

Evaluating the Impact of Electronic Health Records on Nurse Clinical Process at Two Community Health Sites

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Abstract

We conducted two mixed methods studies in community-based health care settings to examine EHR use among nurses documenting direct patient care and EHR impact on nurse satisfaction. Quantitative methods included documentation time-to-completion data and a clinician satisfaction survey. Qualitative methods included observations and follow-up interviews. Qualitative data was merged with the quantitative data by comparing findings along themes. Results indicated nurses increased the number and timeliness of notes documented. Nurse use of the EHR as intended varied between the research sites. Barriers to EHR use included cumbersome functionalities that impacted nurse efficiency, lack of interoperability, and hardware issues. Facilitators to adoption included functionalities that provided memory prompts during the care process and enabled nurses to communicate about patient care. Interpretation of findings underscores the importance of the interaction of workflow, EHR functionality, and usability to impact nurse satisfaction, efficiency, and use of the EHR.

Introduction

Most health care in the United States is delivered in the community by interdisciplinary teams composed predominantly of nurses. Care delivered by interdisciplinary teams necessitates a high level of planning and communication among providers to coordinate care properly. It is expected that electronic health records (EHR) can support the required service coordination to improve the quality and safety of care. Although community settings have a high rate of EHR adoption, little is known about the impact of nurse EHR use on clinical process and patient care. What we know about nurses' use of health information technology (HIT) is from studies of their use of clinical information systems. There is evidence of benefits including: (1) support for developing care plans¹ and improvement of documentation quality,^{1,2} increased efficiency,^{1,2} increased team communication,^{1,3} and more effective organization of nursing tasks.² However, HIT has also been shown to create new problems, such as work-arounds to circumvent the system⁴ and changes to organizational structure and work processes⁵⁻⁷ that may affect patient care.⁷ Nurses also perceive use of HIT to be responsible for impaired critical thinking due to (i) documentation being limited to checkboxes and drop-down selections and (ii) nurses' use of cut and paste functionality to copy previous notes in their entirety without editing.²

We hypothesized that implementation of EHRs will result in significant improvements in workflow, and organizational outcomes. Our evaluation of these hypotheses involved studies at two community health sites using an embedded mixed methods design with the EHR implementation as the focusing event. The study at a Program of All-inclusive Care for the Elderly (PACE) site has been completed. The home care agency study is in process.

Methods

Both study sites used similar data collection and analysis procedures. We present the design, participants, and methods for the data collection methods, with differences between sites noted. The methods employed and related findings at the PACE site have been presented elsewhere.⁸

The mixed methods research design's quantitative experiment used retrospective data without a comparison group to measure the impact of the EHR. The embedded qualitative component consisted of prospective data collection for post-intervention observation. Quantitative data (the primary data set) and qualitative data were analyzed concurrently and used to inform each other. The comparison of findings was designed to enrich the interpretation of quantitative findings.⁹ The Institutional Review Boards approved the studies.

HIT Evaluation Framework. The authors used the HIT Reference-based Evaluation Framework (HITREF) to integrate results from the quantitative and qualitative segments, and identify how the qualitative themes contributed to understanding the quantitative findings. The HITREF is a comprehensive HIT evaluation framework, firmly grounded in research evidence, that identifies a range of clinician satisfaction characteristics and dimensions to be measured.¹⁰ It provides a comprehensive list of 20 criteria as themes for the mixed methods analysis of EHR and was operationalized in the clinician satisfaction survey used in both studies.¹¹

Study Settings. The studies were conducted in two community settings in Philadelphia, PA. At both sites, multi-disciplinary teams, predominantly nurses, delivered direct patient care and documented in an EHR. The PACE site

managed the care of nursing-home eligible members to enable them to avoid nursing home admission and reside in their homes.¹² Twenty-four nurses provided care for 338 PACE members and documented in the EHR. The goal of the EHR implementation was to enable clinicians to provide at least the same level of care to an increasing population of patients. One full-time, on-site information technologist supported the system.

The home care agency was not-for-profit and private. The agency provided home care services to 1200 patients monthly in a five county urban and suburban area. There were 97 nurses who documented care in the EHR. For Medicare patients, care is reimbursed based on the Outcome and Assessment Information Set (OASIS) assessment instrument and congruence with documentation of the care. The agency's goal in implementing the point-of-care EHR was to improve overall operations. Specific goals included improving the quality and timeliness of billing to improve reimbursement, and improving clinical quality by aggregating data in real time and improving patient safety with documentation that was timely, in one place, and available in real time to all clinicians. A staff of five full-time-equivalent technologists supported the home care EHR and the HIT in two related organizations of similar size. Both settings were part of the same integrated health care system which provided server and infrastructure support.

Interventions. Both sites were selected because they had implemented commercially available EHRs: the PACE site in October 2007 and the home care site in 2009. Both EHRs supported documentation management including medication management and patient history. The PACE EHR also supported ordering diagnostic tests and non-medication orders, managing results, and capturing external clinical documents with scanning. The home care EHR supported sharing patient information among clinicians and had limited interoperability of referrals from health system hospitals. Neither EHR supported workflow management, clinical task assignment/routing, clinical decision support (e.g., alerts), or interoperability with off-site organizations performing clinical services (e.g., imaging or laboratory studies).

Quantitative and Qualitative Methods. The PACE analysis focused on cross-sectional analyses and comparisons between two post-implementation results taken six months apart. The on-going home care study's analysis focused on longitudinal analyses and comparisons between pre-implementation (11/07-2/09) and post-implementation (8/09-2/10) time periods. The differences (or lack of differences) between time points at each site were interpreted as the impact of the EHR on the outcome of interest. We entered and analyzed all quantitative data using STATA 10¹³ for PACE data and SAS¹⁴ for home care data. In both studies, all nurses were eligible to participate with different levels of participation in each method. For instance, all were included in documentation time-to-completion analysis, and only consented nurses were observed, surveyed and interviewed. Consent was sought in each study from all nurses who attended on-site staff meetings. In the home care study, consent was also sought with internet surveys and postal mail to the clinician's home.

Documentation time-to-completion. Workflow was assessed using time-to-completion of clinical documentation data in the EHR. The PACE system-input data included date/time of start and completion of clinical notes. The home care system-input data included date/time the nurse completed ("attached") the note. User-input home care data included date/time of nurse departure from the patient home.

Nurse satisfaction. The impact of EHR use on nurse satisfaction with clinical process was assessed using the EHR Nurse Satisfaction (EHRNS) survey.¹⁵ The EHRNS instrument includes dimensions of patient, workflow, and organizational outcomes.¹¹ Each item has a six-point Likert-type response indicating the magnitude of agreement or disagreement. The open-ended question at the end of the survey asks respondents what worked well or what were their concerns with the EHR. Respondents were asked about their demographics and experience with computers. The survey administered at the PACE site had 21 items. The survey administered at the home care site had an additional item asking about functionality. The survey was administered post-implementation two times, six months apart at both sites.

Nurses were observed during a patient visit to see what information the nurse recorded and where in the EHR the nurse recorded. Nurses were selected by work sampling¹⁶ to cover each role (i.e., LPN, RN, NP at the PACE site) and each team. Nurses were observed until saturation; that is, observations offered no new information, or a functionality was seen at least three times.^{17,18} (personal communication, 2007) Nurses were observed immediately prior to survey administration.

Following observation and survey administration, semi-structured interviews were conducted (PS) with nurses to elicit information about their areas of concern or satisfaction with the EHR. Interviews were conducted until saturation. Content analysis of interview responses entailed use of the HITREF as a start list. The coding framework was not limited to the HITREF so other categories could be derived from the data. Coding categories and themes were developed for the data through a process of constant comparative analysis, a technique in which the

lead researcher (PS) simultaneously collected information through interviews, and two authors (PS, KB) read interviews as individual cases and disassembled interviews through coding categories.¹⁹ These authors mapped the coded themes to the HITREF, creating a conceptualization that encompassed the experiences of all subjects.

Results

Reported here are final results from the completed study at the PACE site. Also reported are preliminary findings from the on-going study at the home health agency.

Documentation Time-to-Completion. In the observation week of the first 6 month PACE post-implementation time period, nurses created approximately 215 clinical notes for the 338 patients. Nurses created 331 notes in the observation week of the second 6 month time period. Median time for note completion was 0 days for the skewed distribution of times in both study periods. The range of days to completion decreased from 271 days in the first period to 90 days in the second period. Quantitative analysis of EHR data and survey responses (below) and qualitative analysis of observations and interviews suggest that every nurse who provided and documented patient care used the EHR during both time periods, and that EHR usage increased between time periods.

Home care nurses documented 12,603 notes in the 16 month pre-implementation period and 37,187 notes in the 7 month post-implementation period. Pre-implementation, median elapsed time for note documentation ranged from 12 to 18 days which exceeded the compliance guideline of 7 days. Post-implementation, median elapsed time dropped to under 1 day, which met the compliance requirement of 1 day. Nurses in the post implementation period were 15.4 (95% confidence interval: 14.6, 16.2) times more likely to be in compliance in comparison to nurses in the pre implementation period. Completion of documentation was required for billing, and every nurse used the EHR to document care.

Nurse Satisfaction. Thirty-seven PACE clinicians (95% of eligible clinicians including therapists and physicians) completed the first administration of the survey, and 32 clinicians (82%) completed both surveys. The average survey respondent was an experienced, middle-aged, female nurse with prior EHR experience and average computer skills. The reported results indicated satisfaction with the EHR. Overall, clinicians were satisfied with the impact of the EHR on the clinical process. They were not satisfied with Usability (“The patient health record is user friendly”) or Clinician Involvement in EHR Selection, Development or Training (“People who use the patient health record should have had more to say about its design”).

At the PACE site, the lead author observed 11 nurses (42%) during 8 visits to the EHR site over the course of 6 weeks during the first study time period. During the second time period, 8 nurses (33%) were observed during 5 visits over the course of 2.5 weeks. The same roles were observed during both time periods. Observations of PACE nurses revealed that they infrequently consulted the EHR before the visit. Most nurses were familiar with the members they saw. The researcher did not observe any nurse referring to the EHR during episodic care as a memory prompt or to simultaneously record information. Seventeen months after implementation, there was an increase in the number of nurses observed using the EHR and accessing patient information from previous visits as compared to six months earlier. Nurse communication solely via EHR was not observed. Two PACE nurse practitioners participated in followup interviews after the first and second survey administrations. Their responses were mostly negative (96%). Participants reported they used some functionalities less or omitted functionalities because they were cumbersome, did not support workflow, or impacted efficiency (slowed them down). Observed and reported barriers to EHR use included: (1) usability issues finding/documenting information due to silos of data and difficulty navigating the EHR; (2) usability issues which decreased the completeness of patient information; (3) lack of interoperability which decreased the completeness/correctness of data from external services; (4) decreased efficiency due to manual annotation, increase in time required to document, and too many screen changes and delayed response time that slowed workflow; and (5) placement of the computer. Work-arounds included making notes on paper, which created a time lag before the information was available to other clinicians, and cutting and pasting EHR notes forward.

In the home care study, surveys were completed by 59 of the 137 clinicians (43% of eligible clinicians including therapists and social workers). The average home care agency respondent was similar in demographics and prior experience to the average PACE site respondent, although the home care respondent lacked prior EHR experience. Home care respondents were satisfied with the EHR overall, but they were not satisfied with Clinician involvement, Unintended consequences (“...problems with the EHR interfere with patient care”), or Costs of computers (“Part of the increase in costs of healthcare is because of computers”).

Four home care nurses were observed (4%) and interviewed during 15 home care visits over 5 weeks. Nurses were observed documenting in the EHR during the visit. Some nurses also made notes on paper. Nurses began entering start-of-care (admission) information in the EHR and wrote the balance of the documentation on

paper for subsequent entry later. Some nurses were familiar with the patients they saw, even though another nurse might have seen the patient during the preceding visit. EHR characteristics that supported the clinical process were observed and reported. For example, as nurses documented, the format of the documentation template (i.e., “tree”) provided a memory prompt for clinical data collection and documentation of patient education provided. Nurses who provided care alone in the patient home communicated via the EHR with clinicians on their team. Nurses were observed referring to clinical data from previous visits by viewing a display window within the documentation screen or by navigating to the documentation of a prior visit. Nurses who referred to previous clinical information documented by another clinician sometimes asked the patient about the issue. Observed and reported barriers to use included: (1) hardware issues such as inadequate laptop battery power; (2) usability issues including slow screen changes, difficulty logging on, and needed clinical information (e.g., care plan) not displayed in the documentation window; (3) lack of interoperability which decreased completeness/correctness of data from external sources; (4) reduced efficiency due to time required to document, usability, and support issues resulting in nurses spending up to two hours at home documenting; and (5) the need for technical support in the field and improved training. Notably, only one nurse commented on impact of EHR on patient outcomes and was noncommittal: “I don’t know what kind of difference it has made on outcomes.”

Mixed Methods Analysis. Six themes, or characteristics of the EHR, emerged from mixed methods analysis of the PACE findings: (1) functionality that did not match the workflow; (2) cumbersome usability; (3) lack of complete/correct and timely data; (4) reduced efficiency; (5) lack of impact on team communication; and (6) dissatisfaction with EHR. There were six themes in the home care finding. Four of the PACE themes were also in the analysis of home care findings: (1) needed functionality, such as interoperability among referring hospitals; (2) cumbersome usability and navigation; (3) complete and correct data; and (4) reduced efficiency. The last two themes from the home care analysis were new: (5) appropriateness of care including access to other disciplines’ notes (not team communication) and (6) technical support and training.

Discussion

In this paper, we present the first known evaluation of EHRs in a PACE and in home care for informaticians seeking to assess how the EHR potentially achieves its effect on the clinical process and ultimately on patient outcomes. In terms of limitations, given small sample size, lack of comparison groups, these studies should be considered exploratory. Also, the few nurses who were interviewed may not represent the perspectives of other nurses. Additionally, the home care component is still in progress. At both sites, EHRs adequately supported aspects of the clinical process, including documentation. Nurse adoption of EHRs for documenting notes was wide and universal. At both sites following EHR implementation, documentation time-to-completion was reduced. At both sites, EHR functionality was cumbersome to use or did not support the clinical workflow. At the PACE site, where EHR use was not required for reimbursement, nurses did not use the EHR as intended. At both sites, functionality and workflow mismatch introduced inefficiency. At the PACE site, this mismatch was a barrier to clinician access to the EHR during patient visits. Diminished efficiency was reflected at the PACE site in incomplete documentation and untimely input of notes. Home care nurses who documented during the visit were dissatisfied with the time required to document and with functionality and navigation that did not match their workflow. These nurses were satisfied with the structure of the notes template and with their ability to access other clinicians’ notes. Home care nurses reported reduced efficiency due to lengthy documentation that they completed on their own time. Also, efficiency was decreased due to technical issues that delayed nurses being able to document. These issues arose in the field where support was limited due to lack of Internet connectivity or physical availability of technicians.

Nurses from both studies did not comment about whether the EHR had any impact on patient outcomes. Nurse satisfaction with EHR impact on patient outcome is a facilitator to nurse EHR adoption. If nurses do not see the value in EHR for patients, they are less likely to use it.²⁰ Therefore, it is important that researchers analyze EHR impact on patient outcomes and bring this evidence to nurses and EHR implementation decision-makers. Future work will assess the impact of home care nurse use of EHRs on patient outcome and integrate these findings with our home care time-to-completion and nurse satisfaction findings.

Matching system functionality and usability to workflow, while complex,^{4,6} is necessary to achieve the promise of EHR in improving the safety, quality, and efficiency of patient care.²¹ Attaining this promise also involves improving timeliness and access to clinical information²² and communication among clinicians and across time.⁵ Nurses at both community health care sites were less than satisfied with these EHR characteristics.

Conclusion

We suggest that community health care sites that are planning to deploy an EHR consider assessing the EHR’s functionality and usability in regard to the site’s workflow before and during the implementation. The goal is that

the nurses use EHR as intended, realizing its benefit as a memory aid for timely and appropriate patient care interventions. Additionally, EHRs in community settings should be interoperable to improve nurse access to patient data from off-site services (e.g., lab) or care (e.g., emergency department visit or hospital referral). Lastly, nurses should see the value of the EHR for patients to facilitate nurse adoption.

Acknowledgement

NLM Informatics Training Grant T15LM07452, Robert Wood Johnson Foundation Public Health Informatics Training Grant, The Johns Hopkins University School of Medicine.

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