OR of the Future – A Vision?!

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Modern-day operating rooms are crammed full of high-tech devices, but none can yet overcome their primary weakness – their logistical connective inadequacies. It is time to redesign the OR based on a meticulous analysis of processes and material flows, with new data and user interface standards.

Today's operating room is a work environment with deep-rooted historical origins. Current device-related components have improved significantly, particularly during the last few years; new medical devices have been added (especially intraoperative support systems for imaging, monitoring, navigation and robotics). The OR's general concept, however, has changed very little – logistically, today's operating room is an island: currently, the on-call resources are more or less limited to elementary supplies such as water, electricity, medical gases and air conditioning (we will discuss PACS later). All other factors (support systems, sterile equipment, patient-related data) contributing to the success of any type of head and neck surgery have to be manually supplied and configured for each operation. Ensuring the availability of these systems requires keeping a costly inventory of equipment, with individual provisions tying up highly qualified personnel and bringing about costly delays.

Strong market growth vs. a poor ergonomic posture

Medical technology continues to grow at a rapid pace worldwide: According to a survey conducted in Germany by the Federal Ministry of Education and Research 5,700 million euros are invested in medical technology products every year. Another 6,800 million euros are spent on devices from foreign manufacturers. Worldwide, the German medical technology industry ranks second between the USA and Japan. However, a survey conducted by U. Matern, M.D., University Hospital Tuebingen in Germany, among 3,600 surgeons also showed that:

- In the opinion of approximately 40% of those surveyed, a surgeon's incorrect working posture can endanger both the patient and the OR team
- 70% do not consider the current surgical devices' functionality to be intuitive; switches are too small, the systems' navigation menus are not clear
- 70% of the ORs are not part of a hospital's network

- Only 13 of the 3,600 surgeons surveyed actually use alternative input assistance such as voice control
- Only 7% of the users read the instructions (most of which are simply too long)

Studies on ergonomics have shown that the optimum line of sight to the monitors (one, not several!) is straight ahead and slightly below the horizontal viewing plane: only 50% of the users operate their screens properly; half of the other 50% know they are doing it incorrectly, but have not changed their habits. The others are not aware of this fact at all. As a consequence, most surgeons prefer floaters to operate their medical devices.

In most complex work systems, 70 to 80% of all mistakes can be traced to human error. Various studies have come to the conclusion that 50 to 80% of human errors can be linked to inadequately designed technology or its flawed implementation.

Redesigning the workflow

To implement the OR of the future, it will not suffice to install a 3 Tesla MRI in a sufficiently large room. The essential work lies in a comprehensive OR space redesign based on a meticulous analysis of processes and material flows:

- How does the patient get to the OR?
- Which technology and information must be available? When and where?
- Which staff is required? When and where?
- How is the required sterile equipment provided on time?
- How can the safety for patient and staff be increased?
- How are complications recognized, controlled and recorded? How can everybody learn from such events?

Modern research on the extensive topic of ergonomics provides suitable measures to carry out such analyses. However, creating real-life solutions from such results can only succeed in close cooperation with the medical technology industry. And herein lies the essential problem: a manufacturer must individualize his brand and distinguish his products from those of the competition. Thus, every manufacturer defines proprietary data standards, tries to establish his understanding of intuitive functionality with the user, and "protects" his systems through missing or incompatible user interfaces. Therefore, product concept diversity becomes the obstacle in advancing

BrainSUITE iMRI is a fully integrated image-guided neurosurgical OR suite from BrainLAB AG

the user interface and system functionality.

The handling of radiological image data shows that processes can work: the DICOM standards for the patient-specific coding of image data has existed for many years. Also, hospitals are increasingly implementing PACS (Picture Archiving and Communication System) configurations, allowing constant availability of this information even in the operating room. However, progress in linking such data with CIS/HIS frameworks has not yet reached this level.

One screen, one mouse, one manager

Most intraoperative support systems provide visual output, usually on a screen; input generally occurs over a keyboard, mouse or touch screen. These common characteristics offer vast possibilities to improve system functionality: as not all information is required at the same time – or could even be digested by the surgeon, if provided – only one touch screen with one sterile mouse (or similar pointing instrument) would, in most cases, suffice in the surgery's proximity. The requested information for each case (image data, device settings, patient's vital signs, etc.) is displayed on demand. In fact, a handful of innovative research projects are elaborating these important questions.

In the operating room of the future, a data manager will handle the flow of information. This person should be very familiar with the surgical and anesthesiological subsystems in the operating room. Before surgery, he can process image data, for example, the merging of CT and MRI volumetric images, and segment structures, if required, and define approach routes in collaboration with the surgeon. He should also be capable of judging intraoperative measuring data, recognize pathological changes during surgery and communicate these to the surgeon. These activities entail considerable responsibility: the data manager can, of course, be supported in his tasks with knowledge-based software algorithms; the final responsibility, however, rests with the personal judgment of the operating surgeon. The invaluable advantage for the surgeon would be focusing on only a few, but highly significant interfaces.

Every second the surgeon does:

- not have to ask for the floaters
- not have to operate a device
- not have to wait for material supplies and patient information and does
- not have to flip through an instruction manual

is valuable time he can dedicate to treating his patients.

Image courtesy:
BrainLAB AG, Feldkirchen, Germany

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