Exploring Novel Graphical Representations of Clinical Data in a Learning EMR

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To reduce the risks of cognitive overload associated with large amounts of data in Electronic Medical Records (EMRs), we are designing a Learning EMR that is able to draw a physician's attention to the right patient data at the right time (1). The system, developed for use in Intensive Care Units (ICUs), uses a data-driven approach to analyze patterns of past EMR usage by clinicians and highlight the most relevant data for each patient.

In order to facilitate the development of an EMR user interface that prioritizes the presentation of high-value data, it is necessary to acquire a thorough understanding of the information practices of ICU providers. Most prior work in the literature focuses on investigating ICU clinicians' data needs, reasoning strategies and use of information sources. A literature review provided us with useful insights on design aspects that we found applicable to the design of a Learning EMR. We identified four main themes:

1. EMRs should **convey and summarize clinical information effectively**, by encoding health parameters to visual attributes, and by utilizing information views that prioritize the display of high-value data, organize information into clinically relevant concepts, and provide quick overviews of the patient's conditions.
2. EMRs should **highlight changes in clinical outcomes** across different data points or from an expected course: physicians prioritize cases based on level of concern. They are reassured by patients who are progressing as expected, while patients showing unexpected changes escalate on their prioritization list.
3. EMRs should **offer features that facilitate comparisons across patients** for clinical prioritization purposes, by helping physicians to quickly identify appropriate groupings for their patients, and by showing how a patient's affinity towards different groupings changes over time.
4. EMRs should **provide support for analytical reasoning**, by visually arranging related data together, and by providing highly configurable user interfaces, smart search tools, and workspaces that make it easy to manipulate information at the level of entities and their relationships.

To inform the design of our Learning EMR user interface, we intend to combine the design principles identified above with observations and design activities. To gain a deeper understanding of information practices in ICUs, we will shadow ICU physicians and collect observational data on their information seeking activities and interactions with the EMR. Interviews conducted outside of care settings will be used to help characterize such activities and organize them into general process models, representing how ICU physicians interact with the EMR to perform care activities. We will use these models to inform the creation of a series of wireframes, identifying possible ways to highlight high-value data in our Learning EMR.

In a subsequent focus group session, we plan to actively involve ICU physicians in the user interface design process, using techniques inspired by Participatory Design. After learning about our goal to develop an EMR designed to reduce information overload in the ICU, clinicians will be asked to provide feedback about the concept. Physicians will then generate and discuss design ideas for the Learning EMR user interface, using craft materials and low-fidelity sketches. Participants will then be asked to provide their feedback on the user interface strategies for highlighting data of interest explored in our wireframes.

Study findings will help us gain a deeper understanding of ICU clinicians' information practices and desiderata regarding EMR user interface design. Feedback on the Learning EMR concept and suggested design ideas will lead to the creation of a new series of wireframes reflecting participants' work and preferences. These revised wireframes will inform future design choices for our Learning EMR, and eventually the implementation of a fully functional EMR user interface.

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References

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