Use of Information Technology in Intensive Care Units (ICUs)

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Mayo Clinic is the first and largest integrated, not-for-profit group practice in the world. Doctors from every medical specialty work together to care for patients, joined by common systems and a philosophy of “the needs of the patient come first.”

Background

Information overload is a significant problem in health care, especially in intense settings. Figure 1 shows the volume of patient information that health care professionals at Mayo Clinic must scrutinize daily while caring for patients in the ICU. Researchers are redesigning the electronic environment in order to reduce cognitive load, resource utilization and human error associated with processing such large amounts of data.

Situation Summary

The first 24 hours after acute illness or injury are critical. If poor decisions are made during that time, a patient is more likely to experience complications. Such complications can prolong hospital stays and result in death or severe loss of function, necessitating long-term care. Good decision-making in the ICU is essentially about pattern recognition; small changes in a patient’s condition can form a recognizable pattern, forecasting ICU complications.

Example: Sniffers

Researchers at Mayo Clinic are using informatics, epidemiology, systems engineering and in-depth medical-record studies to create tools called “sniffers”—sophisticated computer algorithms embedded in software that detect potential patient problems and alert staff. Computer programmers create these algorithms based upon defined consensus conference diagnostic criteria for specific syndromes. The goal is to improve patient safety while reducing health-care costs.

The “sniffer” software crunches patient data that is fed continually into a “Data Mart.” (See Figure 2.) When the computer detects a problem, it sends a text message to a clinician. For example, if a patient on a ventilator is receiving too much air (based on the individualized estimation of lung size according to gender, height, type of lung injury and lung stiffness), the

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Information Overload

<table>
<thead>
<tr>
<th>MEAN Data Points/Day</th>
<th>Per Patient</th>
<th>Per 24 bedded ICU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labs</td>
<td>60</td>
<td>1440</td>
</tr>
<tr>
<td>Drug Orders</td>
<td>10</td>
<td>240</td>
</tr>
<tr>
<td>Microbiology</td>
<td>2</td>
<td>48</td>
</tr>
<tr>
<td>X ray</td>
<td>2</td>
<td>48</td>
</tr>
<tr>
<td>Vitals</td>
<td>1950</td>
<td>46800</td>
</tr>
</tbody>
</table>

Figure 1: This figure shows the mean number of data points generated through the care of ICU patients in the Mayo electronic environment every day. This excludes documents/medical notes/nursing and ancillary health care provider reports.

Figure 2: The “sniffer” system alerts providers to potential complications.
computer texts a respiratory technician to check that patient’s ventilator setting. This helps prevent ventilator-induced lung injury.

**Example: ICU Dashboard**

Reams of data stream through Mayo’s Data Mart, and researchers are studying decision-making processes to determine which information is needed to make safe and timely decisions. Out of thousands of pieces of data, investigators have identified 30 items that caregivers use regularly to make decisions. The data’s relative importance varied according to patient demographics and condition. Combining those findings with in-depth medical records research, researchers created an information-scoring system that prioritizes information for ICU syndromes such as sepsis, coma and bleeding. The next step is to help ICU clinicians get that customized information quickly — most likely through a dashboard that will display information relevant to specific patients.

**Conclusion**

The electronic environment can be redesigned to reduce the cognitive burden, errors and costs associated with caring for critically ill patients. (See Figure 3.)

![An Electronic Environment that Imposes Less Cognitive Burden on Providers](image)

**Figure 3:** Cognitive load is measured using NASA-TLX (Task Load Index). Using novel ways to present all of the data collected on an ICU patient decreases the task load index as compared to standard displays.