# Rapid Implementation of Inpatient Electronic Physician Documentation at an Academic Hospital

J.S. Hahn[1,2,3]; J.A. Bernstein[2]; R.B. McKenzie[2]; B.J. King[3]; C.A. Longhurst[2,3]

[1]Department of Neurology, Stanford University School of Medicine, Stanford, CA, USA; [2]Department of Pediatrics, Stanford University School of Medicine, Stanford, CA, USA; [3]Information Services, Lucile Packard Children's Hospital, Palo Alto, CA, USA

## Summary

Electronic physician documentation is an essential element of a complete electronic medical record (EMR). At Lucile Packard Children's Hospital, a teaching hospital affiliated with Stanford University, we implemented an inpatient electronic documentation system for physicians over a 12-month period. Using an EMR-based free-text editor coupled with automated import of system data elements, we were able to achieve voluntary, widespread adoption of the electronic documentation process. When given the choice between electronic versus dictated report creation, the vast majority of users preferred the electronic method. In addition to increasing the legibility and accessibility of clinical notes, we also decreased the volume of dictated notes and scanning of handwritten notes, which provides the opportunity for cost savings to the institution.

**Correspondence to:**
Jin S. Hahn, MD
750 Welch Road, Suite 317
Palo Alto, CA 94305, USA
Phone 650.723.6841, Fax 650.723.7299
Email: jhahn@stanford.edu

# 1. Background

Electronic Medical Records (EMRs) have been widely implemented in the past decade[1, 2]. A primary emphasis of EMR deployments has been on improving patient safety by employing computerized physician order entry (CPOE) and clinical decision support systems (CDSS). While there have been many reports on the benefits of CPOE and CDSS, [3, 4] there have been fewer reports on the impact of electronic physician documentation. However, barriers to adoption such as disruption of the physician's workflow and perceived increased time required to document have been noted [1, 5]. Additionally, unintended consequences of conversion to electronic notes have been documented [6, 7]. This report describes the implementation of inpatient physician documentation at an academic pediatric and obstetric hospital and how we addressed these challenges.

This work was conducted at Lucile Packard Children's Hospital (LPCH) at Stanford University Medical Center (SUMC). LPCH serves as the major teaching hospital for pediatric and obstetric care for SUMC. In 2010, LPCH had 303 beds (of which 118 are intensive care beds and 52 are obstetrics beds), and 12,898 discharges and 4,575 births. LPCH has 1,051 attending physicians on the medical staff. At SUMC there are approximately 1,065 residents and fellows (81 pediatric residents, 84 pediatrics fellows, and 25 obstetric residents).

In 2007 a clinical transformation program was implemented at LPCH, which included CPOE and electronic documentation by nurses and support personnel [4]. Electronic physician notes were not implemented at that time. However, without physician notes available in the EMR, the medical record was fragmented as these notes were not readily available to all of the caregivers. Workflow was also fragmented as physicians entered orders and reviewed nursing notes electronically, but still dictated or handwrote their own notes. Therefore, in 2010 an electronic inpatient clinical documentation project was undertaken.

# 2. Case Report

The implementation team consisted of two analysts, a physician lead, a clinical informatics fellow, a programmer, and a project manager. The project was overseen by a steering committee consisting of the Chief Medical Officer, Chief of Surgery, Chief Medical Information Officer, Director of IS Operations, Director or Health Information Services, Director of Professional Services Billing Integrity, and Director of Professional Revenue Cycle. The project was formally initiated in January 2010.

Our primary goal was to convert paper-based inpatient documentation to an electronic form for all physicians, mid-level providers, and medical students. Our desired outcomes included improving access to all inpatient documents, improving compliance of documentation requirements for quality, safety and billing purposes. Other expected benefits for the organization included cost savings for transcription of dictated notes and reduced costs of scanning paper-based notes.

Our EMR vendor at the time of this work (Cerner Corporation, Kansas City, MO) offered two applications for electronic note entry, Clinical Note Editor and PowerNote. PowerNote, the vendor preferred tool, is a structured note-entry application in which encoded clickable elements are used to create the note. Although free-text entry is possible, it relies less on narrative free-text documentation. The Clinical Note Editor is an older tool that uses a text editor similar to word-processing software. Both applications enable importing of other clinical data from the EMR. Despite the apparent ease of documentation using PowerNote, data from the University of Washington indicated that it took substantially more time for end-users to enter notes with PowerNote when compared to the Clinical Note Editor [5]. Furthermore, experiences at the Boston Children's Hospital (personal communication, Dr. Marvin Harper, 2010) and D.C. National Children's Hospital (personal communication, Dr. Brian Jacobs, 2010) indicated that it took at least twice the time for the Information Technology Department to build, customize, and maintain templates for PowerNote. Based on these data and the experience of others [5, 6, 8], we decided to implement all inpatient notes using the Clinical Note Editor.

Rolling go-lives for inpatient services occurred once every 2 to 4 weeks and were completed within 12 months (June 2010 to June 2011). For each service we developed several specialized templates for History and Physical (Admission Note), Progress Note, Discharge Summary, Consult Note, In-

terim Summaries, and various Procedure Notes. When a note is generated, the electronic template includes an outline of the note (*i.e.*, headings such as History, Physical Exam, Assessment, and Plan) where free text can be entered (▶Figure 1). The electronic templates automatically import pertinent data elements from the EMR (e.g., medication orders, allergies, vital signs, weights, input & output, laboratories, microbiology, and a list of radiology tests). Each specialty service participated in the design of the note layout and selection of the system data elements to be automatically included. For each service we created a set of templates that were specifically designed for the service, but were not disease-specific. For a few services, additional disease-specific templates (e.g., ones for diabetes or heart failure) were developed. We employed a standardized, modular approach to these system data elements, so that they could be used by multiple specialties. This facilitated rapid development cycles and led to a more consistent format to the notes of various specialties.

To facilitate the creation of new notes, a one-step process was developed. The user clicks on the "Add Document" button and then selects the desired note type, which is associated to a specific template. Because the template auto-populates the patient-specific data (Figure 1), the note itself allows users to review the recent vital signs data, biometric measurements, and laboratory results without having to look up each item. System-wide macros were created that allowed users to enter a shortcut that would populate the note with additional system data elements or text. Examples include medications, laboratories, and teaching physician attestations. Users also had the ability to create and save their own personalized macros that could be brought into the notes.

Although we provided electronic templates for all inpatient note types, we did not eliminate the ability for physicians to dictate notes (e.g., Admission Notes, Discharge Summaries, and Consult Notes which were primarily dictated before the rollout). Dictated notes continued to be uploaded via a transcription interface to the EMR and were available in the same location as the electronic (typed) notes.

Provider training was provided both in the classroom and web-based tutorials. The vast majority of the users opted for the 45 to 60-minute classroom training. For each service go-live, 2 to 3 project team members provided hands-on user support for one to two weeks.

We deployed various mobile devices including 48 large laptops (with 17-inch monitors) on carts and 90 small notebooks (with 12-inch monitors) to complement the existing desktop workstations in the hospital.

Time-motion analysis was performed before and after the rollout. We followed providers at all levels and measured the time required to handwrite or create electronic notes, focusing on progress notes.

In addition, online questionnaire surveys of providers were performed before the implementation (June 2010) and after the completion of the rolling go-lives (June and July 2011). All medical staff and residents were invited to participate. The questions related to their current practices and preferences for documentation methods.

## 3. Results

The rollout involving 46 inpatient services (31 medical and 15 surgical) was completed in 12 months. A total of 254 specialized note templates were created for these services. In addition, 181 system-wide auto-text shortcut macros were created that brought in vitals, intake and output, medications, laboratories, and teaching physician attestations. As a result of this effort and the previous CPOE and nursing documentation implementation [4], the entire hospital is now considered to be level 6 on the HIMSS EMR Adoption Model [9]. Level 6 means that a hospital is essentially paperless with electronic physician and nursing documentation, full clinical decision support, computerized provider order entry, and full picture archiving and communications systems.

We initially launched electronic documentation on the inpatient general pediatrics (hospitalist) and neurology services. The rolling go-live strategy provided an opportunity to learn from the workflow on those services, and optimize the templates to improve the physician documentation workflow. We then continued with other pediatric specialties, followed by surgical specialties. The surgical specialties presented additional challenges since those services tend to make quick rounds on a large number of patients, and to write shorter notes. The early experiences were crucial for expansion of

the roll out into critical care units, where the documentation requirements are more complex. For example, the simple medication list that we created for the earlier services needed to be modified to include continuous infusions with the latest dosages. The obstetric service was the last service to go live because of the need to incorporate the documentation requirements of the American Congress of Obstetrics and Gynecology [10].

After the completion of the rollout, physicians and non-physician providers (nurse practitioners and physician assistants) entered an average of 4,205 electronic notes per week. Approximately 40% were entered by residents, 17% by fellows, 25% by attending physicians, and 19% by non-physician providers. Although users had a choice, 73.5% of admission notes and 82% of consults notes were completed electronically rather than being dictated (▶Table 1). The vast majority of discharge summaries (96.5%) were completed electronically. The bulk of the electronic notes were inpatient progress notes (approximately three-quarters), which are no longer being scanned into the EMR.

When the pre- and post-rollout periods were compared, the number of transcribed characters decreased by 88% and the cost of transcriptions decreased by 91% (▶Table 2). The number of inpatient paper documents scanned into the EMR also decreased by 63%.

Our time and motion data showed that the mean time required for a provider to complete a progress note on acute care units did not significantly increase from pre- to post-implementation (10.1 to 12.1 minutes, $p = 0.21$) (n = 33 handwritten notes pre-rollout vs. 49 electronic notes post-rollout). In the intensive care units (ICUs) the mean time increased from 9.0 to 19.3 minutes ($p = 0.0013$) (n = 25 handwritten notes pre-rollout vs. 37 electronic notes post-rollout) (▶Table 3).

The observation of the physicians during the time and motion study revealed that the documentation was well integrated with their workflow. Residents and fellows typically started their progress notes during morning pre-rounds while they performed a chart review. The notes get updated during morning rounds and the Assessment and Plan sections would be completed after rounds. The attending physicians typically modified the resident/fellow notes in the afternoon by adding the teaching physician attestations with a macro and electronically cosigned the notes.

The online survey was completed by 106 providers (47 residents, 21 fellows, and 38 attendings) before implementation and 101 providers (42 residents, 18 fellows, 41 attendings) after implementation. After implementation most responders favored electronic documentation for notes of all types, including Admission/Consult Notes, Progress Notes, and Discharge Summary. (See detailed results in ▶Table 4).

# 4. Discussion

At LPCH, we implemented an electronic documentation system for physicians for the inpatient services over a 12-month period. This continuous rollout followed a multiyear project that included CPOE and electronic documentation by nursing and support staff. Our data show that we were able to reduce the number of dictated notes and scanned handwritten notes. Although it is not feasible to calculate a specific return on investment because of the challenge of quantifying all costs associated with EMR implementation, it is clear that organizational costs outside of Information Services did decrease as a result of this project. These included a 91% reduction of transcription costs for inpatient documentation. The savings in document imaging was more difficult to quantify due to a fixed contractual cost.

Rosenbloom et al. [11] have identified four factors that influenced satisfaction with clinical documentation tools: time efficiency, availability/accessibility, expressivity, and quality. During the implementation we addressed these factors and other previously described unintended consequences of electronic documentation [5–7, 12–15].

## 4.1 Time efficiency

One of the main barriers of electronic documentation is the perceived time required to enter notes [1, 5]. Although we saw a slight increase in the time required to document acute care notes, this was not statistically significant. Survey data indicated that the templates probably helped users save time when reviewing the chart before rounds and reduced the time required in re-transcribing the data

into their notes. However in the ICUs, we saw a significant increase in the time required. It is possible that the time measured for handwritten notes was underestimated since it did not include the time required to review the chart for data. In the ICUs, the complex systems-based templates created documents that were often long and difficult to navigate and edit during rounds.

Despite the negative impact of electronic documentation on the time required for clinical note creation in some units (such as ICUs), we were able to achieve widespread adoption of the electronic documentation process. This may have been due to other aspects of the tool that increased user efficiency. The post-implementation survey revealed that 82% of providers thought that electronic documentation was the most efficient method of creating progress notes. For admission notes and discharge summaries, where the user had the choice between electronic versus dictated report, most users chose the electronic method.

## 4.2 Availability/Accessibility

Accessibility has three components: ability to use the documentation method immediately during or after patient interactions; ability to access other documents for review before generating a new note; and integration of methods with other sources of information relevant to documentation [11]. All of these components also have an impact on time efficiency.

Our deployment of notebook computers and laptops on carts allowed our users to document close to the patient bedside. Providers often used these devices during walk rounds, which allowed them to integrate the documentation process into their workflow.

The immediate availability of the electronic notes once submitted was superior to the usual delay experienced with dictated/transcribed documents. Accessibility was also enhanced because the notes were available to all users from anywhere in the hospital.

The third component of integrating other data was made possible by our templates. The auto-population feature allows users to review the recent vital signs data, measurements, and laboratories as they create the note without having to look up each item in different sections of the EMR.

Because of the large number of electronic notes that are being created in the EMR, it can be more difficult to find a note of interest compared to the paper chart. This is especially true when there are hundreds of different note types [16]. We addressed this problem by utilizing a simplified folder structure for the inpatient notes (e.g. Admission Notes, Progress Note, Discharge Summary, and Consult Note) that combined various specialty notes. For example the Consult Note folder contains the electronic or dictated/transcribed notes for all of the specialty services that are consulting on the patient. The specialty name is readily visible in the document-viewing tool because the specialty name is included in the index, thus facilitating finding a particular note of interest (▶Figure 2). We also implemented a semantic search tool, which allowed users to search throughout a patient's clinical documents using a Google-like search function. This search tool utilizes semantic technology, so that it can understand the contextual use of each indexed clinical concept, and can intelligently match and rank the documents so that that the most important and useful documents will move to the top of the result list.

## 4.3 Expressivity

Expressivity is defined as the narrative character of the text in clinical documents [11]. The decision to use a more free-form text editor (Clinical Note Editor), rather than a structured documentation tool (PowerNote) allowed users to express themselves more freely in the narrative sections. Recent studies have suggested that on balance, the needs of facilitating communication with narrative sections may outweigh the benefits of collecting discrete data [8, 17]. The disadvantage of choosing the free-form text editor is the inability to collect discrete data for reuse and analysis. We addressed this concern in two ways. First, we implemented the semantic search tool, which utilizes *post hoc* natural language processing (NLP) to index concepts and generate discrete data from the narrative notes. However, current NLP systems are limited in precision and recall and have not yet been widely adopted in EMRs [8]. Secondly, a few specialties, where discrete data collection was important, chose to implement structured forms in addition to the narrative notes templates.

## 4.4 Quality

Technical quality involves a document's legibility, accuracy, thoroughness, and compliance with administrative documentation standards [11]. We did not directly study the effects of electronic documentation on technical quality. By using standardized templates that had headings with prompts for the required elements of a clinical document, we provided a structure that would allow providers to create more complete and legible documentation. We were also able to integrate documentation on required quality indicators of patient care (e.g. addressing the need for central lines each day or use of physical restraints) by using smart templates that pulled in those elements when appropriate. Changes in documentation compliance are being studied currently.

## 4.5 Mitigating the Copy and Paste Problem

The copy and paste function (CPF) available in EMRs may negatively impact the quality of clinical notes. CPF makes it easy to copy a note from one day to the next, leading to much redundancy in the narrative content of the notes [13, 14]. This makes it difficult to find new developments about the patient and may result in the propagation of outdated or erroneous information [13, 18]. Our multiprong approach included use of templates, scripts, and education in partnership with the medical staff HIMS committee.

Since our templates contain an admixture of free-text fields and system data (that changes constantly), the structure of our templates discouraged copying of entire note from one day to next since the system data would be outdated.

Realizing that providers frequently use CPF despite the pitfalls [12], we developed a copy-forward function (CFF) that brought forward only the Assessment & Plan (A&P) section from the previous day. Using scripts developed at the Children's Hospital of Los Angeles (personal communication, Dr. Sajjad Yacoob, 2010) we developed a customized A&P expandable box with CFF. When a new progress note is created, the A&P from the previous day's note is automatically copied into current note, but data outside the A&P box is not. Users are reminded to update, modify, and verify the contents have before signing a note. Although we did not explicitly quantify the impact, project leaders (BK, RM, JH) anecdotally witnessed a substantial decrease in manual copy/paste outside the copy-forward A&P box when they were introduced.

## 4.6 Finding relevant information in a note

Another frequent criticism of EMR-based physician documentation is that it is difficult to find relevant information in the voluminous notes [18]. This is in part due to the large amount of system data that is being brought into a note that pushes the crucial A&P section to the bottom of the note. The A&P box in our templates highlights the most valuable aspect of the note, the synthesis or medical decision making section [19], and makes it easier to find the important narrative information. We also chose to put this at the top of most daily progress and consult follow-up notes, reversing the traditional SOAP format [20] to create an "APSO" format. This allowed the user to review the A&P section without having to scroll to the bottom of the note and also facilitated the perusal of multiple notes. We believe this is the first published implementation of this inverted approach, which made reviewing of the notes easier.

## 5. Conclusion

In summary, we implemented an inpatient electronic documentation system for physicians and mid-level providers at an academic pediatric and obstetric hospital over a 12-month period to augment an existing CPOE and EMR. The free-form text editor chosen for the platform permitted more expressivity. This documentation tool fit well within physician workflow and while the time required to document was increased for complex notes, it provided other efficiencies in chart review. After the implementation, it became the preferred method of documentation and reduced the number of dictated notes and scanned handwritten notes. The adoption of online documentation was also facili-

tated by the availability of all physician notes in the EMR, which led to a reduction in the fragmentation of workflow for physicians and hospital personnel.

# 6. Clinical Relevance

Rapid implementation and adoption of electronic inpatient documentation is possible when the design and deployment of the documentation system fits within the workflow of the physician. Despite the increased time required using electronic documentation method, other time efficiencies gained by the users in a comprehensive EMR seem to offset this barrier. The choice of a free-form text editor and an APSO-format for our notes not only allowed for a reduced deployment time throughout the hospital, but also allowed for more expressivity and easier perusal of electronic notes.

**Conflict of Interests**
The authors declare that we have no conflicts of interest in the research.

**Human Subjects Protection**
The Stanford Institutional Review Board approved this project as being compliant with the institutional standards for research involving humans.

**Fig. 1** Example of an Admission Note template using Clinical Note Editor created by a user before free-text entry. The left and right screens are continuous. When a note is created, available system data is automatically retrieved (such as the problem list, medications, allergies, vital signs, growth parameters, labs, and radiology results) and displayed in blue characters. The major headings are highlighted in bold and the underscores indicates 'tab' stops where the user can easily navigate to and add free-text (displayed in plain black font). Additional system or personal macros can be inserted anywhere in the document.
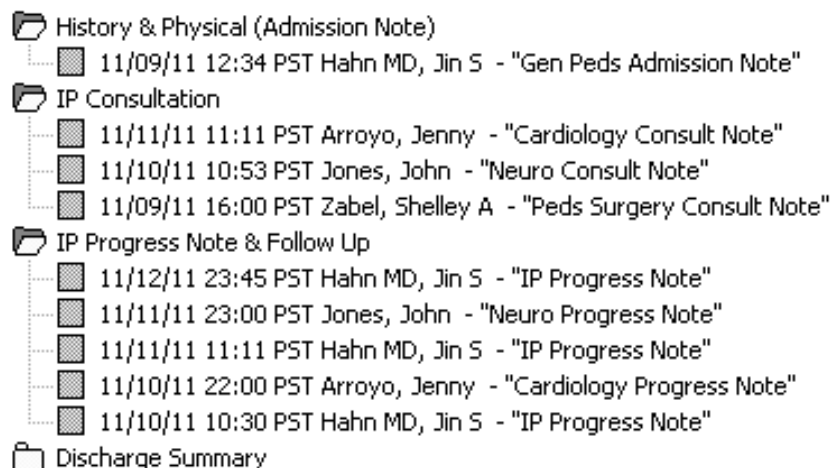


**Fig. 2** Example of folder structure for notes.

**Table 1** Number of electronic and dictated inpatient documents by document type after completion of rollout (one month period).

| Document Type | Electronic (%) | Dictated (%) | Total |
|---|---|---|---|
| History & Physical (Admission Note) | 1,008 (73.5%) | 363 (26.5%) | 1,371 |
| Consultation | 623 (82%) | 137 (12%) | 760 |
| Progress Notes | 11,177 (100%) | 0 (0%) | 11,177 |
| Discharge Summary | 1,925 (96.5%) | 70 (3.5%) | 1,995 |
| Other Miscellaneous | 1,477 (97.5%) | 38 (2.5%) | 1,515 |
| Total | 14,733 (96.3%) | 570 (3.7%) | 15,303 |

**Table 2** Impact of electronic documentation on inpatient transcriptions and document imaging before rollout (June to August 2010) compared to after completion of rollout (June to August 2011).

| | Pre Rollout* | Post Rollout Completion* | Change |
|---|---|---|---|
| Transcribed Characters (million) | 31.0 | 3.7 | −88% |
| Transcription Costs (thousand) | $98.4 | $9.3 | −91% |
| Scanned Documents** | 2,447 | 909 | −63% |

*numbers represent average monthly values.
**number of History & Physical and Progress Notes scanned. Each scanned document contains multiple pages. Document count includes some outpatient History & Physicals, progress notes, and non-physician notes. Cost per document was not available due to fixed contractual costs.

**Table 3** Time-motion analysis of time required to complete an inpatient progress note before rollout (handwritten) versus after rollout (electronic)

| Location | Handwritten | | Electronic | | P* |
|---|---|---|---|---|---|
| | Mean time required (min) | N | Mean time required (min) | N | |
| Acute Care | 10.1 | 33 | 12.1 | 49 | 0.21 |
| Intensive Care | 9.0 | 25 | 19.3 | 37 | 0.0013 |

*P values determined by unpaired t-test.

Table 4 Pre and Post Implementation Questionnaire Results.

| Question | Choices | Pre-implementation N (%) | Post-implementation N (%) |
|---|---|---|---|
| What is the most efficient method to create Admission and/or Consult Notes? | Handwritten | 14 (14) | 5 (5) |
| | Dictated | 72 (71) | 29 (31) |
| | Electronic | 5 (15) | 59 (63) |
| What is the most efficient method to create daily Progress Notes? | Handwritten | 61 (61) | 14 (14) |
| | Dictated | 9 (9) | 4 (4) |
| | Electronic | 30 (30) | 80 (92) |
| What is the most efficient method to create Discharge Summaries? | Handwritten | 14 (15) | 1 (1) |
| | Dictated | 72 (75) | 14 (15) |
| | Electronic | 10 (10) | 77 (84) |

# References

1. Ash JS, Bates DW. Factors and forces affecting EHR system adoption: report of a 2004 ACMI discussion. J Am Med Inform Assoc 2005; 12(1): 8–12.
2. Jha AK, DesRoches CM, Kralovec PD, Joshi MS. A progress report on electronic health records in U.S. hospitals. Health Aff (Millwood) 2010; 29(10): 1951–1957.
3. Buntin MB, Burke MF, Hoaglin MC, Blumenthal D. The benefits of health information technology: a review of the recent literature shows predominantly positive results. Health Aff (Millwood) 2011; 30(3): 464–471.
4. Longhurst CA, Parast L, Sandborg CI, Widen E, Sullivan J, Hahn JS, et al. Decrease in hospital-wide mortality rate after implementation of a commercially sold computerized physician order entry system. Pediatrics 2010; 126(1): 14–21.
5. Payne TH, tenBroek AE, Fletcher GS, Labuguen MC. Transition from paper to electronic inpatient physician notes. J Am Med Inform Assoc 2010; 17(1): 108–111.
6. Ash JS, Berg M, Coiera E. Some unintended consequences of information technology in health care: the nature of patient care information system-related errors. J Am Med Inform Assoc 2004; 11(2): 104–112.
7. Embi PJ, Yackel TR, Logan JR, Bowen JL, Cooney TG, Gorman PN. Impacts of computerized physician documentation in a teaching hospital: perceptions of faculty and resident physicians. J Am Med Inform Assoc 2004; 11(4): 300–309.
8. Rosenbloom ST, Denny JC, Xu H, Lorenzi N, Stead WW, Johnson KB. Data from clinical notes: a perspective on the tension between structure and flexible documentation. J Am Med Inform Assoc 2011; 18(2): 181–186.
9. EMR Adoption Model. HIMSS Analytics; 2012 [cited 2012 January 20]; Available from: www.himssanalytics.org/hc_providers/emr_adoption.asp.
10. McCoy MJ, Diamond AM, Strunk AL. Special requirements of electronic medical record systems in obstetrics and gynecology. Obstet Gynecol 2010; 116(1): 140–143.
11. Rosenbloom ST, Crow AN, Blackford JU, Johnson KB. Cognitive factors influencing perceptions of clinical documentation tools. J Biomed Inform 2007; 40(2): 106–113.
12. O'Donnell HC, Kaushal R, Barron Y, Callahan MA, Adelman RD, Siegler EL. Physicians' attitudes towards copy and pasting in electronic note writing. J Gen Intern Med 2009; 24(1): 63–68.
13. Hirschtick RE. A piece of my mind. Copy-and-paste. JAMA 2006; 295(20): 2335–2336.
14. Wrenn JO, Stein DM, Bakken S, Stetson PD. Quantifying clinical narrative redundancy in an electronic health record. J Am Med Inform Assoc 2010; 17(1): 49–53.
15. Bernstam EV, Hersh WR, Sim I, Eichmann D, Silverstein JC, Smith JW, et al. Unintended consequences of health information technology: a need for biomedical informatics. J Biomed Inform 2010; 43(5): 828–830.
16. Payne TH, Kalus R, Zehner J. Evolution and use of a note classification scheme in an electronic medical record. AMIA Annu Symp Proc 2005: 599–603.
17. Rosenbloom ST, Stead WW, Denny JC, Giuse D, Lorenzi NM, Brown SH, et al. Generating Clinical Notes for Electronic Health Record Systems. Appl Clin Inform 2010; 1(3): 232–243.
18. Hartzband P, Groopman J. Off the record – avoiding the pitfalls of going electronic. N Engl J Med 2008; 358(16): 1656–1658.
19. Feblowitz JC, Wright A, Singh H, Samal L, Sittig DF. Summarization of clinical information: a conceptual model. J Biomed Inform 2011; 44(4): 688–699.
20. Weed LL. Medical records that guide and teach. N Engl J Med 1968; 278(11): 593–600.