Appendix B: Guidelines for design of IT to support acute care decisions

1. **Provide fast access to frequently used information**
   
   1.1. Prioritize attention to system performance with respect to fast information display. Any effort to advance information presentation through graphical user interfaces or the application of intelligence will not be accepted if information is slow to load [1].

   1.2. Prioritize presentation of new information.

   1.3. Use highlighting techniques to emphasize data that has not yet been seen by the clinician (eg, techniques similar to those used in email applications to differentiate read and unread email).

   1.4. Design and implement smart search functionality that will allow clinicians to access specific data quickly.

   1.5. Provide smart and informative patient list displays that provide rapid access to new and clinically relevant information for multiple patients on a single screen.

   1.6. In acute care settings, prioritize presentation of acute patient information.

2. **Improve information organization, prioritization, and navigation** [2]

   2.1. Organize information groupings based on medical concepts (problem or human body system) or by context [3, 4].

   2.2. Separate acute (current stay) and chronic (history) patient information.

   2.3. Provide context-sensitive intelligent filtering of alternatives in choice lists. For example, order alternatives based on user’s demonstrated frequency of use or based on role-, specialty-, or region-based expectations of frequency of use.

   2.4. Provide graphical user interface navigation techniques that allow clinicians to more naturally "drill-down" or "zoom in" for more detail.

   2.5. Reduce clutter of infrequently used options through techniques such as providing a "More..." alternative.

   2.6. Provide contextually relevant shortcuts or links to clinically related data. For example, when clinicians are viewing fluid intake and output, provide links to display intravenous fluid orders or medications to manage fluids. Additional research using expert knowledge elicitation techniques or usage data may be necessary to build models of relatedness among clinical data.
3. **Improve the presentation of dynamic quantitative data [2, 5-9]**

3.1. Eliminate problems related to managing data that do not fit on the screen (e.g., wrapping and scrolling problems).

3.2. Use graphical user interface techniques to clearly indicate the presence of data beyond the display area.

3.3. Although labels and units are important to include, minimize clutter of repetitive information by using small font sizes, lighter font shades, or by placing information in summary locations (column or row headers, scales).

3.4. Provide "fast access" graphical plots of frequently accessed vital sign, laboratory data, and volume input and output data. Make scale selections that will allow display of 4 or more data points (e.g., 24 hour scales for lab data collected every 4 to 6 hours; shorter time frames of 8 – 12 hours may be appropriate for hourly vital signs).

3.5. Provide simple user interaction tools for supporting change of scale (e.g., zoom in/out) and manipulate data and formatting (e.g., font/symbol size, additional data detail) as appropriate to the selected scale.

3.6. Provide means for displaying multiple quantitative data trends across the same time scale[5]. Additional research is needed for identifying data elements (and specific groupings) to include (e.g., for fast access, on main display pages, and/or prioritized in selection lists).

3.7. Use statistical (e.g., Trigg's tracking variable[10]) or other intelligent models[11] to interpret whether quantitative data are exhibiting clinically meaningful (in the context of the patient-specific variability of relevant data) change over time and use graphical user interface techniques such as symbolic coding to depict whether specific data are changing.

4. **Integrate clinical decision support within the EHR (see also Bates et al.[1])**

4.1. For CDS that becomes more critical over time (e.g., foley catheter removal) and/or underlying surveillance algorithms (e.g., detecting ventilator induced lung injury), use techniques such as symbolic or color-coded highlighting to signify changing need for attention (as opposed to ill-timed pop-ups).

4.2. For CDS that naturally integrates within a workflow (e.g., medication recommendations at ordering time), implement techniques such as defaulting to (or prioritizing in a list view) recommended alternatives and/or symbolic coding to indicate preferred and contraindicated alternatives.
4.3. Although "pop-ups" may still be necessary on occasions when contraindicated choices are made or when information becomes critical, facilitating the initial selection of a recommended choice and providing ongoing situation awareness of changing information over time is preferred to the disruption of "pop-ups".

4.4. If "pop-up" reminders are used,
   4.4.1. ensure they are delivered to the right clinician role,
   4.4.2. track repetition of "pop-ups" delivered to a single individual and work to resolve underlying logic to reduce repetition of problem reminders,
   4.4.3. track and visually indicate new (to the specific clinician) versus repeat reminders, and
   4.4.4. consider providing functionality that allows clinicians to select appropriate timing (eg, to prevent repeated reminders, within limits) for the next reminder.

5. Improve the management and sharing of patient narrative information between clinicians (progress reports)
   5.1. Separate the functionality and display of documentation to support billing and information sharing. With respect to documentation to support billing, automate these processes as much as feasible.
   5.2. With respect to patient information sharing, integrate tools that will allow easy cross-referencing to relevant dynamic data in the context of a narrative report.
   5.3. Integrate techniques from social media to support collaborative patient decision making discussions across clinicians with different roles and specialization.

6. Support paper-based processes and task management
   6.1. Paper-based processes, such as the development of personal notes, play an important role in patient care. Support these processes by providing functionality to print patient lists including a subset of key patient data or patient summary pages with space available for personal notes.
   6.2. There is a need for additional research to better understand how support for task management can be integrated within EHRs.
7. **Implement user-centered design processes, research activities, and multi-contextual collaborations to ensure the usability and effectiveness of new EHR designs [12]**

7.1. Use user-centered evaluation methods such as usability testing to evaluate the effectiveness of new organization, navigation, display, and user-interaction implementations. There is a need for testing by both manufacturers (and subsequent redesign) and by healthcare organizations both pre- and post-deployment (and subsequent modification/redesign and feedback to manufacturers) [6, 7, 13-15].

7.2. In particular, the ability to quickly navigate to relevant information will moderate usage. Usability testing to evaluate the ease of finding key information or specific display formats is necessary.

7.3. Use change management processes to ensure that systems do not become unwieldy over time. When adding new display alternatives, evaluate opportunities to reduce clutter and distraction by removing (and no longer maintaining) infrequently used display alternatives. Continually evaluate system performance issues (eg, page loading times).

7.4. Work not only toward interoperability of multiple systems, but toward consistency in user interface display and interaction techniques. Multi-contextual (across health information technology industry, healthcare organizations, government, and academia) collaboration is necessary to develop relevant standards, guidelines, or style guides to support these efforts.

7.5. Use intelligence to prioritize information, not to provide decisions [13]. Carefully balance principles of consistency, simplicity, and transparency in the design of systems that use intelligence to predict information needs, prioritize information presentation, or to provide clinical decision support.

**References**

