

## THE IMPACT OF ELECTRONIC HEALTH RECORD SYSTEMS ON PHYSICIAN PRODUCTIVITY

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### ABSTRACT

*This study examined the impact of electronic health record (EHR) systems on physician productivity in terms of a concept called “relative value unit (RVU) intensity.” The researcher gathered 10 years of productivity data from 20 physicians in an effort to understand how the implementation of an EHR system impacted productivity. Through the evaluation of this data, the researcher identified the overall impact of the implementation impact of the EHR on the practice as well as the impact of the system on the mean individual RVUs generated per patient visit.*

**Keywords:** EHR, Electronic Health Record, Physician Productivity, RVU, Relative Value Unit

### INTRODUCTION

In 1999, the Institute of Medicine released “To Err Is Human,” a controversial report claiming that somewhere between 44,000 and 98,000 deaths occur each year as a result of medical errors (Brennan, 2000). With data collected from studies conducted in New York, Utah, and Colorado and then extrapolated across the United States, the report seemed to make the conclusion that the healthcare industry was failing to make progress in caring for patients though the study allows for a wide interpretation of what a medical error could be which could wildly swing the metrics. The conclusion of the study was a series of recommendations on ways that the healthcare industry could reduce medical errors by 50% and provided some foundational technological guidelines to move it into the future (Brennan, 2000). The massive devastation brought on by Hurricane Katrina in 2005 which resulted in the loss of the paper-based medical records for a large portion of the patients in the affected area meant that the medical industry was extremely vulnerable (Tang et al., 2006). Up until this point, the healthcare industry was severely lagging behind other industries in investments in technology and relied mostly on paper. The time was quickly approaching for a revolution (Baker et al., 2008).

On the heels of the report from the Institute of Medicine and Hurricane Katrina, President George Bush announced his initiative push to adopt electronic health records across the healthcare industry by 2014. Soon after, in 2009, President Barak Obama signed the American Recovery and Reinvestment Act (ARRA) which also included the goal of establishing a nationwide network to improve the healthcare system (Richards et al., 2012). The ARRA set aside \$27 billion in Medicare and Medicaid funding to drive adoption of electronic health record (EHR) systems, aid interoperability of the systems by expanding Health Information Exchanges (HIE) patient data sharing networks, and give support to Meaningful Use initiatives (Gold & McLaughlin, 2016). Partially as a result of these incentives, adoption of EHRs rose to over 80% of large physician practices and 75% of hospital systems by 2016 (Mennemeyer et al., 2016).

Once implemented, practices and hospital systems struggle with the business case of whether or not the enormous costs of the initial purchase and ongoing maintenance of the systems are worth having the systems. Additionally, studies have demonstrated that the implementation of an EHR system leads to a decrease in physician productivity which can have a negative effect on the finances of a practice (Brunt & Bowblis, 2014; Janchenko, 2020; Lam et al., 2015; Meyerhoefer et al., 2016; Vanderhook & Abraham, 2017). Costs of these systems vary wildly and though most costs are a tightly guarded secret from sales representatives and are negotiated on a case-by-case basis, reported costs range are as much as \$44,000 per full-time physician and as much as \$8,000 per year in maintenance fees (Brunt & Bowblis, 2014).

The purpose of this study is to understand the impact that electronic health record (EHR) systems have had on physician productivity. Specifically, this study evaluates any changes in relative value unit (RVU) intensity which is the amount of RVUs physicians generate during a patient visit that have occurred after the implementation of an EHR system. This study evaluates 10 years of patient visit data from 20 physicians and compares it to a baseline year before the physicians adopted the EHR system.

## **BACKGROUND AND LITERATURE REVIEW**

Electronic Health Record systems (EHRs) often come with the promise of not only modernizing the way that healthcare providers deliver care but also the promise of significant cost savings (Kumar & Bauer, 2011). It is the promise of these savings as well as the incentives provided by government programs such as Meaningful Use that have sometimes been the catalyst for some practices and hospitals to adopt the new technologies. However, the cost of adopting and support the systems on a perpetual basis has the potential to overshadow any savings. A boost to physician productivity due to the automation of repetitive tasks or through the elimination of manual tasks could be the answer and would help practices realize gains in efficiency through the reduction of labor (Song et al., 2011). Electronic charts mean that practices no longer have to employ staff to maintain charts and stage charts for patients to be seen that day, pay for order entry, or pay for transcription. Additionally, the use of an electronic system has the potential to capture visit charges that could otherwise be forgotten or overlooked by a physician leading to increased profitability of the practice.

This study differs from other studies in the field by its evaluation period after the implementation of the EHR system. Other studies limit their evaluation period from anywhere from 18 months to three years after the implementation. This makes it difficult to examine adoption trends over the long term as well as to see how or if anything that is potentially cyclical in nature could impact the use of the software or the productivity of the users. Examples of cyclical phenomenon could be cycles of seasonal illnesses such as influenza seasons, annual school physicals, or how annual or semi-annual software upgrades could impact productivity.

### **The Relative Value Unit**

The Relative Value Unit (RVU) is a standard measure of physician productivity adopted by the Centers for Medicare & Medicaid Services (CMS) in 1992 (Kentros & Barbato, 2013). The primary goal of the RVU was to provide insurance companies and the government a guideline to reimburse physicians for expenses that were “usual, reasonable, and customary” which were incurred during the treatment of a patient and were a function of such things as hiring staff, leasing space and other costs associated with conducting a medical business (Becker et al., 1988). RVUs are then calculated by combining the work effort required by the provider to treat the patient, the expenses associated with the practice, and the cost of malpractice insurance (Pickard, 2014).

In slight contrast to a straight RVU calculation is the concept of work effort, or intensity as it is referred to. Intensity, the amount of mental or physical effort expended by the physician or the amount of stress incurred by the physician in order to care for a particular patient by the physician can vary greatly by patient and specialty. A surgeon’s RVU intensity might be 50% higher than those RVUs for a typical internal medicine and as such the calculated RVU values will reflect that higher intensity (Hsiao et al., 1993). At each phase of a patient’s visit with the physician, services rendered, tests performed, and immunizations administered combined with the diagnosis for the visit as well as a coded decision-making complexity level determine the total RVU value for the visit. When a physician is writing down the services performed on paper and forgets to list a service, provided that it is not caught by back office billing staff, the charge is not captured, and income revenue is lost. The paper system relies heavily on the memory of an already burdened mind. The electronic health record (EHR) system has the potential to capture these charges, and more, and suggest better coding to the physician which can lead to higher reimbursements from insurance companies and the government.

### **Standardization of Evaluation and Management (E&M) Coding**

For the physician to be able to send a bill to Medicare/Medicaid or to an insurance company for reimbursement for their services, she or he must document the details of the visit, the type of visit, diagnoses, and the amount of time spent with the patient. Sending this information in long form would be arduous for the physician and almost impossible for the insurance companies to work through so instead, the data is transmitted in a codified form. The codes, called Current Procedural Terminology (CPT) codes give detail regarding the services performed, complexity of the visit and the decision-making level undergone by the physician to arrive at the diagnoses and treatment plan (Kurec, 2014). With each code level comes a different level of reimbursement from the payers with higher coded visits received higher reimbursement. Submitting a code for a visit with a lower value than the visit should be worth

due to visit length or complexity, undercoding, will result in a lower reimbursement than the physician would normally receive had the visit been coded correctly. Conversely, overcoding a visit, that is using a code that would result in a higher payment than should be reimbursed due to length of visit time or complexity, could result in payers taking back reimbursement funds if discovered in periodic audits. Studies reveal that visits are coded incorrectly between 20%-55% of the time resulting in underpayments or funds being taken back by insurance companies (Kikiano et al., 2000; King et al., 2001). EHR systems often feature functionality which can evaluate the amount of documentation completed by a physician on a particular visit and suggest an appropriate evaluation and management code. A 2010 study conducted in New York City among 75 physicians at a Federally Qualified Health Center (FQHC) revealed that the clinic experienced a 53% decrease in CPT code 99241 (office consultation for new or established patient, 15 minutes) while at the same time experiencing a 73% increase in CPT code 99234 (office consultation for new or established patient, 40 minutes) after the implementation of an EHR system compared to before the implementation of the system. This decrease in the lower-level code and increase in the upper-level code suggests that the software recommended a higher code for the visits which were being manually coded previously which would have a positive financial impact on the clinic.

### **METHODOLOGY**

This study examined the RVUs generated by 20 physicians at a pediatric practice in southwestern Pennsylvania who have been using an electronic health record (EHR) system for 10 years as well as one year before the EHR implementation and looked for any changes in the characteristics of the RVUs generated over time. The pre-EHR year was included as a baseline and serves to demonstrate the RVU generation characteristics of the 20 physicians when they documented patient visits in a paper-based charting system. Even though the physicians documented on paper-based charts, the office staff used an electronic system for scheduling and billing. Because of the use of electronic system, the researcher was able to export productivity data into Excel and graph the data to identify trends. This study addressed the following research question:

RQ1 – What impact does an electronic health record system have on relative value unit intensity?

#### **Population and Sample**

At the practice from which the population was selected, there are 38 Doctor of Medicine (M.D.) or Doctor of Osteopathic Medicine physicians, six physician assistants (PA), and eight certified registered nurse practitioners (CRNP) for a total count of 52 providers. In this study, the researcher identified any potential participant who used the EHR system for 10 years and eliminated anyone who was not a M.D. or a D.O. After these restrictions were placed on the potential population, the potential sample size was reduced to 23. In the end, 20 physicians agreed to share their data with the researcher.

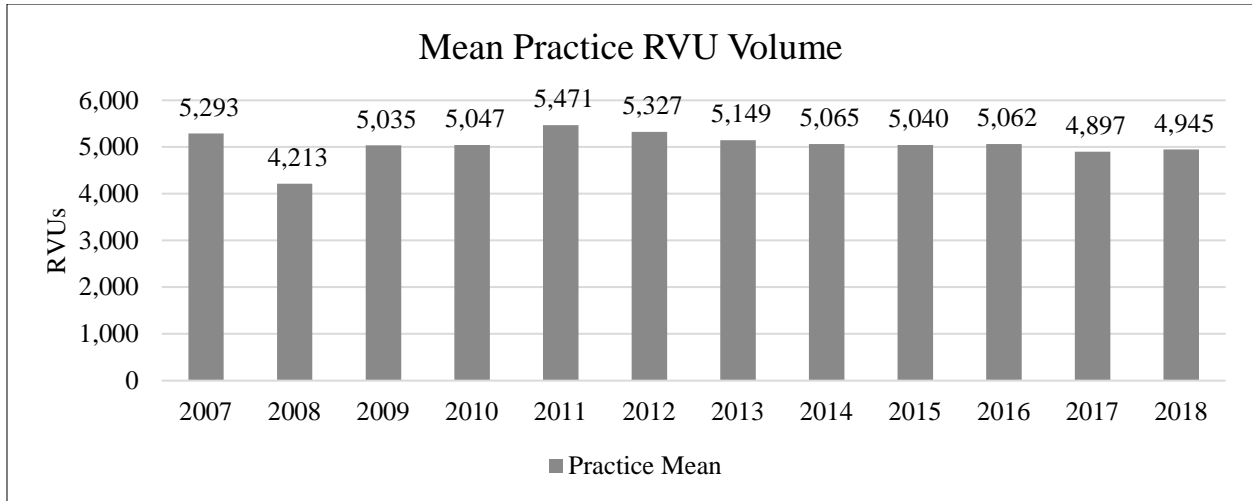
#### **Data Collection Procedures**

Data that was collected and used in the calculation of productivity was extracted from the organizations database and did not consist of any patient-identifiable data nor any physician identifiable data. The data that was extracted consisted of the date of the encounter, the current procedural terminology (CPT)code, and a hashed value encounter ID to ensure no visits were duplicated. Data was extracted one physician at a time and encoded with a number identifier by the researcher to preserve anonymity. This study was subjected by the IRB of the physician organization as well as the University. Consent was obtained from each participating physician before their respective data could be extracted. Access to the population sample and data was obtained because the researcher was an employee of the company. All activity of the researcher was tracked by the software's audit software and was subject to the scrutiny of the organization's security team for ethical and potential HIPAA violations.

### **FINDINGS**

In 2007, the practice was still using paper-based charting for all patient records and the 17 physicians out of 20 in this study produced a mean of 5,293 RVUs during that year. Three physicians were not part of the practice in 2007 and therefore were not able to be a part of the baseline year. During 2008, the various offices that comprise the practice began their EHR implementations and the physicians of this study experienced a sharp decline in RVU

output from 5293 in 2007 to 4,213 (-20.4%). By 2009, however, productivity recovered to the near pre-EHR level with 5,035 RVUs and with some fluctuation, stayed near this level through 2018. At one point, in 2011 and 2012, productivity with the EHR surpassed the pre-EHR level of 5,293 RVUs in 2011 with 5,471 RVUs and in 2012 with 5,327 RVUs produced. Despite the years of productivity growth, the change in RVU output from the pre-EHR level of 5,293 in 2007 to the ultimate output of 4,945 RVU in 2018 reveals a -6.57% change in physician productivity after the implementation of the EHR.



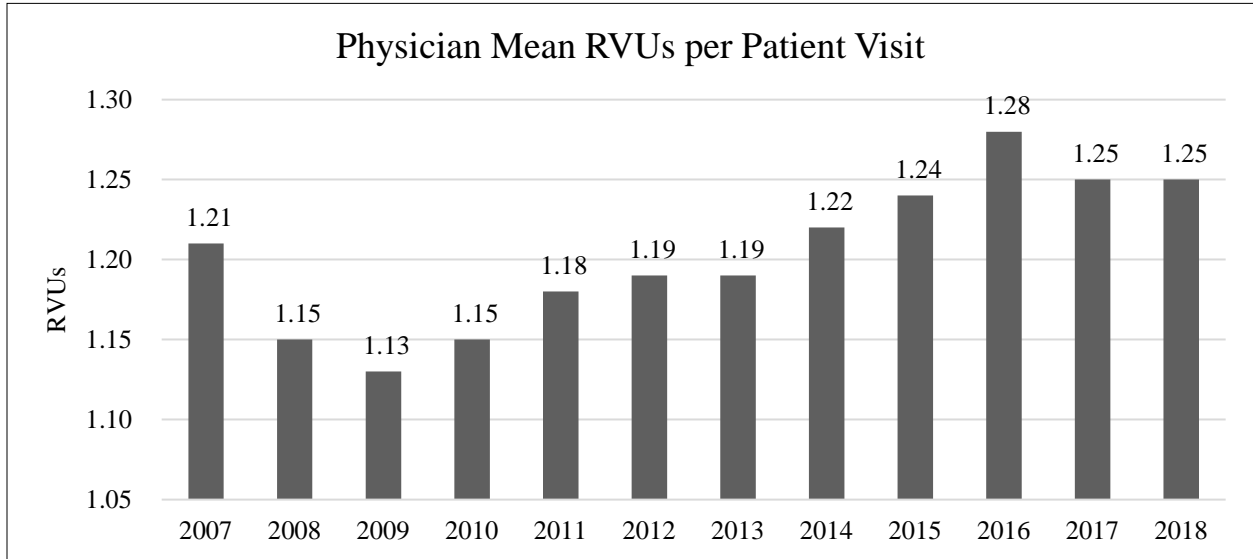
**Figure 1.** Mean Practice RVU Volume

A decline of 6.57% in productivity after the implementation sounds like bad news for the EHR software industry but anecdotally, a physician whose data was extracted for this study noted that EHRs are just a part of medicine now and like it or not, they are here to stay. A poor showing of metrics will not likely spell the end of EHRs. Instead, it means that software developers must find ways of making their software better as anticipating the needs of the physicians, changing to be easier to use and navigate, and better at making sure that the software is capable of capturing all of the possible charges for each patient visit. Indeed, this study does seem to indicate that EHR software may in fact be better at capturing charge for patient visits and perhaps helping the physician feel more confident about which visit code to use, which level of complexity to choose and helping them find the appropriate diagnosis code to use for their documentation faster.

Physicians involved in this research noted that while they had the coding already in mind or the visit complexity already in mind in many cases, the software's algorithms which help to suggest evaluation and management coding often helped them be more confident in their code. On some occasions, the software would alert the physician that there was enough documentation to submit a higher complexity code than was originally selected which would result in a higher reimbursement from the insurance company. In addition, in the event that a physician forgot to circle a charge for a vaccine administration, a service rendered, note time for a counseling, etc., the charge would be unbilled. EHR software has the capability to automatically include for these items as they are clicked on the screen, lessening the likelihood that charges are missed, and money is left on the table. As these suggestions are made, items automatically billed or greater confidence in coding compound over the year, a trend is identified that suggests that the EHR assists by increasing RVU intensity, or the value of the RVUs per patient visit.

In Figure 2 below, it is possible to visualize the change in RVUs generated in patient visits over time at the practice. This change in RVUs per patient visit, or intensity, may be the result of the EHR system suggesting upward coding of visits to the physicians or capturing more charges which may have otherwise been forgotten with other visit charge documentation methods. In 2007, the pre-EHR year in the study, the mean RVU generated per patient visit was 1.21. During 2008, the first year in which the EHR was used at the practice, the mean RVU generated per patient visit declined to 1.15 and declined again to 1.13 in 2009. From 2007 to 2009, the overall decline was -6.61%. Six years after the implantation of the EHR, in 2014, the mean RVU per patient visit reached 1.22 and had fully recovered from the pre-EHR level of 1.21. From this point, the RVU level continued upward growth through

the remainder of the study, which ended in 2018. In 2016, the practice purchased an existing practice from a retiring physician and some of the physicians in this study began to see more patients than they had previously for a short period of time. Ultimately, it appears that the RVUs generated per patient visit stabilized at 1.25 throughout the end of this study. The 1.25 RVUs generated per patient encounter in 2018 compared to the pre-EHR level of 1.21 RVUs per patient encounter in 2007 represents an RVU intensity growth of 3.20%.



**Figure 2.** Mean RVUs Generated per Patient Visit

### DISCUSSION OF FINDINGS

The main focus of this research is on the RVU intensity and for that reason, the discussion will focus on potential reasons related to those findings. The initial decrease in mean RVUs generated per patient visit of -6.61% during the first two years are hardly startling considering that much of the existing literature discusses physician productivity decreases after the implementation of EHR systems. As many of us experience with anything new, there is a period where the user slows down how fast they can use the piece of software; a learning curve. Then, as proficiency increases, so too does the speed at which they use the system. We can see the same phenomenon here with the physicians use of the EHR systems. During the years in which the 20 physicians included in this study are also using the system, it was upgraded at least annually. Each of these upgrades brought about new changes in look, navigation or new functionality and with each change came a learning curve adjustment for the users. Therefore, the researcher feels that the gradual increase in overall RVU intensity per patient visit makes sense, given that the software was in an almost constant state of change for the entire 10 years of data this study observes.

Additionally, as the physicians' use of the software matured over the 10 years, they would become more use to the overall navigation and functionality as well as its algorithm for suggesting visit codes. Over time, it is reasonable to suggest that just as one intuitively understands how one's car might drive under certain weather conditions, a physician might start to be able to know how the software might interpret patient visit documentation and the physician could adapt accordingly. This could, in turn, increase their proficiency [speed/productivity] during a visit or make the physicians more in tune with the way the EHR software might code the patient visit. Eventually, barring 2016, the increase in RVU intensity started to level off in 2016 and fully so in 2017 and 2018. This could suggest that, at long last, the physicians and the software were in harmony. The physicians had finally worked with the software long enough to understand how it would suggest coding for visits and that the physicians knew which billing opportunities they commonly missed that the software would catch and regardless of who, the physician or the software, added them to the visit, that they would be added regularly and RVU growth was no longer attained. Outside of the EHR itself, it is possible that through training and coaching from the billing team, the physicians have learned better ways to bill or are taking part in new procedures in the offices which they were not doing 10 years ago which are increasing their RVU intensity. Perhaps, as they have simply matured as physicians, they have just gotten

more thorough and better at billing and making sure they are coding comprehensively and correctly, and it has nothing to do with the EHR; it was simply along for the ride.

### **LIMITATIONS**

This study was conducted at within a single pediatrics-based healthcare practice located within Southwestern Pennsylvania. Though the practice had various office locations, the patient population still draws from the same geographic metropolitan area. A further limitation of this study is that it only evaluates pediatrician and does not take into account patient data or physician productivity data for those physicians in other specialties. A further limitation of this study is that it only had the opportunity to observe a practice using one particular EHR software. Lastly, this particular study does not take into consideration changes in the population of the region which could have impacted the number of patients available to have visits with the physicians at the practice. An increase or decrease in the number of patients available could have an impact on the visit volume. Lastly, the practice evaluated only had one year of data available in a previous electronic practice management system which the researcher could use to plot the productivity trends before the implementation of the EHR system. It would be ideal to have been able to have perhaps three years' worth of pre-EHR productivity data to establish a more robust pre-EHR productivity baseline.

### **IMPLICATIONS FOR FUTURE RESEARCH**

Areas for future research in this area are plentiful. It may be valuable to evaluate physician productivity at various levels of a physician's career life cycle and potentially with or without the introduction of an EHR system. With regard to the research presented in this document, the ages of the respective physicians could be overlaid with the productivity or intensity data and evaluate the data for any groupings that may emerge and try to understand the characteristics of those potential groups. This research was conducted only at an outpatient pediatric practice and it would be valuable to repeat the research at other specialties and within hospital settings and then compare findings across care settings. One last potential implication to mention is that it could be valuable to repeat this study at facilities using various EHR software vendors to gain insights into how the specific software and its usability could affect physician productivity.

### **CONCLUSIONS**

It is unlikely that the electronic health record (EHR) will be going away and will remain the new way that physicians keep records of the medical care of their patients. The practice which was the subject of this study experienced a -20.4% decline in the Relative Value Units (RVUs) in the first year the software was used compared to the previous year when the physicians documented patient visits on paper. Relative Value Units (RVUs) are a standardized unit of physician productivity adopted by the Centers for Medicare & Medicaid Services (CMS) in 1992. Over the next several years, physician productivity improved and, in some years, actually surpassed the pre-EHR year metrics. However, by the end of the study in 2018, physician productivity for the 20 physicians involved in this study experienced a change of -6.57%. A facet of physician productivity which may have had a positive change as a result of the implementation of EHR is the mean value of the RVUs per individual patient visit. Called "intensity," the suggestion of this is that the EHR systems are able to help physicians by better capturing service or procedure charges to be billed to the patient or insurance company compared to the physician remembering to document these charges on their own. Additionally, using algorithms built into the software, the EHRs can evaluate the visit documentation and help guide the physician towards appropriate levels of evaluation and management coding which is used by insurance companies for physician reimbursement payments. This study concludes that compared to pre-EHR values, RVU intensity levels, or mean RVUs per patient encounter, have increased 3.20%, suggesting that the EHR has increased RVU intensity.

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