Comparison of documentation time between an electronic and a paper-based record system by optometrists at an eye hospital in south India: A time–motion study

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A B S T R A C T

Purpose: The adoption of electronic medical record (EMR) system is gradually increasing. However, various time–motion studies reveal conflicting data regarding time effectiveness on workflow due to computerization. One of the major issues for physicians is their uncertainty with EMRs’ potential impact of time on workflow. A tertiary eye hospital in south India was in the process of implementing an EMR system in their ambulatory care unit. Many of the staff did not have previous computing experience and there were conflicting views on the time effectiveness of the computerized system after implementation. The management was thus interested to know the real time effectiveness of EMR in their hospital. The study compliments existing studies of this type by comparing the time efficiency of documentation time using EMR system with paper documentation in a hospital in a developing country where a transition between paper and EMR documentation was currently in progress.

Methods: Ten randomly selected optometrists documented the time they spent during consultation with both paper and EMR documentation. The time spent was documented for a total of 200 records (100 EMR and 100 paper records). The independent-samples t-test and analysis of variance were used to compare the means of the consultation time and calculated documentation time spent between the electronic and paper records.

Results: There was no statistically significant difference in the time spent for documentation between electronic and paper records. The mean time spent in documenting electronic records was 0.92 min (95% CI –3.06 to 1.14) longer than in paper records.

Conclusion: EMR systems can be adopted in eye hospitals without having significant negative impact on duration of consultation and documentation for optometrists. More time–motion studies that include ophthalmologists are however needed in order to get a more complete picture of time impact of the EMR system on clinical workflow in eye hospitals.

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1. Introduction

The information technology (IT) revolution has impacted every sector of society, and the health care system is no exception. IT has, however, penetrated much deeper into sectors of the economy such as banking and transportation than it has in the health sector [1]. Electronic medical records (EMRs) in particular have received great expectations from clinicians to improve safety, quality, and efficiency in medicine [2,3]. Despite the existing barriers, an increasing number of publications indicate growing acceptance for EMR systems in developed countries [15]. Adoption, however, has been slower than expected. A number of barriers exist including negative attitudes of some healthcare staff toward information technology, technical difficulties when using EMR systems, and uncertainty among healthcare staff on how EMR systems may impact their workflow [4]. Another key concern is the assumption that clinicians require more time to accomplish their work using EMRs [5].

Compounding these problems is that few EMR systems have been evaluated in literature [6–9]. Studies that do exist also contain conflicting data regarding the time effectiveness on the workflow by computerization in general [10,11]. There are studies suggesting that computerizing facilitates time savings [12] and computerized data entry takes little to no extra time [13,4]. On the other hand, there are studies also advocating computerization needs more time for data entry [14].

The issue of time effectiveness with respect to EMR systems in developing countries is even less clear as there is less available knowledge to draw upon from existing studies. A good number of existing time–motion studies of EMR systems have been conducted in the developed world [2,11,4,16]. The available literature also does not adequately describe the potential capabilities and utility of EMR systems in developing countries [17]. This leaves a gap of knowledge for the developing world since IT solutions in the developed world are not always easily transferable to the developing world [9].

In order to improve understanding of EMR systems at eye hospitals, and for those in developing countries an interpretive study was conducted at Sankara Nethralaya an Eye Hospital in Chennai, India. Among other things the study revealed that 60–70% of the information inputted into the EMR system was done so by optometrists and that the time effectiveness of the system was unclear and was a significant concern among many of the health staff [18]. The management of the hospital was interested to evaluate time effectiveness of documentation for optometrists when using the EMR system compared with paper records.

This study was thus conducted to measure the time taken by optometrists when documenting patient data while using the EMR system at Sankara Nethralaya compared with paper records. During the time the study was conducted Sankara Nethralaya was undergoing a stepwise implementation process and was using both electronic and paper records. An additional contribution of the study is thus that, unlike previous time–motion studies of EMR systems, it was possible to employ methods that collected data on the usage of paper and electronic documentation concurrently.

2. Methods

A time–motion study was performed at Sankara Nethralaya eye hospital in Chennai, India. During the time of the study the hospital was undergoing a stepwise implementation process with the EMR system. This EMR system was developed by one of the leading Indian IT vendors along with IT staff from this hospital. It was a multi-user system with a centralized database. Since many of the health staff did not have previous computing experience the implementation process was designed to allow them to increasingly incorporate the EMR system into their work practice as they became more familiar with the system.

The hospital has day and evening clinics, and implementation of EMR system was first initiated in the evening clinic. The strategy was to continue serving existing patients with their paper record, while creating an electronic record for the new patients. In the beginning of the process an electronic record was created for four patients and then increased to six during the evening clinic. The number of new electronic records created was gradually increased until all new patients at the evening clinic had an electronic record created for them. A similar process was then introduced at the day clinic. At the time the study was conducted all the new patients visiting the day clinic still did not have an electronic record created for them, and optometrists were working with both paper and electronic records. This implementation process allowed for a favorable time to conduct this type of study, since data on documentation time could be collected for paper and electronic records concurrently.

Ten optometrists that were attending the evening and day clinics during the week when study was scheduled were randomly included in the study.

3. Data collection

Each optometrist was given two sheets of paper with tables to record sign-in and sign-out times (one to note EMR files and other for paper files), and determine the procedures or examinations performed for a total of 20 patients. Each optometrist was instructed to record the time spent with the first 10 patients served with paper records, and the first 10 patients served with electronic records, that visited him/her during the study. The time spent for documentation was recorded in a total of 200 records (100 EMR and 100 paper records) were selected for the analyses.

The use of the EMRs and paper records during the study was consistent with the current practice for use of the EMR system at the clinic. There were no differences in content in paper and electronic records. All consultations were done according to standard practice for optometric routines. Patients had no special role in the study, and optometrists were not aware of the objective of the study in order to avoid any possible bias. The data was collected in one week between 24th and 29th of December 2007.
Table 1 – Comparisons between electronic and paper records.

<table>
<thead>
<tr>
<th></th>
<th>Paper records</th>
<th>Electronic records</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of subjects</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>72</td>
<td>66</td>
</tr>
<tr>
<td>Females</td>
<td>28</td>
<td>34</td>
</tr>
<tr>
<td>Work intensity score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>15</td>
<td>13.2 (3.1)</td>
</tr>
<tr>
<td>2</td>
<td>80</td>
<td>18.2 (6.2)</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>25.3 (6.5)</td>
</tr>
<tr>
<td>Age* (years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time* (min)</td>
<td>43.6 (22.1)</td>
<td>45.6 (17.5)</td>
</tr>
</tbody>
</table>

*Mean (standard deviation).

Work intensity score: 1: Vision check up; 2: 1 + Slit-lamp examination and measuring intra ocular pressure (IOP); 3: 1 + 2 + Gonio/Pachy (special examination done for Glaucoma patients).

3.1. Statistical analysis

All times were measured to the nearest minute. Since there can be large variability regarding the amount of work necessary for each consultation, a work intensity score was calculated by summing up the values of all examinations performed on each patient [6]. Each examination or procedure was given value of 1 for this calculation. Usually the procedures done depended on the specific complaints or problems of the patient. The maximum work intensity that was recorded by any optometrist was 3. After deducting estimated procedure time from total consultation time, documentation time was calculated. The independent-samples t-test was used to compare the means of both consultation and documentation times between the electronic and paper records. In addition, adjustments for possible confounders (age, gender and work intensity score) were performed using analysis of variance. A p value less than 0.05 was considered statistically significant. All analyses were performed using SPSS 17.0 software.

4. Results

Comparisons between electronic and paper records are presented in Table 1. The overall mean of the consultation time spent by optometrists was 19.0 min. Table 2 shows comparisons of the consultation time spent between electronic and paper records. Although there is a trend, there was not a statistically significant difference in the consultation time spent between electronic and paper records. The mean consultation time spent with electronic records was only 1.52 min (95% CI −3.64 to 0.59) longer than in paper records.

Male patients required 1.7 min more (95% CI −0.5 to 3.8) than female patients to complete their consultation. Adjusting for gender did not affect the relationship between type of record and the consultation time spent by optometrists. Adjusting for age of the patient reduced the difference in the time spent between electronic and paper records to 0.48 min, with p value 0.62.

The work intensity score showed a significant effect on the time spent. Patients with more and difficult procedures spent more time; the p value for the trend was less than 0.001. However, the relationship between type of record and time spent was reversed when adjusting for the work intensity score. Although, not significantly different, the consultation time spent in electronic records was shorter than in paper records by 0.39 min (95% CI −1.5 to 2.2). Adjusted for gender, age and work intensity score, the difference in mean time spent between electronic and paper records was 0.43 min, p value 0.64.

5. Calculated documentation time

Calculated documentation time was calculated by subtracting procedure time from consultation time. Consulting with senior optometrist and head of department, a unit of time was agreed that is spent for each of the examination or procedure performed in this hospital. For example 8 min for vision check up, 12 min for vision check up and measuring intra ocular pressure and 18 min for just mentioned procedures plus Gonio/Pachy. Table 3 compares calculated time taken for documentation between electronic and paper records. The mean difference of calculated documentation time was found to be...
Table 3 – Comparison of calculated time taken for documentation between paper records and electronic records in minutes.

<table>
<thead>
<tr>
<th>Group statistics</th>
<th>Record_TYPE</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Standard error mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consultation time</td>
<td>Paper</td>
<td>100</td>
<td>18.04</td>
<td>6.5</td>
<td>0.41</td>
</tr>
<tr>
<td></td>
<td>EMR</td>
<td>100</td>
<td>19.56</td>
<td>7.1</td>
<td>0.71</td>
</tr>
<tr>
<td>Documentation time</td>
<td>Paper</td>
<td>100</td>
<td>6.62</td>
<td>7.4</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>EMR</td>
<td>100</td>
<td>7.58</td>
<td>7.6</td>
<td>0.72</td>
</tr>
</tbody>
</table>

Independent-samples test

<table>
<thead>
<tr>
<th></th>
<th>Levene’s test for equality of variances</th>
<th>t-test for equality of means</th>
<th>95% confidence interval of the difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>Consultation time</td>
<td>.101</td>
<td>.75</td>
<td>−1.37</td>
</tr>
<tr>
<td>Documentatiion time</td>
<td>.000</td>
<td>.98</td>
<td>−.89</td>
</tr>
</tbody>
</table>
0.96 (95% CI –3.06 to 1.14) min longer while using electronic records.

6. Discussion

The results of the study showed no significant difference in the time spent between paper and electronic records. The mean consultation time spent with electronic records was only 1.52 min longer than with paper records. When adjusting for the work intensity scores, however, the time spent using electronic records was shorter than with paper records by 0.39 min. The calculated documentation time spend with electronic records was only 0.92 min longer than with paper records. Neither of these differences was statistically significant.

The study does not provide a definitive answer on why a greater work intensity score was recorded for the EMR system. A probable explanation is patients on their first visit to a hospital commonly have more issues to discuss, and the implementation process resulted in more new patients being served with the EMR system than paper records.

The lack of standardized methods for assessment of quality and time consumed for documentation makes it difficult to compare results between studies [19]. Hence the environment of every study should be clearly defined to allow for comparison [20]. This study was conducted differently from the studies cited above for comparing time efficiency between EMR and paper-based records in several aspects. Previous studies were generally performed during pre- and post-implementation of the EMR system [12,13,14]. Such studies have chances to favor the EMR system due to the experience and skill gained by health staff between the study periods. In this study it was possible to eliminate this factor due to a stepwise implementation process that allowed data on the usage of electronic and paper records to be collected concurrently. In addition the same optometrists were studied while using both electronic and paper records. This further eliminates experience and habitual bias.

Overall, the results of this study support previous findings [13,4,16] of no significant difference in the time spent between paper and electronic records. This is a fairly positive result for the EMR system when considering several factors that could have favored the paper record system. This study compared a well-practiced paper record system with a new EMR system. It was thus more likely for the EMR system to take longer time than the paper-based system. The system was also implemented at a hospital in a developing country where staff was fairly resistant to the system initially, where many of them lacked IT skills, and where preliminary feedback from staff members gave conflicting results regarding any time savings or expenditure with the system. As such, it would not have been surprising if the EMR system performed poorly compared to paper records.

The inclusion of age and gender of the patients and work intensity is unique to this study and is not reported in similar studies. Overall, the results revealed that age and gender of patient did not play a significant role on the relationship between type of record and the time spent by optometrists during consultation. However, male patients required 1.7 min more than female patients for their consultation to be completed.

Although the study results are representative only for similar environments (e.g. optometrist consultation) they are interesting to general medical informatics for several reasons. The results can be compared with studies in other departments at hospitals since the time for documentation was calculated instead of only the time taken to perform procedures. In addition, the method used in study may be useful for measuring time effectiveness in hospitals where a transition between paper and EMR documentation is in place, and for formative evaluations conducted during implementation phases of EMR systems. Formative evaluations have recently been recommended as a critical and often overlooked component of EMR implementation [21].

A conclusion of the study is adoption of EMR systems has no significant negative impact on time spent during consultation with optometrists. More time–motion studies that include ophthalmologists are needed in order to get a more comprehensive and complete picture of time effectiveness of the EMR system on workflow.

Acknowledgements

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