We need to talk: an observational study of the impact of electronic medical record implementation on hospital communication

Stephanie Parks Taylor,1 Robert Ledford,1 Victoria Palmer,2 Erika Abel1

1Division of Hospital Medicine, University of South Florida Morsani College of Medicine, Tampa, Florida, USA
2Biostatistics Core, University of South Florida Clinical and Translational Science Institute, Tampa, Florida, USA

Correspondence to Dr Stephanie Parks Taylor, Division of Hospital Medicine, University of South Florida Morsani College of Medicine, 1 TGH Circle, Suite F-170, Tampa, FL 33606, USA; spezzo@health.usf.edu

ABSTRACT

Background Increasing attention is being given to the importance of communication in the delivery of high-quality healthcare. We sought to determine whether communication improved in a hospital setting following the introduction of an electronic medical record (EMR).

Methods This pre-post cohort design enrolled 75 patient-nurse-physician triads prior to the introduction of EMR, and 123 triads after the introduction of EMR. Nurses and patients reported whether they communicated with the physician that day. Patients, nurses and physicians answered several questions about the plan of care for the day. Responses were scored for degree of agreement and compared between pre-EMR and post-EMR cohorts. The primary outcome was Total Agreement Score, calculated as the sum of the agreement responses. Chart review was performed to determine patients’ actual length of stay.

Results Although there was no difference between the frequency of nurses reporting communication with physicians before and after EMR, face-to-face communication was significantly reduced (67% vs 51%, p=0.03). Total Agreement Score was significantly lower after the implementation of EMR (p=0.03). Additionally, fewer patients accurately predicted their expected length of stay after EMR (34% vs 26%, p=0.001).

Conclusions The implementation of EMR was associated with a decrease in face-to-face communication between physicians and nurses, and worsened overall agreement about the plan of care.

INTRODUCTION

Increasing attention is being given to the importance of communication in the delivery of high-quality healthcare. The Joint Commission National Patient Safety Goal 2 charges that communication between healthcare providers must improve.1 Unfortunately, communication between physicians and nurses has been reported to be poor. For example, one study found that physicians and nurses were in agreement only 11% of the time about upcoming procedures, and only 40% were in agreement about medication changes.2 The problem of ineffective communication has been cited as a leading cause of preventable medical errors.3–6

In 2001, the Institute of Medicine identified six healthcare domains that should be the focus of substantial improvement, and called for the introduction of electronic medical records (EMR) as a means of achieving these goals.7 A subsequent Institute of Medicine (IOM) report specifically endorsed the use of EMR to increase communication and connectivity in healthcare.8 In response, there has been a federal push toward the adoption of health information technology with the Health Information Technology for Economic and Clinical Health Act of 2009 establishing financial incentives to promote the early adoption of EMRs followed by penalties if EMR is not integrated by 2015. However, there has been little empirical assessment of the actual effect of EMR on communication between providers and patients. There is evidence that EMR use may decrease the time clinicians spend with patients; a recent time-and-motion study in a setting with EMR showed that internal medicine interns spent 40% of their time using a computer, compared with only 12% of their time spent in direct patient care.9 The impact of this distribution of time on communication is unknown. This study


Copyright Article author (or their employer) 2014. Produced by BMJ Publishing Group Ltd under licence.
aimed to assess the effect of EMR on communication among nurses, physicians and patients.

METHODS
The study was conducted at Tampa General Hospital, a tertiary care centre affiliated with the University of South Florida. The study was approved by the University of South Florida institutional review board. We designed the study as a pre-post experiment with data collected before and after hospital-wide implementation of a complete EMR (Epic EpicCare Inpatient EMR, Verona Wisconsin) in October 2011. Data from the pre-EMR cohort were collected in August 2011, and data from the post-EMR cohort were collected in August 2012. The cohorts were separated by one calendar year for two reasons: (1) to maintain similarity in resident experience between groups and (2) to allow 10 months for staff to familiarise with the EMR, and minimise the possible detrimental effect that ‘learning’ the EMR may have had on time spent between providers and patients.

EMR functionality
Several components of the EMR are designed to facilitate shared understanding between providers regarding the plan of care. An ‘Active Problem list’ is highly visible upon opening each patient’s chart and can be updated as conditions resolve and new problems arise. An ‘Order Manager’ pane is always accessible for viewing active and recently completed orders, including specific sections for medications and consults.

Physicians and nurses attended mandatory training sessions (8 h total) prior to implementation, including training on integration of EMR into the visit. Newly hired physicians and nurses were required to complete the same training.

Study population
The study enrolled triads consisting of a patient, his or her nurse on the day of interview, and his or her treating physician. The treating physician was defined as the senior resident caring for the patient, because this is the person on the team likely to have the most up-to-date information about the patient after rounds have occurred. Patients admitted to a general medical service were eligible for the study. Patients with cognitive deficits limiting their ability to provide consent (such as delirium or advanced dementia), or the inability to speak or understand English were excluded. Ability to provide consent was assessed based on the clinical judgment of the study investigator conducting the interview. Once a patient provided informed consent to participate in the study, his or her nurse and treating physician were consented verbally. Patients, nurses and physicians were interviewed between 12:00 and 15:00 on the first day after an attending physician had staffed the patient. This time was selected for two reasons: (1) the majority of teaching rounds took place before didactic conference at 12:00, so that a plan of care would theoretically be established and (2) many nurses change shift at 15:00.

Assessment of communication
We conducted standardised interviews using a communication assessment tool modified from O’Leary and colleagues. Patients were questioned about the plan of care for that day regarding his or her primary diagnosis (ie, reason for admission), any planned tests, procedures, medication changes, or pending consultations for the day, and the expected length of stay in the hospital. Nurses and physicians answered the same questions. Additionally, we asked nurses and patients if they recalled communicating with the physician that day. Nurses who reported communicating with the physician were asked whether communication occurred face-to-face or via telephone.

Three board-certified internists (SPT, RL, EA) rated physician-nurse and physician-patient agreement for each question. Following O’Leary et al, the ratings were recorded as ordinal variables: complete agreement, partial agreement, or no agreement. For example, if a nurse and physician both respond that a patient’s primary diagnosis is ‘headache’, complete agreement will be scored. If the nurse responds that the planned procedures for the day include a CT of the head, and the physician responds that a CT head and lumbar puncture are planned, then partial agreement will be scored. For length of stay, complete agreement was scored if there is an exact match on the anticipated day of discharge, partial agreement if there was 1 day difference, and no agreement if there was greater than 1 day difference. The primary outcome, Total Agreement Score, was calculated by assigning 0, 1, or 2 points for no agreement, partial agreement and complete agreement to responses of each of the six questions and taking the sum. To ensure inter-rater reliability, one-third of responses were selected for duplicate review.

Chart review was performed to determine patient’s actual length of stay. Patients’ predicted length of stay was compared with their actual length of stay and determined to be accurate, overestimated, or underestimated.

Data analysis
Descriptive statistics are reported as means and SDs for continuous variables, and as frequencies and percentages for categorical variables. The inter-rater agreement was assessed using κ statistics. χ² Tests were conducted to compare the proportion of nurses and patients reporting occurrence of communication with their physician, mode of communication between physicians and nurses, and accuracy of expected length of stay before and after the implementation of EMR. An independent samples t test was used to compare mean differences in Total Agreement Score.
before and after EMR implementation. Posthoc analyses were performed using a series of proportional odds models to compare the level of agreement between physicians and nurses, as well as between physicians and patients on specific aspects of the plan of care before and after the implementation of EMR. The models were tested for compliance with the proportional odds assumption using the score test, and separate binary logistic regression models were used on dichotomised responses for each test if the proportional odds assumption was violated. All statistical analyses used two-sided significance tests, and statistical significance was set at p<0.05. All analyses were performed using SAS V9.3.

RESULTS
Seventy-five patient-nurse-physician triads were enrolled in the pre-EMR group, and 123 patients-nurses-physician triads were enrolled in the post-EMR group. One hundred per cent of patients and nurses completed the interview, and 196 (99%) of physicians completed the interview.

Communication between physicians, nurses and patients
The reported frequency and proportion of communication between physicians, nurses and patients, and of the mode of communication between physicians and nurses before and after the implementation of EMR are shown in table 1.

Among the physicians and nurses, reported communication decreased after the onset EMR implementation from 69.33% to 60.98%. However, no statistical evidence was found to suggest a significant difference ($\chi^2=1.16$, df=1, p=0.28). Further examination of the mode of reported communication between physicians and nurses revealed that among the 113 nurses reporting the occurrence of face-to-face communication with the physician, significantly fewer reported face-to-face communication after the onset of EMR use than before (66.7% vs 51.2%, $\chi^2=4.54$, df=1, p=0.03). Reported communication between patients and physicians was not statistically significantly different following EMR implementation (73.3% vs 75.6%, $\chi^2=0.13$, df=1, p=0.72).

Agreement between physicians, nurses and patients
Physician-nurse and physician-patient agreement before and after the implementation of EMR are shown in table 2.

Inter-rater reliability between the authors’ rating agreement was high for pre-EMR and post-EMR cohorts (κ=0.81–1.00). An independent samples t test was conducted to evaluate the effect of EMR use on agreement among physicians, nurses and patients on all aspects of planned care. The results indicate a significant mean difference in Total Agreement Score (mean difference=1.72, 95% CI 0.17 to 3.26) following the implementation of EMR ($t=2.19$, df=192, p=0.03). Specifically, Total Agreement Score was significantly greater prior to the use of EMR (mean=25.00, SD=5.41) compared to after EMR implementation (mean=23.26, SD=5.23).

Table 1  Comparison of communication patterns and outcomes before and after implementation of the EMR

<table>
<thead>
<tr>
<th></th>
<th>Before EMR (n=75)</th>
<th>After EMR (n=123)</th>
<th>p Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nurses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reported communication with physician, n (%)</td>
<td>52 (69.3)</td>
<td>76 (61.8)</td>
<td>0.28</td>
</tr>
<tr>
<td>Mode of communication, n (% of total)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Face to face</td>
<td>50 (66.7)</td>
<td>63 (51.2)</td>
<td>0.03†</td>
</tr>
<tr>
<td>Phone</td>
<td>2 (2.7)</td>
<td>13 (10.6)</td>
<td></td>
</tr>
<tr>
<td><strong>Patients</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reported communication with physician, n (%)</td>
<td>55 (73.3)</td>
<td>93 (75.6)</td>
<td>0.72</td>
</tr>
</tbody>
</table>

*p Values based on two-sided $\chi^2$ tests of independence.  
†p Value <0.05.  
EMR, Electronic medical record.

Exploration of specific aspects of planned care
The post-EMR group demonstrated significant differences in level of agreement on expected length of stay between nurses and physicians (OR=0.36, 95% CI 0.19 to 0.70, p=0.002) and between patients and physicians (OR=0.38, 95% CI 0.21 to 0.69, p=0.002). Agreement between patients and physicians was significantly reduced after the onset of EMR use for pending consultations (OR=0.53, 95% CI 0.29 to 0.95, p=0.03), and marginally decreased after the onset of EMR use for planned procedures (OR=0.38, 95% CI 0.14 to 1.08, p=0.07). These results suggest that following EMR implementation, the chances of having partial or complete agreement between physicians and nurses, as well as between physicians and patients, on expected length of stay was significantly decreased. Additionally, following the implementation of EMR, the likelihood of obtaining increased levels of agreement between patients and physicians on pending consultations was significantly decreased.

Adjustment of the significance level was not made for multiple tests due to the exploratory nature underlying the examination of agreement. Therefore, future replications are needed to determine the reliability of the present findings assessing the effects of EMR use on the level of agreement between nurses, patients and physicians on multiple aspects of plan of care.

Predicting length of stay
When patients’ predictions regarding their expected length of stay were compared with their actual length of stay, significantly fewer patients were accurate following the implementation of EMR (33.9% vs 25.8%), and more patients responded ‘I don’t know’.
when asked about their expected length of stay after EMR (18.5% vs 46.7%), p<0.01.

DISCUSSION

Addressing the problem of poor communication between healthcare providers is a principal goal of most healthcare systems. The implementation of EMR has been advocated as a means towards this end. Our study presents the somewhat surprising finding that EMR may hinder communication for hospitalised medical patients. Although the percentage of nurses and patients reporting that communication with the physician had occurred did not change, face-to-face communication between physicians and nurses was significantly less frequent after EMR. The primary outcome of Total Agreement Score, reflecting a shared understanding of the plan of care for a given patient, decreased after the implementation of EMR, suggesting that the quality of communication may have worsened due to the use of EMR.

The reason why face-to-face communication seems to be so important in the delivery of healthcare is not clear. Organisational theorists have pointed out several favourable features of face-to-face communication compared with electronically mediated exchange. Face-to-face communication allows participants to observe and react to verbal and non-verbal cues. Nuances associated with facial expressions, tone of voice and hand gestures may convey important information not captured in the electronic format. For example, the urgency of an order or uncertainty about a diagnosis may be more accurately expressed through a face-to-face discussion. Another advantage of face-to-face interaction is that it results in ‘real-time’, rather than asynchronous exchange of information. This allows for immediate assessment of understanding and opportunity for clarification. Whether these or other factors are important to successful communication deserves further study.

Although the existing literature on the effect of EMR on communication is not robust, several studies have examined the impact of one specific EMR functionality, computerised physician order entry (CPOE). There is evidence that CPOE has a negative effect on communication between physicians and nurses, particularly by replacing face-to-face (or synchronous) communication with asynchronous communication. By contrast, a recent study found that although CPOE had a negative effect on communication in the short term, this effect was neutralised after 1 year of use.

Our study has important limitations. Foremost, the study is small and an a priori power analysis was not performed due to lack of information about expected effect sizes. Thus, we did not know whether the number of patients evaluated would be adequate to find a difference in outcome measures. Following the recommendations given by Chen and Cohen suggesting that a standardised mean difference of 0.5 and an OR of 2.50 are indicative of a medium effect, the results of the posthoc power analyses indicate that although the current study is small, it does have a large enough sample to detect at least a small standardised effect of EMR group on Total

**Table 2** Effects of EMR use on total agreement between nurses and patients with their physicians on multiple aspects of the plan of care

<table>
<thead>
<tr>
<th>Specific aspect of care</th>
<th>Total agreement score</th>
<th>Pre-EMR agreement (n=75)</th>
<th>Post-EMR agreement (n=121)</th>
<th>OR (95% CI)</th>
<th>p Value 0.0299*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total agreement score</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-EMR (n=75)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-EMR (n=121)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Physician-nurse, n (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary diagnosis</td>
<td>10 (13.3)</td>
<td>18 (24.0)</td>
<td>47 (62.7)</td>
<td>13 (10.7)</td>
<td>20 (16.5)</td>
</tr>
<tr>
<td>Planned tests†</td>
<td>13 (17.3)</td>
<td>0</td>
<td>62 (82.7)</td>
<td>32 (26.4)</td>
<td>6 (5.0)</td>
</tr>
<tr>
<td>Planned procedures‡</td>
<td>4 (5.3)</td>
<td>0</td>
<td>71 (94.7)</td>
<td>14 (11.6)</td>
<td>1 (0.8)</td>
</tr>
<tr>
<td>Medication changes</td>
<td>31 (41.3)</td>
<td>5 (6.7)</td>
<td>39 (52.0)</td>
<td>58 (47.9)</td>
<td>11 (9.1)</td>
</tr>
<tr>
<td>Pending consultations</td>
<td>12 (16.0)</td>
<td>3 (4.0)</td>
<td>60 (80.0)</td>
<td>26 (21.5)</td>
<td>11 (9.1)</td>
</tr>
<tr>
<td>Expected LOS‡</td>
<td>17 (22.7)</td>
<td>32 (42.7)</td>
<td>26 (34.7)</td>
<td>54 (44.6)</td>
<td>24 (19.8)</td>
</tr>
<tr>
<td><strong>Physician-patient, n (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary diagnosis</td>
<td>16 (21.3)</td>
<td>15 (20.0)</td>
<td>44 (58.7)</td>
<td>22 (18.2)</td>
<td>25 (20.7)</td>
</tr>
<tr>
<td>Planned tests†</td>
<td>20 (26.7)</td>
<td>1 (1.3)</td>
<td>54 (72.0)</td>
<td>39 (32.2)</td>
<td>2 (1.7)</td>
</tr>
<tr>
<td>Planned procedures‡</td>
<td>5 (6.7)</td>
<td>0</td>
<td>70 (93.3)</td>
<td>19 (15.7)</td>
<td>1 (0.8)</td>
</tr>
<tr>
<td>Medication changes</td>
<td>40 (53.3)</td>
<td>6 (8.0)</td>
<td>29 (38.7)</td>
<td>66 (54.5)</td>
<td>6 (5.0)</td>
</tr>
<tr>
<td>Pending consultations</td>
<td>20 (26.7)</td>
<td>3 (4.0)</td>
<td>52 (69.3)</td>
<td>44 (36.4)</td>
<td>14 (11.6)</td>
</tr>
<tr>
<td>Expected LOS‡</td>
<td>23 (30.7)</td>
<td>28 (37.3)</td>
<td>23 (30.7)</td>
<td>66 (55.4)</td>
<td>18 (14.9)</td>
</tr>
</tbody>
</table>

Measures of agreement were categorised as none (0), partial (1), or complete (2) agreement. No agreement served as the reference group.

* p Value <0.05.
† p Value <0.10.
‡ Proportional odds assumption violated. p Value based from binary logistic regression modelling ‘At Least Partial Agreement’ versus ‘No Agreement’.

EMR, Electronic medical record; LOS, Length of stay.
Agreement Score. Despite being somewhat underpowered to detect a medium standardised effect (Cohen’s d ≥ 0.42 or OR ≥ 2.80) given the current sample size, the observed effects are near to those needed. Therefore, it is essential to replicate the findings of the study with a more adequate sample size. Additionally, the study enrolled only general medical patients at a single academic institution with one particular EMR, which may limit generalisability to other populations. Although we are not aware of any other intervention affecting communication between the August 2011 and August 2012 cohorts, it is possible that a factor other than EMR implementation was responsible for the observed worsening in communication.

Despite the limitations, our finding that EMR actually impaired communication in the hospital setting is noteworthy. Although EMR provides definite advantages through enhanced information sharing, this study demonstrates the importance of preserving interpersonal communication in the setting of EMR. Efforts toward communication skills training and the modification of clinical workflows and in the setting of EMR are necessary to facilitate quality communication.

Contributors All authors listed have contributed sufficiently to the project to be included as authors, and all those who are qualified to be authors are listed in the author byline.

Competing interests None.

Ethics approval USF Institutional Review Board.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES


We need to talk: an observational study of the impact of electronic medical record implementation on hospital communication

Stephanie Parks Taylor, Robert Ledford, Victoria Palmer, et al.

BMJ Qual Saf published online February 6, 2014
doi: 10.1136/bmjqs-2013-002436

Updated information and services can be found at:
http://qualitysafety.bmj.com/content/early/2014/02/06/bmjqs-2013-002436.full.html

These include:

References
This article cites 11 articles, 3 of which can be accessed free at:
http://qualitysafety.bmj.com/content/early/2014/02/06/bmjqs-2013-002436.full.html#ref-list-1

P<P
Published online February 6, 2014 in advance of the print journal.

Email alerting service
Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Notes

Advance online articles have been peer reviewed, accepted for publication, edited and typeset, but have not yet appeared in the paper journal. Advance online articles are citable and establish publication priority; they are indexed by PubMed from initial publication. Citations to Advance online articles must include the digital object identifier (DOIs) and date of initial publication.

To request permissions go to:
http://group.bmj.com/group/rights-licensing/permissions

To order reprints go to:
http://journals.bmj.com/cgi/reprintform

To subscribe to BMJ go to:
http://group.bmj.com/subscribe/