Impacts of Computerized Physician Documentation in a Teaching Hospital: Perceptions of Faculty and Resident Physicians

PETER J. EMBI, MD, MS, THOMAS R. YACKEL, MD, MS, MPH, JUDITH R. LOGAN, MD, MS, JUDITH L. BOWEN, MD, THOMAS G. COONEY, MD, PAUL N. GORMAN, MD

Abstract Objective: Computerized physician documentation (CPD) has been implemented throughout the nation’s Veterans Affairs Medical Centers (VAMCs) and is likely to increasingly replace handwritten documentation in other institutions. The use of this technology may affect educational and clinical activities, yet little has been reported in this regard. The authors conducted a qualitative study to determine the perceived impacts of CPD among faculty and housestaff in a VAMC.

Design: A cross-sectional study was conducted using semistructured interviews with faculty (n = 10) and a group interview with residents (n = 10) at a VAMC teaching hospital.

Measurements: Content analysis of field notes and taped transcripts were done by two independent reviewers using a grounded theory approach. Findings were validated using member checking and peer debriefing.

Results: Four major themes were identified: (1) improved availability of documentation; (2) changes in work processes and communication; (3) alterations in document structure and content; and (4) mistakes, concerns, and decreased confidence in the data. With a few exceptions, subjects felt documentation was more available, with benefits for education and patient care. Other impacts of CPD were largely seen as detrimental to aspects of clinical practice and education, including documentation quality, workflow, professional communication, and patient care.

Conclusion: CPD is perceived to have substantial positive and negative impacts on clinical and educational activities and environments. Care should be taken when designing, implementing, and using such systems to avoid or minimize any harmful impacts. More research is needed to assess the extent of the impacts identified and to determine the best strategies to effectively deal with them.

and learning of it.\textsuperscript{7} CPD has the potential to improve these activities through better document accessibility, increased legibility, and decreased costs. However, studies of EHR-based documentation effects have yielded mixed results. While some have found that the use of an EHR resulted in “more complete” and “more understandable” documentation when compared with paper-based records,\textsuperscript{8,9} others have noted that EHR-based documentation may promote the completion of such information-intensive tasks at the expense of patient communication.\textsuperscript{10}

In addition, earlier research suggests that a transition from paper to computer-based documentation might have other unintended impacts. Nygren and Henriksson\textsuperscript{11} showed that the format, layout, and other textural features of the paper record are critical to a physician’s ability to search, read, and assess the relevance of information contained therein. Features such as the ability to manually tabulate pertinent data and mark up abnormal findings may be important to the cognitive processing of clinical information and could be lost with CPD. Indeed, more recently conducted research by Patel et al.\textsuperscript{12} found that EHR use was associated with changes in physicians’ cognitive behaviors such as information gathering, organization, and reasoning strategies.

Furthermore, the implementation of new technology into complex social systems often results in unanticipated consequences. Negative effects on clinical practice, organizational culture, and medical education have been documented to result from the transition to other EHR-based technologies, including computerized physician order entry (CPOE).\textsuperscript{13–16} However, unlike other such EHR components, which have undergone substantial evaluation in recent years,\textsuperscript{17–21} relatively little research has been focused on defining the impacts of CPD.

Because of the potential for important effects from the use of CPD, the likelihood that this technology will proliferate, and the paucity of research related to its use in the inpatient setting, we set out to identify the range of clinical and educational impacts that are perceived to have been caused by the transition to CPD in a teaching hospital.

Methods
Given the early stage of knowledge regarding the impacts of CPD, we used qualitative methods to identify a broad range of issues and generate insights based on the data gathered.

Design
We conducted a cross-sectional study of internal medicine faculty and resident physicians. Their perceptions of CPD were gathered through a series of semistructured interviews. Individual interviews were conducted with the faculty, while the residents were interviewed as a group. The appropriate institutional review boards approved the study.

Setting
All interviews took place at the Portland VAMC, a 303-bed facility that serves as a quaternary referral center for the U.S. Department of Veterans Affairs in Oregon, southern Washington, and part of Idaho. This facility is affiliated and directly connected to the Oregon Health & Science University and serves as a training facility for medical students, residents, fellows, and other health-related trainees in most medical and surgical disciplines. As noted above, the system used in this setting is CPRS, a comprehensive EHR developed and implemented in the nation’s VAMCs beginning in the late 1990s. CPRS has been described elsewhere.\textsuperscript{22,23}

Subjects
Subjects were selected to ensure they had experience before and after the implementation of CPD. The faculty physician sample population was drawn from those internists who had worked as either a hospitalist or a subspecialist consultant on the medicine wards for at least two consecutive weeks before and after the implementation of CPD. The resident sample population was drawn from those internal medicine residents who had spent one month on either a general medicine inpatient ward service or a consultation service before and after the implementation of CPD and internal medicine interns (first-year residents) who began using CPD shortly after starting their clinical work at the Portland VAMC. Due to the coincidence of CPD implementation and the start of the intern year, none of the interns had experience with the pre-CPD system.

Selection of Sample Units
For the faculty physician sample, ten physicians were selected from the population defined above using a purposive sampling method to achieve a representative sample that included generalists and subspecialists, men and women, and varied clinical experience (junior as well as senior faculty). The resident physician group sample was chosen using a convenience sampling method. Ten residents who met the criteria noted above and were available to attend a weekday afternoon group interview session were selected to participate.

Data Collection
The principal investigator (PJE) conducted all interviews using a semistructured interview technique. This approach was used to allow the emergence of unanticipated relevant issues and attitudes, while still ensuring consistent coverage of key topics with all subjects. The goal was to elicit each respondent’s views and perceptions in his or her own words and to permit exploration and clarification as necessary. Due largely to issues of convenience, all faculty participants were interviewed individually, while residents were interviewed as a group.

Three pilot interviews were conducted with subjects who fit the inclusion criteria but whose responses were not included in the study. These pilot interviews allowed the interviewer to practice his or her technique and refine the questions. Each study interview began by briefing the subject(s) on the study topic and obtaining informed consent to proceed. Subjects were instructed to focus on the CPD features of CPRS. This was followed by an open-ended question regarding the interviewee’s perceptions of the possible impacts of CPD on clinical care and medical education. Open-ended follow-up questions were asked as needed to delve more deeply into a particular subject area. Only when these techniques yielded little or no response were closed-ended questions used to further explore issues of potential importance as identified during the pilot and prior study interviews.
Field notes were taken during each interview, and interviews were tape-recorded. The audiotapes were transcribed after all interviews were completed.

Data Analysis
Two reviewers (PJ E, TRY) independently analyzed the transcripts. Thirty-one pages of handwritten field notes and 84 pages of single-spaced interview transcriptions were analyzed. A sentence or phrase in the transcriptions served as the unit of analysis for coding purposes. Content analysis was performed using a grounded theory approach to identify emergent themes. Descriptions for each unit of analysis were based on participants’ utterances whenever possible. After their independent analyses, the reviewers entered an iterative process beginning with discussion of their descriptions of the data. This led to agreement regarding broad categorizations that could be directly linked to the raw data. While some data points could be assigned to unique categories, many represented more than one concept and were therefore cross-categorized. Finally, summary interpretations were drawn from the categorizations, and the categorizations were organized into common themes.

Validation
To enhance the validity of our findings, we conducted postanalysis data verification. Member checking was performed by sending participants a summary of the final categorizations, themes, and conclusions via e-mail and asking them to confirm the accuracy of the interpretations. Nine of ten faculty subjects and eight of ten resident subjects responded to the request for feedback regarding the results. All respondents agreed that the coding accurately represented their perceptions. Peer debriefing via presentation of the findings and interpretations to a group of internal medicine faculty physicians was also carried out. The feedback gathered at the peer-debriefing session indicated that the findings and categorizations were appropriate.

Results
Physician subjects’ characteristics are described in Table 1. Individual faculty interviews ranged from 21 to 48 minutes in duration and the resident physician group interview lasted 44 minutes. Participants responded at length with little need for the interviewer to prompt responses via the use of predefined questions.

Review of the data revealed that the phenomenon of saturation was reached after the first four interviews; the final seven interview sessions revealed no new categories beyond those identified during the first four interviews. Initial analysis of the resident and faculty interview data yielded similar categorizations. Thus, a common coding scheme was used for all data. Comparing thematic results between faculty and residents, no differences were found. We have, therefore, combined the data from these groups for this report and have highlighted any distinguishing findings in the sections that follow.

Emergent Themes
Evaluation of the data yielded many categories of specific CPD impacts. From these categories, four major themes emerged that reflect the impacts of CPD on (1) documentation availability, (2) work process, (3) documentation characteristics, and (4) concerns and mistakes.

In the sections that follow, we describe each of these themes, highlight key findings, list the categories of comments captured by each theme, and present representative quotations in Tables 2–5.

Table 1 ■ Descriptive Statistics of the Study Subjects

<table>
<thead>
<tr>
<th></th>
<th>Faculty</th>
<th>Residents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of participants</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>% Female</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>Mean age in yr (range)</td>
<td>46.7 (36–56)</td>
<td>28 (26–30)</td>
</tr>
<tr>
<td>% Subspecialist</td>
<td>50</td>
<td>N/A</td>
</tr>
<tr>
<td>Years at facility (range)</td>
<td>12.7 (3–22)</td>
<td>60% PGY-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30% PGY-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10% PGY-3</td>
</tr>
<tr>
<td>Exposure to CPD in mo (range)</td>
<td>2.25 (1–7)</td>
<td>1.5 (1–2)</td>
</tr>
</tbody>
</table>

CPD = Computerized physician documentation; PGY = postgraduate year.

Theme 1: Documentation Availability
Of all the CPD impacts identified in this study, most participants spontaneously identified those regarding documentation availability as having the most profound effect on their clinical and educational activities. In fact, several subjects were eager to make it clear that the benefits of improved availability far outweighed any of CPD’s negative impacts.

Availability in this context relates to more than simple accessibility. Similar to the description by Connelly et al. of the “availability” of medical knowledge resources, we use the term to describe the broader concept of having access to clinical documentation when and where it is needed as well as having it presented in a way that allows the information to be readily usable.

Subjects reported that both patient care and educational activities were benefited by improvements in availability. Some faculty physicians expressed that improvements in aspects of availability, namely, accessibility and legibility, increased the likelihood that they would review the documentation created by trainees under their supervision. They felt that this enhanced their ability to assess residents’ knowledge while also improving their supervision of and involvement in patient care.

Lack of concern over “finding the chart,” an activity that had previously consumed a great deal of their time, and the ability to review documentation from a variety of locations, relieved some time pressures and encouraged some of the faculty to spend more time teaching. Likewise, some residents felt that the increased accessibility of the chart facilitated documentation tasks. It was also noted that the ability to scroll through the electronic chart to find a clinical document was easier than with the paper record due to improved organization and titling of notes in CPRS.

The major negative impacts noted regarding availability included the lack of documentation accessibility in certain areas (e.g., the patient’s bedside during critical situations such as resuscitation events) and some deterioration in comprehensibility (e.g., resulting from changes to documentation
characters described below, including "poor formatting" and "more clutter").

Comments represented by this theme were assigned the following descriptive categories during the coding process: (1) accessibility (improved and worsened), (2) improved legibility, (3) worsened comprehensibility, and (4) improved chart organization. Representative quotations can be found in Table 2.

**Theme 2: Work Processes and Communication**

All participants commented that using CPRS to create and review physician documentation had significantly changed some aspects of physician workflow. Most noted overall increases in time spent performing documentation tasks, despite the improvements in availability noted above, as well as changes to where, when, and how those tasks were performed.

These work process changes largely related to the need to sit at a computer to complete documentation tasks, and appear to have negatively affected social and professional interactions as a result. In addition to adversely affecting communication between physician team members, many felt that these changes had significantly compromised the manner and extent to which physicians interacted with nurses. Many also related the perception that they spent less time with patients since the transition to CPD. Indeed, most of the noted impacts on work process were negative and reflected a perceived worsening of workflow and the work environment.

Comments represented by this theme were assigned the following descriptive categories during the coding process: (1) less interaction with colleagues, (2) less time with patients, (3) more time documenting, (4) more time in office, (5) documenting at different times, (6) documenting in different locations, and (7) less dictation, more typing. Representative quotations can be found in Table 3.

**Theme 3: Alterations in Document Structure and Content**

Our subjects noted several qualitative and quantitative changes in documentation characteristics, including an increase in document length, redundancy, poor formatting, and more overall "clutter." The use of CPD features, including copy and paste, automated data insertion, and template generation of notes, were at the root of many of these issues. While respondents felt that these "automated" features of CPD were helpful in decreasing the amount of time required to author documents, they also saw them as facilitating some of the negative changes noted above.

Most felt that the increase in document length did not necessarily result in the conveyance of more useful information when compared with paper-based documentation. Many expressed concern that these changes hindered efficient patient care. Faculty lamented that residents often used the "automated" features inappropriately, thereby creating documents that were less useful for educational as well as clinical care purposes.

Comments represented by this theme were assigned the following categories during the coding process: (1) redundancy,

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**Table 2 — Theme 1—Documentation Availability: Representative Quotations**

<table>
<thead>
<tr>
<th>Categories</th>
<th>Quotations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessibility</td>
<td>&quot;It’s also easier for me to document because I don’t have to try to find the chart.”</td>
</tr>
<tr>
<td></td>
<td>“I can even log in from home and sort of review what kind of patients are coming in, what the issues are. If I feel there’s something that needs to be addressed before morning, I can query the housestaff without them even knowing that I’ve actually been looking at their notes. Having a preview is really sometimes helpful.”</td>
</tr>
<tr>
<td></td>
<td>&quot;I’m more likely to read notes now, because of accessibility and legibility, from the peace of my own office. So, I spend more time looking at them now.”</td>
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<tr>
<td></td>
<td>&quot;It’s improved (teaching) rounds a bit for me. I’m not so pushed because I know the period of time I have to do my own documentation goes more quickly than before. It was interesting, I couldn’t figure out what was going on for a while. Then, I realized, I don’t have this sense of time pressure that I used to have, because I don’t have to try and find the charts.”</td>
</tr>
<tr>
<td></td>
<td>&quot;(During critical situations)... there aren’t monitors in every room, so you can look for information (on a computer outside the patient’s room) and relay it back to the room, but it’s not the same as having the chart in the room.”</td>
</tr>
<tr>
<td>Legibility</td>
<td>&quot;Back in the old days, sometimes you couldn’t read people’s handwriting, and at least in the electronic note it’s going to be forced to look a certain way; you will be able to see that an ‘a’ is an ‘a.’”</td>
</tr>
<tr>
<td>Comprehensibility</td>
<td>&quot;The subspecialties, when we come by, we sometimes have trouble figuring out exactly what’s happened. It may all be there, but it’s buried in this huge mass of data.”</td>
</tr>
<tr>
<td>Chart organization</td>
<td>&quot;One clear advantage is organization. It is easy to pick and choose which notes to read.”</td>
</tr>
<tr>
<td>Legibility, accessibility, and chart organization</td>
<td>&quot;The beauty though, is that they’re legible; I can get to a note no matter where I’m at. It’s just fantastic. I can be sitting anywhere, at home, here, and I can pull up the note and see what the team is thinking about that patient, and I’m sure the resident can do the same by looking at the intern’s note; you don’t have to be on the ward; you’re not looking for that chart like you always were before; I can’t even remember how much time we wasted looking for charts and getting frustrated because we couldn’t find them, and lose pieces of paper getting lost, and that just doesn’t happen anymore. It’s all there, and there’s just something so beautiful about it. I love the way it’s all organized on the computer; it’s just so easy to access everything.”</td>
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</tbody>
</table>
Table 3  Theme 2—Work Processes and Communication: Representative Quotations

<table>
<thead>
<tr>
<th>Category</th>
<th>Quotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less interaction with colleagues</td>
<td>“...it's like being in a steno pool where you walk in (to the physician team office) and everybody's typing; there's no actual communication going on, no interaction with anybody else.”</td>
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<tr>
<td></td>
<td>“I definitely notice we spend less time with the nurses (since the transition to CPD)...we're missing that 'by the way' interaction that we had before.”</td>
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<td></td>
<td>“There’s none of the socialization happening at the nurses station where people come and talk to one another.”</td>
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<tr>
<td>Less time with patients</td>
<td>“...and now (the information) is like all gathered and you don’t sit with the patient as much.”</td>
</tr>
<tr>
<td>More time in documenting</td>
<td>“We’re definitely spending more time in the hospital, especially if you’re a bad typist.”</td>
</tr>
<tr>
<td>More time in office</td>
<td>“The immediate thing I notice is that doctors are now confined to their offices for a huge amount of their time...I don’t know if that’s good or bad; it’s just different, and it’s made the wards seem like a different place. There’s a different milieu up there in general.”</td>
</tr>
<tr>
<td>Documenting at different times</td>
<td>“Because you can only do it when you’re sitting right there, ... you can’t write little bits of your note on the fly like we used to. I suppose you could log into a computer somewhere else (to complete it), but it’s just too much of a hassle; logging in, logging out, logging in.”</td>
</tr>
<tr>
<td>Documenting at different locations</td>
<td>“I remember having my piece of paper and my clipboard, filling in my H&amp;P and talking to the patient at the same time, and getting my information and establishing a rapport, ...”</td>
</tr>
<tr>
<td>Less dictation, more typing</td>
<td>“I think the dictated note has much better flow and amount of content and actually pertinence of information is better that way, too, because you actually have to think about what you’re saying. The problem with typed notes, is that either there’s not as much information that goes into it, and you leave stuff out, or they automatically put in vast reams of information that are irrelevant.”</td>
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<tr>
<td></td>
<td>“I saw this specifically with this new group of interns, where since nobody’s ever taught them how to do this...”</td>
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</tbody>
</table>

Many felt that the use of such features sometimes resulted in the propagation of misinformation or even in frank errors. Of note, while many felt that some of these errors were new, some admitted uncertainty as to whether all of these mistakes were, in fact, new. They wondered whether the features of CPD had exacerbated old documentation problems or whether the improvements in availability simply made some old documentation problems more apparent.

Comments representing this overarching theme were assigned the following categories during the coding process: (1) data overlooked, (2) uncertain if data interpreted, and (3) duplication and verification concerns and mistakes. Representative quotations can be found in Table 5.

Additional Results

Finally, when each subject was asked whether he or she would prefer to return to paper-based documentation rather than continuing to use CPD, the universal response was “no.” Respondents felt that the benefits of CPD, particularly the improved accessibility and legibility of documentation, outweighed any detriments.

Discussion

As EHRs increasingly replace traditional health records, the transition from handwritten documentation to CPD will likely follow. This study’s findings suggest that CPD may substantially affect several important aspects of clinical practice and physician education.

Positive Impacts

The impacts of CPD on documentation availability were noted to be of great importance by our subjects and were largely positive. Given that improvements in accessibility and
legibility are often cited among the major factors prompting the deployment of EHRs in hospitals,27 this finding is not surprising. Even so, in the context of the negative impacts noted by our subjects, it is again worth noting that the improvements in availability were seen as substantial enough to override the detrimental effects they attributed to CPD.

This finding suggests that availability of the clinical record is so fundamental as to make any other impacts secondary. While suggestive, we must be cautious not to interpret this as evidence that the impacts of CPD are necessarily more heavily weighted in the positive, as our methods do not support such a conclusion. Indeed, an alternative explanation might be that external pressures on physicians to perform their expected documentation activities are so strong that chart availability is simply seen as necessary for getting work done, whatever the cost.

Nevertheless, the data are compelling regarding this perceived positive impact on availability of the record and offer support for this often-cited reason to implement CPD.

**Negative Impacts**

In addition to the positive impacts, some negative availability impacts were noted as well. These included the issues of poor accessibility in certain key patient care areas and the decline in aspects of comprehensibility noted above. The latter impact of CPD may be at least partially explained by earlier findings that the pattern formatting and encoding characteristics of the traditional paper record help physicians search for data by complementing normal reading and providing effortless orientation, navigation, and detection of changes.21,25 In addition, data presented in a “pattern-dead” format, with test results tightly packed together, as is often the case with computer-generated reports, require more time and effort to interpret than data presented according to a meaningful pattern, even when physicians are familiar with the “pattern-dead” report.29 CPD features such as automated data entry appear to exacerbate this comprehensibility problem by facilitating the inclusion of such reports in clinical documents.

These findings suggest that, while clinical documents may be more accessible and legible when created directly in an EHR, computerization alone is not sufficient to overcome all of the limitations associated with paper-based records. In fact, computerization performed without attention to proper formatting and to content issues may even worsen certain documentation-related tasks.

In addition to the changes in documentation, CPD also appears to be affecting the cultural environment of the inpatient teaching hospital in ways similar to those seen after CPOE implementation.30 Physicians felt that they spent more time documenting, less time interacting with colleagues, and less time in patients’ rooms. While this may have resulted from the fact that documentation tasks were more time-consuming and demanding than was previously the case, as some of our data indicate, it may alternatively be the case that improvements in availability led to better communication, thereby obviating the need for as much interaction face to face between colleagues.

Given that such interpersonal communication constitutes a major flow of clinical information in health care,31 determining the actual reason for this finding is of more than academic interest. If interactions are decreased because CPD improves clinical communication efficiency, then the potential changes to the cultural milieu noted by some may not be of great concern in this setting. However, even if this is the case, physicians trained in such an environment may learn to interact differently with their colleagues, the consequences of which may not become evident until they have left the transformed training environment and entered a pre-CPD workplace. Alternatively, if the decline in interpersonal communication is the result of the negative effects of CPD on physician workflow, then CPD may alter the environments and interactions that have for years formed the foundation for patient care in this setting, a change that could adversely affect patients.

In addition to its effects on communication, CPD also appears to have affected the quality of clinical documentation and even contributed to the generation of new errors. Concerns abounded over the inappropriate use of features such as copy and paste and automated data entry, and the resultant alterations in document appearance, content, and accuracy. Two recently completed studies conducted at other VAMC facilities evaluated these very CPD-related issues in inpatient and outpatient settings and support our findings.32,33 Using
Duplication and verification concerns may also underlie the reported heavy use of features such as copy and paste and automated data insertion. Residents may simply be taking advantage of any way to efficiently complete the many tasks assigned to them, and they may not be willing to spend additional time editing and reviewing documents for preferred formatting and accuracy. Alternatively, or possibly in addition, residents may simply perform tasks in the manner they think is appropriate.

In addition to the impact on residents’ work experience, there is also the suggestion that CPD may be affecting their educational development. Faculty commented upon residents’ increased tendency to report patient data without interpreting the data. Faculty also noticed residents’ diminished expression of thoughtful assessments in the clinical record. These reports lead one to wonder if the change to CPD may be unexpectedly affecting the intellectual development of physician trainees. While it may be the case that residents do express their thought process regarding a particular patient in their documentation, and CPD is somehow inhibiting this thought process, an alternate explanation is that CPD is cumbersome, and residents are simply not willing to spend the extra time necessary to express their thought processes as well as they did when handwriting their notes. Of course, as this observation was not directly tested in our study, a third possibility is that trainees’ representations are actually no different than they were in handwritten documents, that their learning and thought processes have been unaffected by the transition to CPD, and that this concern arises only because improvements in availability have led faculty to review more clinical documents and notice discrepancies between what trainees should know and what they express in their documentation.

## Groups Impacted by CPD

As is evident from some of the findings highlighted above, the change to CPD appears to have affected at least four groups: (1) resident physicians, (2) faculty physicians, (3) nurses, and (4) patients.

### Resident Physicians

Computerized physician documentation appears to have directly affected resident trainees in several ways. In addition to their functions as doctor, teacher (residents, interns, and students teach each other throughout their work day), and ward clerk (in the case in which trainees are also responsible for performing CPOE), CPD adds yet another role to those a resident must play, that of transcriptionist.

This escalation in responsibilities may help explain some of the seemingly contradictory changes noted above. For instance, while many felt that improvements in chart accessibility helped them perform their documentation tasks, most also felt that the process of documentation was worsened by having to do it in front of the computer. Many residents also felt that they spent more time documenting overall, a finding that contradicts that of another study, which found no significant difference in time spent handwriting versus performing CPD in an intensive care unit setting using a different EHR.31

Competing responsibilities and perceived time constraints may also underlie the reported heavy use of features such as...

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### Table 5 — Mistakes, Concerns, and Decreased Confidence: Representative Quotations

<table>
<thead>
<tr>
<th>Categories</th>
<th>Quotations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data overlooked</td>
<td>“Pulling (the data) in, I can’t tell you the number of times I’ve missed something because it’s just this blur of data.”</td>
</tr>
<tr>
<td></td>
<td>“We didn’t see the (important lab data) until much later in the day and didn’t actually address it until much later in the day... yet because (the student) just dropped in all the labs, I could see that it was there the day before and he just didn’t even notice it.”</td>
</tr>
<tr>
<td></td>
<td>“The act of writing (the data) makes you think about them.”</td>
</tr>
<tr>
<td>Uncertain whether data interpreted</td>
<td>“In the past, at least they circled (the lab value); you knew they noted it was abnormal even if they didn’t address it in the assessment, but now you don’t know if they just didn’t think it was worth mentioning or they just didn’t notice it.”</td>
</tr>
<tr>
<td></td>
<td>“It’s a data dump; without processing, ... you can’t tell exactly what people thought was important in the lab data.”</td>
</tr>
<tr>
<td></td>
<td>“I just worry that people aren’t thinking the way they used to.”</td>
</tr>
<tr>
<td>Duplication and verification concerns and mistakes</td>
<td>“I worry that people don’t actually do their own history and physicals, but the notes imply that they have.”</td>
</tr>
<tr>
<td></td>
<td>“You’ll see exactly the same physical exam in the intern’s progress note, the resident’s progress note, the attending’s progress note, and then in subsequent subspecialist’s progress notes. They’re copied and pasted from one note to another, and it’s not simply that it isn’t accurate, but probably that it’s not believable that it’s accurate.”</td>
</tr>
<tr>
<td></td>
<td>“(Residents) don’t take medication histories anymore (relying instead on pharmacy data in CPRS) ... but what the computer thinks is not what the patient’s actually putting in their mouth or injecting into themselves or whatever.”</td>
</tr>
<tr>
<td></td>
<td>“A medical student was having difficulty with the pace and actually plagiarized a whole note from one of the interns (using copy-and-paste).”</td>
</tr>
<tr>
<td></td>
<td>“You’ll see people, as a diagnosis changes during a hospitalization, people will not change their written diagnosis because they’re simply copying information from a previous note.”</td>
</tr>
<tr>
<td></td>
<td>“The housestaff simply copied that (inaccurate) history, without going back to verify the initial data, and the patient was started on Vanco (an antibiotic) inappropriately.”</td>
</tr>
<tr>
<td></td>
<td>“I’m absolutely positive that there are cut-and-paste errors occurring.”</td>
</tr>
</tbody>
</table>
Whatever the explanations, these data raise concerns that CPD may be negatively affecting physician trainees’ experiences and development, findings deserving of further study. In addition to being affected directly, residents may also be affected indirectly by the effects to other groups, most notably faculty.

Faculty Physicians
While faculty were also affected by many of the negative aspects of CPD already noted, one impact relates specifically to this group and deserves further mention. Several faculty felt that improvements in availability allowed them to review their trainees’ notes more often and more carefully than was previously possible. While work by Baker et al.35 brings into question the educator’s ability to evaluate diagnostic reasoning based on clinical documentation, several of our subjects noted that the improved availability of CPD did augment their ability to monitor and provide feedback to trainees. Furthermore, the enhanced ability to oversee ongoing patient care delivery by reading trainees’ clinical documentation from multiple locations at any time may enhance faculty awareness of patient-related issues. While such impacts have to be further investigated, these data suggest that CPD alters the way in which faculty supervise and provide feedback to trainees and may even affect their involvement in patient care.

Nurses
The effects of computerized nursing documentation on nurses have been evaluated in multiple studies.36–40 Our findings indicate that CPD may also have an impact on nurses. While we did not directly interview nurses, our subjects felt that face-to-face interactions between nurses and doctors had decreased since the introduction of CPD. Similar findings were recently noted to result from the use of CPOE at other institutions.30 Seemingly benign changes to where colleagues do their work have been noted to produce unintended effects on underrecognized but critical communication patterns, especially in complex sociotechnical settings such as hospitals and air traffic control centers.15,41 If CPD does alter these interactions as our data suggest, there may be unintended impacts on the complex communication networks that have developed around hospital nurses’ stations. In addition to its potential effect on patient care, such a change could produce a decline in esprit de corps and job satisfaction, nontrivial issues given the current nursing shortage facing the country.42,43

Patients
The final group that appears to be affected by the transition to CPD is patients. While it is certainly possible that patient care has been improved overall by the enhanced availability of clinical documentation, our data raise concerns that physicians may be spending less time with patients as a result of CPD. Although two prior studies have found no reduction in time spent with patients by the use of CPD in the outpatient setting or CPOE in the inpatient setting, it is conceivable that differences such as the need to perform inpatient CPD tasks outside the patient room may account for a finding.10,44 Additional concerns regarding adverse effects to patients stem from the perceived inadvertent reduction of access to data in patient rooms during critical situations, the possibility of new errors resulting from changes to document appearance and content, and the possible impairment of interpersonal communication between members of the health care team due to CPD use. Further study of these potentially important impacts is certainly warranted.

Future Directions
As anticipated, our findings reveal at least as many questions as answers and support the need for future research. While our methods do not allow us to answer many of the questions raised, they do provide an indication of some of the future steps needed to determine those answers.

Many of the impacts of CPD relate to alterations in work processes. Unfortunately, current work processes are not well understood, and examples from other settings indicate that inadvertent disruptions to established processes can result in errors.14,15,41 To better anticipate future impacts and avoid the automation of obsolete or inappropriate processes as we change the way we work with tools such as CPD, efforts should be made to enhance our understanding of these processes at baseline, before new tools are implemented. Similarly, current baseline characteristics of clinical documentation are not well understood. Neither are the varied purposes of today’s clinical record, purposes that have certainly changed since Weed’s description of the problem-oriented medical record.45 In addition to helping inform our findings, developing a better understanding of these documentation issues will help us determine what should be the ideal format, structure, and content of clinical documents within a comprehensive EHR.

In conjunction with these efforts, there also appears to be a need to implement features into CPD technologies that help clinicians easily and effectively create complete, accurate, and well-formatted documents. While templates and other text generation tools can help alleviate the sometimes-burden-some task of CPD, care must be taken to keep such tools from contributing to the creation of poorly formatted and less comprehensible documentation. Changes to the technology should be made with an emphasis on helping clinicians create documents that improve communication.

Any technological enhancements will likely be only part of the solution. Successful transitions to CPD will probably require new educational efforts. Our findings suggest that not all physicians will intuit the proper use of CPD tools. Physicians might benefit from being taught the optimal format and content of CPD-created documents. They should be shown how to use CPD generation tools such as templates, copy and paste, and automated data entry appropriately, with special attention paid to avoiding some of the pitfalls noted by our subjects.

Finally, as others have noted,31 more study of the interpersonal communications between members of the health care team is needed. By better understanding these modes of communication, we may be able to devise implementation and education efforts that support crucial interactions between members of the health care team rather than disrupting them.

Limitations
Our study has some limitations. We collected our data at one institution, from a small sample of internal medicine
physicians, in the inpatient setting, at a single point in time. Therefore, despite our finding of saturation and the findings of other recently completed studies as noted above,32,33 our results may not be generalizable beyond the institution involved, to other specialties, or to the outpatient setting. Also, despite our subjects’ having more experience using the EHR for other purposes, most had only a few months’ exposure to inpatient CPD. It is therefore possible that their perceptions of CPD could change as their experience with it grows.

In addition, while the interviewer-researcher was aware of the potential for biasing responses and attempted not to unduly influence the course or direction of the conversation, and while the use of a second independent reviewer, member checking, and peer debriefing help to minimize bias in the analysis of our findings, it is possible that biases were introduced in the collection or analysis phases of this study.

**Conclusion**

Faculty and resident physicians perceived the transition to computerized physician documentation (CPD) from paper-based documentation to have significant effects on the clinical and educational environments and on the personnel of this teaching hospital. While changes in documentation availability were noted to be largely positive, participants also perceived many negative impacts on documentation characteristics, work processes, communication patterns, documentation accuracy, and the confidence of the authors and reviewers of clinical documents. Care should be taken when designing and implementing such systems to avoid or minimize any potentially harmful impacts. More research is needed to assess the extent of the effects identified in this study and to determine strategies to effectively deal with them.

**References**


