Conference Paper

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THE MONITOR-FROG: EXPERT-USERS INTERACTIONS IN ERGONOMICS AND COOPERATIVE DESIGN

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Abstract: Objectives are the improvement of Anesthesia workplaces in a multidiscipline operating room (OR) facility. Method is: a status quo analysis, expert-users interviews and a co-operative design process. Results are significant mismatches of ergonomic principles and user requirements in the analysed workplace layout. This causes distractions from patient care, an high amount of head movements and muscle strains, and a difficult procedures to attach the cables and lines for vital signs and breathing. The interviews show advantages from a new concept of mutual learning between ergonomist and users which is named thing-think interview. The design process results in two new, innovative products, one for to order the cables and one for a flexible and ergonomic positioning of the anesthesia monitor device: The Monitor-Frog.

Introduction

Administering anesthesia is a risk-loaded process in an environment of high technology, where human or equipment failures have disastrous consequences for the patient's health. Therefore here, as well as in intensive care facilities, an ergonomic design of the workplaces and equipment is necessary for the patient's safety and for the best and most economic use of the anaesthetist's skills. Furthermore, the consideration of ergonomics guarantees a positive impact to the over all work quality and efficiency of the work procedure.

On the contrary, workplaces layouts are often randomly [1] and the design of the physician-machine interface mismatches most of the user's requirements and shows overall a lack of ergonomic and systematic concepts. This leads to the question: What causes such problems in fulfilling the user's requirements?

To clarify this, a project of workplace improvement was carried out at the anesthesia's workplaces in a multidiscipline surgery facility.

Materials and Methods

1. Analysis of the status quo: The Ergonomist and an anaesthetist visit the workplaces, they observe several work procedures, photo and video documentation of two complete anesthesia procedures (pre-, inter- and post-operative) are carried out.

2. Task analysis with the FIT-System [3]: The anaesthetist's task in four surgical procedures are analysed with a mobile computer device.

3. Expert-Users Interviews: At all 22 questions, three of them asking for a rating about the layout and the usability of the OR equipment. The rest are semi-structured questions for the description of work procedures, tasks duration and importance, problems and ideas of improvement. All questions are combined with material to show the context, i.e. photographs and layout plans. Each interview took one hour of time.

4. Presentation and Discussion: The results of step 2 and 3 are presented to the anaesthetists during a regular staff meeting. A first idea of improvement is proposed by the ergonomist.

5. Co-operative design process: Sketches, a model (1:10), a working model (1:1) and several tests and discussions onsite in the OR's and in the technical laboratory of the hospital were performed.

Results

1. Analysis of the status quo (Figure 1): The monitor of hemodynamics is placed on a device under the ceiling. It's position is diagonal behind the anaesthetist because of a media support installation under the ceiling which blocks the range of use.

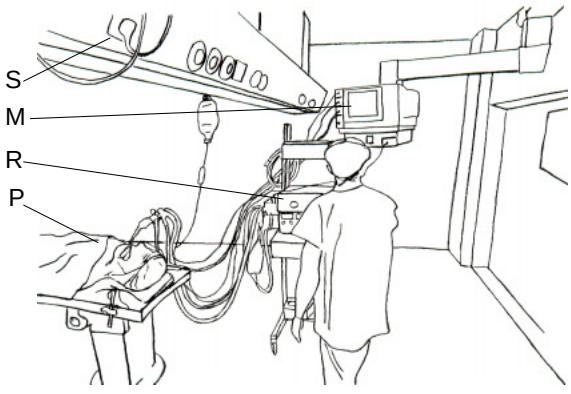

Figure 1: Patient (P), Respirator (R), Monitor (M) and Media-Support (S) at the analysed OR workplace.

Therefor the anaesthetist has to observe a lateral workspace of 140 degree. The first line of the monitor's screen is placed 207 to 217cm above the ground,

because otherwise the monitor is an hindrance and the reason for headaches (Figure 2).

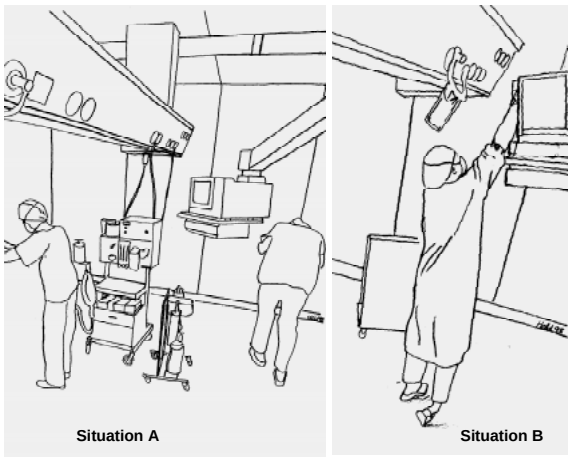

Figure 2: The monitor in a reachable position is an hindrance (A). Consequently the monitor's is mounted high - and not in an ergonomic reachable position (B).

2. Task analysis with the FIT-System [3]: In the four observations (routine cases), the anaesthetist spend during the surgical procedure 22% time for to control and manipulate the monitor and respirator and 26% time for the tasks related to the patient. In 200 minutes, he changed 118 times from the patient to the monitor.

3. Expert-Users Interview: 18 Anaesthetists participated in the interviews. On a five-item scale between good (1) and less good (5), 12/18 rated the equipment arrangement as good (mean rating: 1.6). The most important problem was mentioned in the difficult and time consuming cable and line attachment in the OR (64% of the statements), while the equipment positioning was not mentioned as a reason for attachment difficulties.

4. Presentation and Discussion: The session shows a mutual learning process between Ergonomist and Users, and the consensus to redesign the monitor position.

5. Co-operative design process: Figure 4 show the steps of sketches, a model (1:10), a working model (1:1) and the new product: The Monitor-Frog.

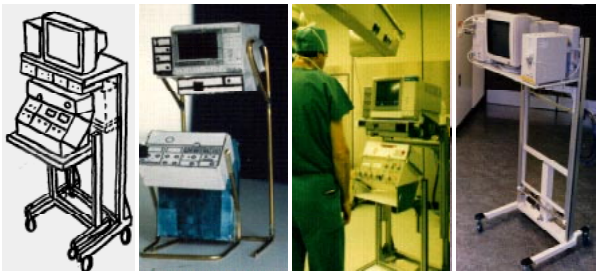

Figure 4: Design process, sketch, model (1:10), working model (1:1) and the product - The Monitor-Frog.
The Frog carries the monitor, can be moved over all types of respirators, over the patient's bed and over other equipment and can attach with a mechanism to his 'partner' - to one workstation. The Frog costs only 30% of a ceiling monitor support.

Discussion

The results demonstrate that in the beginning expert's recognition and interpretation (the monitor is the problem) had nothing together with the user's process of understanding (the spaghettis of cables are the problem). Any recommendation (you have to change the monitor position!) at this point must lead to misunderstandings in a further project and to a lack of acceptance of the proposed or designed changes.

The demonstrated approach shows the benefits of a mutual learning process in the interview sessions (step 3), placed between the expert's observation and measurements (step 1 and 2) and his presentation of results (step 4). The use of semi-structured questions and material, i.e. photographs, sketches (see Figure 2) and data from work procedures in the interview, supported the verbalisation of the user's because of the confrontation with the own work procedures.

Conclusion

It is still standardised [3] to involve the end-users in an early stage of the design process and to use prototyping. Design is flooded with problem solving methods. It became clear, that the problem itself isn't the problem, but mutual (expert and users) understanding of the problem - that is the problem, and has to be solved before any design activities are carried out [4]. That requires learning and costs time in the beginning of a project and is often avoided in the traditional approaches. But then more time is needed to match the user's requirements in several cycles of trial and error and often such developments ended with the latter one. For a task oriented approach, the users are the experts of their work procedures and Ergonomics is the discipline of disseminating and providing such information for a successfully design.

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