of OFB physicians and more than 75% of NOFB physicians combine EHRs with non-electronic records. The combinations do not signficantly contribute to productivity.

The results suggest that the potential benefits of EHRs are limited by the burden of managing multiple types of records. In the absence of an interoperable network, EHRs are converted to paper and faxed or e-mailed as a scanned file, imposing costs on the sending and receiving organizations. The positive effects of e-prescribing for OFB and NOFB physicians exemplify the increases in productivity that are possible when EHR use is combined with health information exchanges. The productivity of EHRs can, therefore, be predicted to increase as the availability of Health Information Exchanges continues to increase.

Patient visits per hour is not the only component of physician productivity. To consider more comprehensive measures, we compared physician's rankings (on a scale of 1 (awful) to 5 (outstanding)) of the productivity effects of their EHRs, to the combinations of records that they used (Table 3).

Both NOFB and OFB physicians ranked *EHR-only* as contributing the most to physician productivity and also the best contributor to staff productivity among OFB physicians. NOFB physicians reserve last place for *EHR+scan*, while OFB

Table 3: EHR effects on productivity ranked by physicians 2012-2014.

Record Mix	Effect on Physician Productivity		Effect on Staff Productivity		Number of Physicians*	
	Office Based	Non-Office Based	Office Based	Non-Office Based	Office Based	Non-Office Based
EHR only	3.3	3.17	3.37	3.2	572	387
EHR+paper	2.95	2.73	3.05	2.76	155	63
EHR+scan	3.28	2.68	3.43	2.74	1,472	992
EHR+paper +scan	3.04	2.71	3.17	2.73	1,263	865

Notes: Rankings are 1=awful and 5=outstanding. Mean rank given in each cell. *= number of physicians submitting productivity ratings.

physicians put *EHR+paper* last.

The primacy of *EHR-only* ranking is consistent with the estimates for NOFB physicians but conflicts with the estimates for OFB physicians. The rankings from both groups of physicians suggest, however, that productivity increases as the number of different types of medical records is reduced.

6 Discussion and Conclusion

This study analyzes the effects of mixing EHRs with non-electronic records on physician productivity.

Estimates that simply compare EHR users to non-users fail to show the predicted increases in productivity from EHRs. EHRs are, however, typically used with non-electronic records. Including information on the combinations reveals that EHR functions, such as e-prescribing and intervention reminders, increase physicians' productivity.

The persistence of paper reflects the transition from paper to EHRs, but the increased use of scanned records with EHRs is caused by the shortage of health information exchanges.

The need to process multiple types of records limits the increases in productivity obtainable from EHRs. The realization of full benefits must await increased access to electronic exchanges to reduce reliance on non-electronic records. E-prescribing exemplifies the increases in productivity when EHRs are combined with an exchange.

The results are limited to Arizona but EHR utilization rates are similar to national averages and the number of physicians is unusually large. Many published studies of physician productivity rely on samples of less than 100 physicians.

The EHR brands used by Arizona physicians are widely used throughout the United States, so the results should not be affected by interstate differences in the design of EHRs.

One important limitation of this study is the reliance on patient visits per hours as the primary measure of physician productivity. Although the measure is used in many studies, there are other important dimensions of productivity, such as the types of services provided to patients. It is equally true that influences on productivity, such as the reliance on non-physician health professionals, including scribes, could not be estimated from the data. This study is ,however, the first to measure the effects of the widespread mixing of electronic and non electronic medical records and can hopefully signal the need to pay more attention to the phenomenon in studies of the effects of electronic health records.

7 Acknowledgement

Feedback on the manuscript was received from James Hernandez, MD (The Mayo Clinic, Scottsdale AZ), Anita Murcko, MD (Biomedical Informatics, Arizona State University); Jack Sipperly, MD (Barnet Dulaney Perkins Eye Center); Margaret Stemmler, MD (The FrameShift Group), Nick Vasquez, MD (Emergency Dept. BannerHealth). The authors gratefully acknowledge the cooperation of Patricia McSorley, Executive Director of the Arizona Medical Board (AMB) and Jenna Jones, Executive Director of the Arizona Board of Osteopathic Examiners. Special thanks to James Gentile and Pushpa Gregory (AMB) for their technical support. None received compensation for their contributions.

8 Author Contribution

William G. Johnson created the survey and wrote most of the paper. Gevork Harootunian received the survey elements and organized the data elements for analysis, including some of the statistical analysis. Richard Butler did the statistical analysis, and contributed to the writing of the paper

9 Conflict of Interest

There is no conflict. No monies (nor other incentives) were received for the publication of these results, nor for the conclusions of the authors.

References

1. Hsiao CJ, Hing E. Use and Characteristics of Electronic

Health Record Systems Among Office-based Physician Practices: United States, 2001–2013. NCHS Data Brief. 2014; 143: 1-8.

2. Johnson WG, Harootunian G, Sama TL, Caughey W. Physicians' use, exchange, and evaluation of electronic medical records. Arizona State University, Center for Health Information & Research. 2014; 1-68.
3. Kellermann AL, Jones SS. What it will take to achieve the as-yet-unfulfilled promises of health information technology. Health Aff. 2013; 32: 63-68.
4. Jones SS, Heaton PS, Rudin RS, Schneider EC. Unraveling the IT productivity paradox-lessons for health care. N Engl J Med. 2012; 366: 2243-2245.
5. Freudenheim M. The ups and downs of electronic medical records. The New York Times. 2012.
6. Lau F, Price M, Boyd J, Partridge C, Bell H, Raworth R. Impact of electronic medical record on physician practice in office settings: a systematic review. BMC Med Inform Decis Mak. 2012; 12: 10.
7. https://www.informationweek.com/healthcare/electronic-health-records/doctors-cant-tear-themselves-away-from-paper-records/d/d-id/1103482
8. https://www.ehidc.org/sites/default/files/resources/files/2012_eHI_Report-on-Health-Information-Exchange--Supporting-Healthcare-Reform_0.pdf
9. Furukawa MF, King J, Patel V, Hsiao CJ, Adler-Milstein J, Jha AK. Despite substantial progress in EHR adoption, health information exchange and patient engagement remain low in office settings. Health Aff. 2014; 33: 1672-1679.
10. Kruse CS, Regier V, Rheinboldt KT. Barriers over time to full implementation of health information exchanges in the United States. JMIR Med Inform. 2014; 2: 1-11.
11. West DM, Friedman A. Health Information Exchanges and Megachange, Governance Studies-Brookings.The Brookings Institution. 2012; 1-43.
12. Mettler T, Eurich M. A "design-pattern"-based approach for analyzing e-health business models. Health Policy Technol. 2012; 1: 77-85.
13. http://www.californiahealthline.org/insight/2010/california-health-it-sphere-in-flux-in-wake-of-calrhio-shake-up
14. Adler-Milstein J, McAfee AP, Bates DW, Jha AK. The state of regional health information organizations: current activities and financing. Health Aff (Millwood). 2008; 27: 60-69.
15. Miller RH, Miller BS. The Santa Barbara County care data exchange: what happened? Health Aff. 2007; 26: w568-w580.
16. Adler-Milstein J, Bates DW, Jha AK. Operational Health Information Exchanges Show Substantial Growth, But Long-Term Funding Remains A Concern. Health Aff (Millwood). 2013; 32: 1486-1492.
17. Bae J, Encinosa WE. National estimates of the impact of electronic health records on the workload of primary care physicians. BMC Health Serv Res. 2013; 16: 172.
18. Fleming NS, Becker ER, Culler SD, Cheng D, McCorkle R, da Graca B, et al. The Impact of Electronic Health Records on Workflow and Financial Measures in Primary Care Practices. Health Ser Res. 2014; 49: 405-420.
19. Adler-Milstein J, Green CE, Bates DW. A survey analysis suggests that electronic health records will yield revenue gains for some practices and losses for many. Health Aff (Millwood). 2013; 32: 562-570.
20. Adler-Milstein J, Huckman RS. The impact of electronic health record use on physician productivity. Am J Manag Care. 2013; 19: SP345-352.
21. Furukawa MF. Electronic medical records and efficiency and productivity during office visits. Am J Manag Care. 2011; 17: 296-303.
22. Cheriff AD, Kaur AG, Qiu M, Cole CL. Physician productitivty and the ambulatory EHR in a large academice multi-specialty physician group. Int J Med Inform. 2010; 79: 492-500.
23. http://www.cdc.gov/nchs/ahcd/namcs_participant.html