ORIGINAL ARTICLE

The impact of electronic medical record implementation on operating room efficiency

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ABSTRACT

Background: First start delays in the operating room have a downstream effect on operating room efficiency and patient satisfaction. In accordance with the American Recovery and Reinvestment Act, in February 2014, our institution adopted EPIC™ as our electronic health record (EHR). The impact of the transition from paper to electronic documentation on operating room efficiency is not known. This study analyzed first start data as a measure of overall operative suite efficiency, looking at the initial impact and the learning curve to return to baseline parameters.

Methods: A retrospective review of on time start data was reviewed for three months prior and 4 months after implementation of the EHR. A start was considered delayed if the patient arrived to the room after the 7:30 start time. Patients transported from the intensive care unit were excluded from analysis. Data was analyzed using control charts for the percentages and comparison of means using Dunnet's methods. Confidence intervals were calculated at .05 and .01 for significance.

Results: After EPIC implementation, there was an initial drop in on time starts from over 60% to 41% followed by gradual return to pre-implementation level within 4 months ($p < .01$).

Conclusions: Implementation of an EHR produced decreased efficiency in on time first starts in the operative suite, but the learning curve was brief, returning to baseline values in 4 months. These findings can serve as a guide for other institutions that are undergoing transition from a paper to an electronic medical record.

Key Words: Electronic health record, Operating room efficiency, Patient satisfaction

1. INTRODUCTION

The American Recovery and Reinvestment Act of 2009 specified for "meaningful use" of an electronic health record (EHR) in an attempt to increase utilization of electronic records in U.S. health care. There were three components to meaningful use: (1) Use of a certified EHR; (2) Electronic exchange of health information to improve quality; (3) Submission of quality and other measures.[1] In July 2010, the Centers for Medicare and Medicaid Services (CMS) published a final rule governing the requirements for meaningful use. In accordance with the CMS guidelines, our institution adopted the commercial product EPIC™ as our EHR in February 2014.

Several concerns exist regarding the impact of EHR adoption in clinical practice. There is a learning curve for efficient use of an EHR[2] and studies have shown the data entry in the EHR can take longer than documentation in a paper record.[3] To mitigate this potential negative impact, several strategies for EHR implementation have been proposed. Some institutions have applied a staggered approach with individual physicians or departments versus a full scale institutional change.[4,5] We chose to enact an institution wide overnight

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change at a large tertiary care, multispecialty hospital. According to representatives from EPIC™, this represented to date, the largest one day cross over from a paper to EHR. Amongst the concerns generated by this endeavor, was the potential impact upon efficient functioning of the operating suite. Diminished efficiency would lead to an increase in personnel costs, scheduling difficulties, and patient dissatisfaction.

On time first starts in the operating suite are a recognized quality parameter and are often reflective of overall operating suite efficiency. "Wheels in" on time of 59% is a recognized national benchmark.[6] Since the inpatient operative suite incorporates EPIC™ modules from the outpatient clinic, inpatient units, preoperative unit, anesthesia and recovery unit, and perioperative services, it required more extensive training and knowledge of the system by providers for efficient functioning. There was concern that during the learning curve after EHR implementation, there would be a decrease in operating room efficiency leading to increased cost and potential diminished capacity.

In preparation for the transition to an EHR, a six month training program was undertaken for all members of the medical staff. This included video presentations, lectures from industry representatives, lectures from physicians that had already utilized EPIC™ in a separate practice, and practice sessions using mock patients. The video presentations were industry developed training modules for self-paced learning. They addressed segmental components of the EPIC™ in 30-60 minutes sessions. Lectures from industry representatives were delivered by individuals whose background was informational technology, rather than clinical. These covered the scope of utility of EPIC™. The lectures from clinicians already versed in EPIC™ proved the most fruitful.[7] In a survey of the educational process, members of the Department of Surgery rated these lectures as the most effective tool for implementation of the EHR. For the purpose of this study, we analyzed the impact of EHR implementation on first start efficiency in the operative suite, and determined the time frame required to return to our historic pattern of on time first starts.

2. METHODS

A retrospective review of monthly on time start data was reviewed for three months prior and 4 months after implementation of the EHR. A start was considered delayed if the patient arrived to the room after the 7:30 start time. Patients transported from the intensive care unit were excluded from analysis. Data was analyzed using control charts for the percentages and comparison of means using Dunnet's methods. Confidence intervals were calculated at .05 and .01 for significance.

3. RESULTS

In the three months prior to initiation of the EHR, the on time first starts ranged from 59%-69% with a mean of 64%. Following EHR implementation, on time first starts dropped to 41% in the first month, and incrementally improved to baseline levels by the 4^{th} month after EHR adoption. After the 4^{th} month, first start efficiency continued at the baseline range of 59%-69% for the remainder of the calendar year. This difference achieved statistical significance with $p < .01$ (see Figure 1).

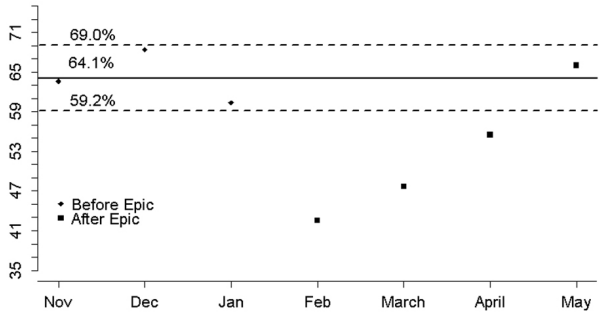

Figure 1. Control chart of percentage of on time starts

When the cause for delay was analyzed, we found that incomplete orders or charting represented over 70% of the delays. Due to the sequential charting in EPIC™, patients could not be taken from the preoperative area to the operating room until all components of the charting were complete. The incomplete charting was due to inexperience with the different components of EHR documentation. A single omission could prevent "completion" of the record and progression to the operating room.

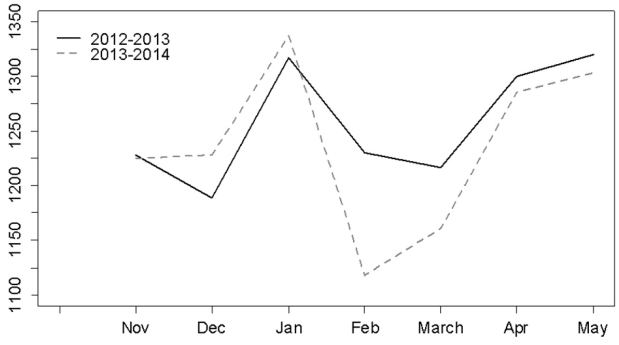

Figure 2. Comparison of total number of cases per period

A separate analysis of case volume was performed to observe whether case volume was impacted during the learning curve of the EHR. There was considerable monthly variation in

case volume that was multifactoral. This limited our ability to demonstrate a statistically significant change in operative volume with EHR implementation. When comparing the curves per period, we can only say descriptively that the drop in February 2014 seems more pronounced than the one in February 2013 (see Figure 2).

4. DISCUSSION

Through the Patient Protection and Affordable Care Act (PPACA), a framework for adoption of an EHR was developed. Subsequent provisions in the Health Information Technology for Economic and Clinical Health (HITECH) in the American Recovery and Reinvestment Act of 2009 have defined adoption of an EHR as a national priority. The Department of Health and Human Services (HHS) outlined a policy of "meaningful use" of the EHR by certain target dates.[8] The adoption of an EHR requires a considerable commitment of time and financial resources by hospitals and physicians. A study by Fleming estimated that EHR implementation incurred a first year per physician cost of over $46,000 for personal computers, software, licensing, and maintenance.[9] An estimate from an earlier study put the combined first year cost of outlays plus lost revenue at $120,000 per physician.[10]

To encourage this process and in part offset the cost of implementation, CMS has offered incentive payments for physicians and hospitals who met the target dates for implementation of meaningful use of the EHR. It has been estimated that these payments have reached $22.9 billion as of March 2014.[11] In spite of the incentive payments and potential advantages of an electronic system, the adoption of an EHR by physicians in the U.S. has been slow.[12]

There is a significant learning curve for health care providers with adoption of the EHR. Several companies offer EHR support that complies with federal guidelines, and we chose the commercial product EPIC™. EPIC™ contains several "modules" for outpatient care, inpatient care, anesthesia care, and perioperative services. Each module requires specific separate instruction for providers and knowledge of each module is required for efficient use of the EHR and delivery of care in the operative suite. Since documentation in each module of EPIC™ is required to bring the patient into the operating room, there was concern that during the learning curve, we would experience an increase in delayed first starts and decreased overall efficiency.

The added cost of diminished operational efficiency is often overlooked as a portion of the total cost of EHR implementation. On time first starts in the operating suite has long been recognized as a measure of overall efficiency. A number of studies have shown how process improvement can significantly improve first start performance.[13,14] Delayed starts increase costs and lead to diminished satisfaction for patients and providers.[15] Chiang reported an increase in the time required for documentation in an EHR compared to a paper record.[16] Many of the studies looking at specifically at documentation in the operating room have related to Ophthalmologic practices because of the high volume and short duration of Ophthalmologic operations. Sanders reported a worsening of intraoperative nursing documentation with implementation of an EHR management system.[17] Our study reflects the influence in a large, tertiary care, multispecialty hospital. Analysis of case volume showed a trend toward diminished case volume in the first month of transition to the EHR.

A variety of strategies have been utilized for the transition to an EHR. Our hospital chose to perform an "overnight" transition to the EHR. In addition, we implemented a 6 month program of training for providers that included video presentations, lectures from EPIC™ personnel, lectures from physicians with prior experience in EPIC™, and practice modules on mock patients. In spite of this, we experienced a drop in on time operating starts from 64% to 41% in the first month of EHR use. On time starts improved progressively each subsequent month until return to baseline performance after four months. This loss in efficiency in the operative suite represents an additional "hidden" cost of EHR implementation. Our experience can serve as a guide to other major hospitals and health systems as they make the transition to an EHR.

Our study has the limitations inherent to retrospective studies. We did not analyze the underlying causes for the increased delays. This study analyzed results with a single commercial EHR product and the results may not be directly applicable to other commercial EHR products. Our study was not intended as an endorsement or critique of EPIC™. Our goal was to determine if the learning curve for EHR implementation would affect operating suite efficiency and productivity and the time frame to return to baseline levels.

5. CONCLUSIONS

In summary, our study demonstrates that on time operating room starts diminish during the learning curve after EHR implementation. The learning curve was relatively brief, and returned to baseline performance within four months. This experience can serve as a model for other major medical centers as they move to adoption of the EHR to anticipate secondary effects of transition from a paper to electronic record.

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