A Daily Hospital Progress Note that Increases Physician Usability of the Electronic Health Record by Facilitating a Problem-Oriented Approach to the Patient and Reducing Physician Clerical Burden

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ABSTRACT
We suggest changes in the electronic health record (EHR) in hospitalized patients to increase EHR usability by optimizing the physician's ability to approach the patient in a problem-oriented fashion and by reducing physician data entry and chart navigation. The framework for these changes is a Physician's Daily Hospital Progress Note organized into 3 sections: Subjective, Objective, and a combined Assessment and Plan section, subdivided by problem titles. The EHR would consolidate information for each problem by: 1) juxtaposing to each problem title relevant medications, key durable results, and limitations; 2) entering in the running lists under Assessment and Plan the most relevant information for that day, including abbreviated versions of relevant reports; and 3) generating a flow sheet in a problem's progress note for any key results tracked daily. To reduce physician EHR navigation, the EHR would place in the Objective section abbreviated versions of notes of other physicians, nurses, and allied health professionals as well as recent orders. The physician would enter only the analysis and plan and new information not included in the EHR. The consolidation of information for each problem would facilitate physician communication at points of transition of care including generation of a problem-oriented discharge summary.

INTRODUCTION
In physician satisfaction surveys from around the world, most physicians are dissatisfied with their electronic health record (EHR). The percentage of dissatisfied physicians appears to be increasing. The degree of dissatisfaction is reflected in these phrases in the titles of recent publications: "Why aren't they happy?" technology as friend or foe;" "hope, hype, and harm;" "time to re-engineer the clinical note;" "transitional chaos or enduring harm;" "an unfulfilled promise and a call to action; "a bitter pill for many physicians;" and "failure or simply time to reboot." Reasons for physician dissatisfaction with the EHR include the perception that the EHR increases physician workload, stress, fatigue, burnout, and cognitive burden; decreases physician productivity; impairs physician communication with patients and other physicians; may have unintended consequences that affect patient safety; and has not been convincingly demonstrated to improve the quality of care. On the other hand, a new industry formed in response to physician EHR dissatisfaction (medical scribes) has been reported to increase physician and patient satisfaction.

Problems with EHR utility and usability are the primary factors that determine physician dissatisfaction with the EHR. Utility is the existence of a system feature necessary to perform a task. Utility problems include those of system functionality (eg, search capabilities, system interoperability). Usability is most simply defined as the ease with which a system allows a user to perform a task. Problems with physician EHR usability are most commonly caused by poor organization and display of information, interference with practice workflow, increased physician cognitive burden, or poor system function design. Some problems attributed to EHR usability are actually caused by physician misuse of the EHR (eg, cloned or bloated notes).

Our focus in this article is on improving physician EHR usability in hospitalized patients. There is an extensive literature (primarily in outpatients) on EHR usability's definitions, principles, metrics, and methods of measurement. Recommendations on EHR usability have been made by the American Medical Association, the American Medical Informatics Association, and the US Office of the National Coordinator of Health Information Technology.

We increase the physician's ability to approach the patient in a problem-oriented fashion. The rationale for this is as follows: 1) usability is the ease with which a system allows a user to perform a task; 2) the physician's main task is to diagnose and treat each patient problem; 3) therefore, if the EHR increases the physician's ability to diagnose and treat each patient's problem this should increase physician EHR usability.

We increase the physician's ability to approach the patient in a problem-oriented fashion by having the EHR provide a consolidated display of information for each patient problem. In the Physician's Daily Hospital Progress Note the most important information for each problem will be displayed together on the same page as the one on which the physician is entering the note. The Agency for Healthcare Research and Quality report: EHR Usability Toolkit—A Background Report on Usability and Electronic Health Records states that physician problem solving would benefit from a succinct summarization of complex clinical data.

Such a problem-oriented information display would reduce the physician's cognitive burden because as the progress note is being composed less information would require retention in working memory. If the amount and complexity of information...
exceed working memory’s limited capacity, this results in cognitive overload and an increased error rate.\textsuperscript{34-36} The 2009 Healthcare Information and Management Systems Society EHR Usability Task Force states that when data retrieval, organization, and summary are done by software, this frees up the physician’s cognitive resources for other tasks.\textsuperscript{20} Cognitive burden would also be reduced to the extent that the EHR, not the physician, converts source-based to problem-based information.

We also improve physician EHR usability by reducing the physician’s clerical load. The EHR, not the physician, would enter the relevant data into the display for each problem. The first recommendation from the American Medical Informatics Association EHR-2020 Task Force was to decrease physician EHR data entry.\textsuperscript{29} Studies in both inpatients and outpatients demonstrate that physicians commonly spend more time with the EHR than with the patient.\textsuperscript{37-39} The physician in a typical outpatient visit averages more than 700 keystrokes and 200 mouse clicks.\textsuperscript{40}

The framework for our proposed EHR modifications is Lawrence Weed’s problem-oriented medical record in which the approach to each patient problem is organized as Subjective, Objective, Assessment, Plan (SOAP).\textsuperscript{41-44} We use a variant of this in which the physician’s progress note rather than the approach to each problem is so organized. We further modify this variant by combining Assessment and Plan into one section, subdivided by problem title. Under each problem title there is a running list of a physician’s daily comments.

To this framework we add EHR modifications to achieve our main goals of problem-oriented information display and reduced physician clerical burden. We have added our EHR modifications primarily in the Assessment and Plan section, but there is marked variability in physicians’ use of the EHR to view data and document findings.\textsuperscript{45-48}

Several EHRs that extensively use problem-orientation are already available, but none go to the extent that we have gone to achieve problem-orientation.\textsuperscript{49,44} Because our EHR modifications are not available in our current EHR, the authors, to varying degrees, manually add them in our hospital progress notes.

Because our key EHR modification is the running list under each problem in the Assessment and Plan section we first discuss the running lists in this section before discussing the relatively minor modifications in the Objective and the Subjective sections. We will end with some projections on the effects of these modifications on physician time spent with the EHR. The Sidebar: Increasing Physician Electronic Record Usability describes the mechanisms by which the proposed EHR modifications would increase physician EHR usability. The Sidebar: Running Lists in the Assessment and Plan Section of the Physician’s Daily Hospital Progress Note is an example of the running lists for each problem in the Assessment and Plan section of the Physician’s Daily Hospital.

### MODIFICATIONS IN THE ASSESSMENT AND PLAN SECTION

#### Daily Running List for Each Problem

Because the vast majority of the information that the physician needs to incorporate into the note is already stored in the EHR, it should not be the physician but the EHR that finds, organizes, and enters the relevant information for each problem in the Physician’s Daily Hospital Progress Note. The physician would enter only the analysis and plan as well as any relevant information not already in the EHR such as changes in the physical findings or recent conversations with other caregivers. These notes are in reverse chronologic order so that the problem’s current note is adjacent to the problem title and information juxtaposed to the problem title.

These running lists would be particularly useful when a physician assumes care of a new patient, especially multiple new patients. For example, the first day that Physician A rounds on a patient seen the previous day by Physician B, the course of each problem could be reviewed simply by scrolling from one problem to another in the last note of Physician B. This review would also be problem-oriented. If Physician A so chooses, the prior day’s note in the Assessment and Plan section of Physician B could be carried forward, and new comments could be added.
The author of each entry would be identified. Carrying forward patient information in this manner would facilitate the continuity of care and not be thoughtless and potentially dangerous cloning. The running lists would also be useful at other points of transition of care such as evening handoffs, consultations, and hospital discharges.

**Entry of Key Daily Results into the Running Lists**

If a problem has 1 or several key results followed daily (eg, laboratory data, input and output) that were entered by the EHR in that problem’s running list adjacent to the date, this would build a flow sheet for those results in the progress note. The physician, via a macro, and/or the EHR could determine which result or results to associate with each problem. Buchanan describes an EHR in which a committee of experts is systematically determining which results the EHR should associate with each problem.

**Entry of Other Important Information into the Running Lists**

Inserting concise impressions of a problem’s major procedures, radiology reports, and pathology reports in each problem’s running list in the Assessment and Plan section would help consolidate the important information for each problem for the duration of the hospital stay. If these impressions were highlighted, they could be viewed “at a glance.” Alternatively, if the information warrants a change in a problem title that could be done.

**MODIFICATIONS IN PROBLEM TITLES**

**Accurate Problem Titles**

Accurate problem lists are an EHR modification only in that they are present in a minority of hospital charts. If the physician or the EHR could update the problem titles in Assessment and Plan during the course of the admission, it would better direct hospital care. Automated problem list generation by the EHR has recently been described using natural language processing and machine learning-based Watson method models.

**Juxtaposition of Relevant Medications to Problem Titles**

With juxtaposition to the title of the medications being given to treat that problem that day, the physician during that problem’s note entry would no longer need to recall the medication list or navigate back to it. Such juxtaposition would also help identify those medications that should be administered for a problem and are not. Medication details would be in the medication list. Relevant maintenance intravenous fluids could be treated as a medication and be similarly displayed (eg, hypotension—normal saline at 200 mL/h).

Displaying a complete medication list in a separate window on the same screen as the one on which the physician is entering the progress note would be another option. A complete list would facilitate the physician’s ability to determine if the patient was receiving any medications contraindicated for that problem. However, in patients with many problems this may require repeated views of a long medication list (unless that problem’s relevant medications in the complete list were highlighted).

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**Running Lists in the Assessment and Plan Section of the Physician's Daily Hospital Progress Note**

**ASSESSMENT and PLAN**

**MYOCARDIAL INFARCTION (aspirin, metoprolol, clopidogrel)**

- **5/8/2017** - 4-vessel coronary artery bypass grafts, tolerated well. J Smith
- **5/7/2017** - troponin T 40 ng/mL, chest pain persists. Thoracic Surgery has seen. J Smith
- **5/6/2017** - troponin T 25 ng/mL, recurrence of chest pain at rest. J Paul
- **5/5/2017** - several 10-beat runs of symptomatic ventricular tachycardia. J Paul
- **5/3/2017** - troponin T 10 ng/mL, no chest pain, heart catheterization in AM. J Smith
- **5/2/2017** - troponin T 15 ng/mL, heart rate 35 beats per minute, temporary pacemaker placed. J Smith
- **5/1/2017** - troponin T 35 ng/mL, new onset of chest pain with ST elevation in a patient who had angioplasty in obtuse marginal 9 months ago. Aspirin and metoprolol started. J Smith

**ACUTE KIDNEY INJURY (prednisone)**

- **5/7/2017** - creatinine 5.9 mg/dL, hemodialysis started. J Smith
- **5/6/2017** - creatinine 4.6 mg/dL, acute interstitial nephritis found on renal biopsy, steroids started. J Paul
- **5/5/2017** - creatinine 3.4 mg/dL, input 2000 mL, output 500 mL, nausea and vomiting worse. J Paul
- **5/4/2017** - creatinine 2.4 mg/dL, input 2000 mL, output 600 mL, renal biopsy. J Smith
- **5/3/2017** - creatinine 1.8 mg/dL, input 2000 mL, output 600 mL, no response to volume. J Smith
- **5/2/2017** - creatinine 1.6 mg/dL, input 1000 mL, output 400 mL, volume depleted? Will give normal saline. Renal ultrasound: Normal renal size, no obstruction. J Smith

**HYPERTENSION (lisinopril, chlorthalidone, metoprolol)**

**normal renal angiogram 2013**

- **5/4/2017** - blood pressure 185/96 mmHg, intravenous antihypertensives stopped. J Smith
- **5/3/2017** - blood pressure 200/99 mmHg, now having headaches and new leg edema probably due to amlodipine so will stop amlodipine and add metoprolol 50 mg/d. J Smith
- **5/2/2017** - blood pressure 205/105 mmHg, no symptoms, chlorthalidone 25 mg/d added. J Smith
- **5/1/2017** - blood pressure 210/125 mmHg, not taking any blood pressure medications at home for months, no papilledema, started on amlodipine 10 mg/d and lisinopril 20 mg/d, will give intravenous hydralazine for systolic BP >200 mmHg as needed. J Smith
Juxtaposition of Limitations or Durable Results to Problem Titles

Some information may be so important to be kept in mind as a problem that is being addressed each day that the physician may choose to juxtapose that information to the problem title. In some examples, the EHR may be able to make this association. Examples are as follows: Atrial fibrillation—no anticoagulants because of fall risk; gastrointestinal hemorrhage—no transfusions, is a Jehovah’s Witness; refractory hypertension—normal aldosterone/renin ratio; metabolic encephalopathy—normal cranial computed tomography scan results; chronic kidney disease—avoid angiotensin-converting enzyme inhibitors (angioneurotic edema).

MODIFICATIONS IN THE OBJECTIVE SECTION

Running Lists in the Objective Section

With a problem-oriented medical record it can be difficult to interrelate a patient’s many problems. Running lists that would help interrelate problems could include: 1) A list of dates of clinically significant events, major procedures, and consultations. This would form a timeline of the hospital course. It would probably benefit from, not just EHR, but also physician input; and 2) A list of the dates of each hospital admission and the principle indication for each admission. This is available in many EHRs, but is not commonly displayed in the physician’s progress note.

Abbreviated Versions of Consultant Notes and Recent Orders

The EHR could further reduce physician chart navigation if abbreviated versions of consultant notes and recent orders were available in the Objective section. For consultant notes, other options would not be just the note of one day but for each day (a running list) or putting the notes in the Assessment and Plan section under the appropriate problem title (so they would be problem oriented).

Significant Events or Critical Laboratory Test Results

Significant events (eg, seizures, severe hypoglycemic reaction) or critical laboratory test results can fail to be communicated to the physician even though there are several mechanisms to do so within and without the EHR.4,5 Reporting and highlighting such information as a subsection in the Objective section would reduce the likelihood of the information being missed and require less physician navigation. Alternatively, if the information was added to a new or already active problem title in the Assessment and Plan section it would facilitate the physician being able to document a response.

MODIFICATIONS IN THE SUBJECTIVE SECTION

Addition of Running Lists of a Patient’s Daily Chief Complaint

A running list of a patient’s daily complaints to the physician could help track a patient’s hospital course and help interrelate problems.

Addition of the Notes of Nurses and Allied Health Professionals

Because notes from nursing and affiliated health care professionals tie in well with the patient’s chief complaint, it would be reasonable to display them in subsections adjacent to the patient’s daily chief complaint as listed above. These notes would need to be very concise and not duplicative for the writer. That hospital notes are commonly read only by the author may contribute to the often poor collaboration between physicians, nurses, and allied health professionals.39,46,56 Just adding a link to such notes would not reduce physician chart navigation. The physician may be more likely to view a note that is not daily and not filled with documentation requirements, but is as needed and succinctly expresses important observations.

MODIFICATIONS IN COMPUTERIZED PHYSICIAN ORDER ENTRY

This article addresses computerized physician data entry (CPOE) only to point out the redundancy of the physician documenting in the progress note that a medication change is going to be made and the rationale, and to also enter the medication name into CPOE. One could easily forget to make this second entry, especially if the physician’s workflow is to enter orders only after all the progress notes have been entered. Seamless integration of the medication name from the progress note into CPOE would prevent this potential error and any quality and cost consequences. In physician satisfaction surveys, if questions on CPOE are excluded from those on other EHR components, the correlation between physician burnout and the EHR is no longer evident.19

EFFECTS ON BUILDING A PROBLEM-ORIENTED DISCHARGE SUMMARY

A daily running list under each problem in Assessment and Plan that consolidates all the relevant information for each problem could facilitate a problem-oriented discharge summary (and problem-oriented outpatient care) in several ways: 1) It could simplify dictation of a discharge summary because all the relevant information for each problem should already be in each problem’s running list. 2) The running list for each problem could actually be the hospital course segment of the discharge summary. If so, the physician’s final entry for each problem could be a brief overview (details are in the running lists). 3) If an electronic discharge summary template were used, the hospital course segment could be autopopulated with the running list for each problem. 4) If on the day of discharge the physician does not have time to compose a high-quality discharge summary, as an interim measure, the running list for each problem and the reconciled discharge medication list could be sent.17-59 Many hospitalists believe they do not have sufficient time on the day of discharge to perform a discharge summary.39 Delayed transmission of discharge summaries to the outpatient physician has been associated with increased 30-day readmission rates.60

EFFECTS ON NOTE LENGTH VS PHYSICIAN ELECTRONIC HEALTH RECORD TIME

For those entering notes into the chart, EHR navigation and data entry would be reduced because the EHR enters the problem title, date of note entry, physician identifier, and all other relevant information (including a mini flow sheet in the progress note for key daily results). If the EHR entered in the Physician’s Daily Hospital Progress Note all the relevant data for each problem,
the physician would click the mouse once to enter the analysis and plan for the first problem and not need to click again until finished with the last problem (unless orders were entered after each problem). In a study comparing a conventional EHR with one in which the information display for each problem could be determined by the user, the data acquisition time was markedly reduced in the experimental EHR.\(^5\)

For those reading the progress notes, duplicate entry of some key information would increase note length, but the problem-oriented information display should reduce physician navigation time. The time required to read a progress note would also be reduced if the EHR and/or the physician could delete inactive problems or remote entries and the EHR could identify which problems include an entry that day. The progress note reader's time would also be reduced by the increased ability to detect note cloning (if the progress notes in the Assessment and Plan section are in a running list format, the physician's daily notes would be adjacent to each other).

**CONCLUSION**

The EHR and the problem-oriented medical record have each been paradigm shifts in medical care, but physicians rarely use the complete problem-oriented medical record and are becoming increasingly dissatisfied with the EHR. Used together in hospitalized patients, their synergistic effects may facilitate the physician's ability to diagnose and treat each patient problem, thereby enhancing EHR usability and physician satisfaction with the EHR. Any benefits of their combined use would require EHR implementation and testing of those modifications so chosen.\(^6\)

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