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Abstract: The presented work is about the impact of an ergonomic study for an architects project to design a new multi-disciplinary ICU (24 beds) to replace the old one. The dimension of the hospital is about 600 beds. Method is a work system analysis including task and link analysis using the FIT-System, user interviews using object-based interview technique, and simulation of work situation using a model (scale 1:25) of the new facility. Task analysis shows that the five most frequent tasks are: 1. Documentation, 2. Application of drugs/infusions, 3. Communication, 4. Manipulation of devices, 5. Observation of devices. The hemodynamic monitor is the most frequently manipulated device and most frequently observed. The communication is one of the biggest time consumer; it costs a quarter of the work shift time. Link analysis shows that the most frequent walking passage is the link between documentation desk and the monitoring and medication pump at the bedside. User interviews showed that the lack of room and space is the biggest problem. Users mentioned the problem, of self-evaluation of their work load. The architect's plan showed his lack of detailed knowledge about the work procedures and related errors in room layout. Proposed corrections due to the ergonomic intervention were accepted by the decision makers and changes were implemented in the planning and realisation.
Keywords: Hospital Design, Task and Link Analysis, User Participation.

1. Introduction

This paper is about the impact of an ergonomic study in the planning of a new multi-disciplinary ICU (24 beds). Context is the new design of an hospital building to replace the old ICU and to solve its problems in capacity, room space, room layout and workplace design. The dimension of the hospital is about 600 beds.

Work systems of intensive care units (ICU's) are characterised by high complexity in their relations between patient, machines and devices and physicians and nursing staff. This often mirrors patient's status of illness and the complexity of the patient's therapy requiring a high amount of information to be manage on a daily basis.

2. Methods

Method is a work system analysis including:

- Visit and documentation (layout measurement, systems elements) of the ICU and Work situation photography and Work procedure observations supported by paper & pencil notes.
- User interview using object-based interview technique of the VALAMO (variable layout model, magnetic objects to support work procedure discussions).
- Task and link analysis using the FIT-System, two inspections at the "patient bed" work place, duration each: 4,5 hours, high work load level 1a and 1b (levels are 3, 2, 1b, 1a according to SGI 1991).
- Evaluation of the architects plan.
- Simulation of work situation using a model (scale 1:25) of the new facility.
- Workshop together with seven users.

[1] Held, J. (2003) Analysis of an Intensive Care Unit. In: Tagungsband der 49. Jahrestagung der Gesellschaft für Arbeitswissenschaft, München, ISBN 3-935089-68-6, S. 673-676.

3. Results

The first visit of the old ICU shows lack of personnel, lack of room and lateral work space, lack in consistency of work place layout, high variation of devices and problematic work procedures. Task analysis shows that the five most frequent tasks are: 1. Documentation, 2. Application of drugs/infusions, 3. Communication, 4. Manipulation of devices, 5. Observation of devices. The hemodynamic monitor is the most frequently manipulated device and most frequently observed. The communication is the biggest time consumer; it costs a quarter of the work shift time. Link analysis shows that the most frequent walking passage is the link between documentation desk and the monitoring and medication pump at the bedside. Approx. 50 times in each observation the nurse walked away from the work place at the patient bed to other destinations of the ICU. User interviews showed that the lack of room and space is the biggest problem. Figure 1 presents two of the three old ICU rooms.

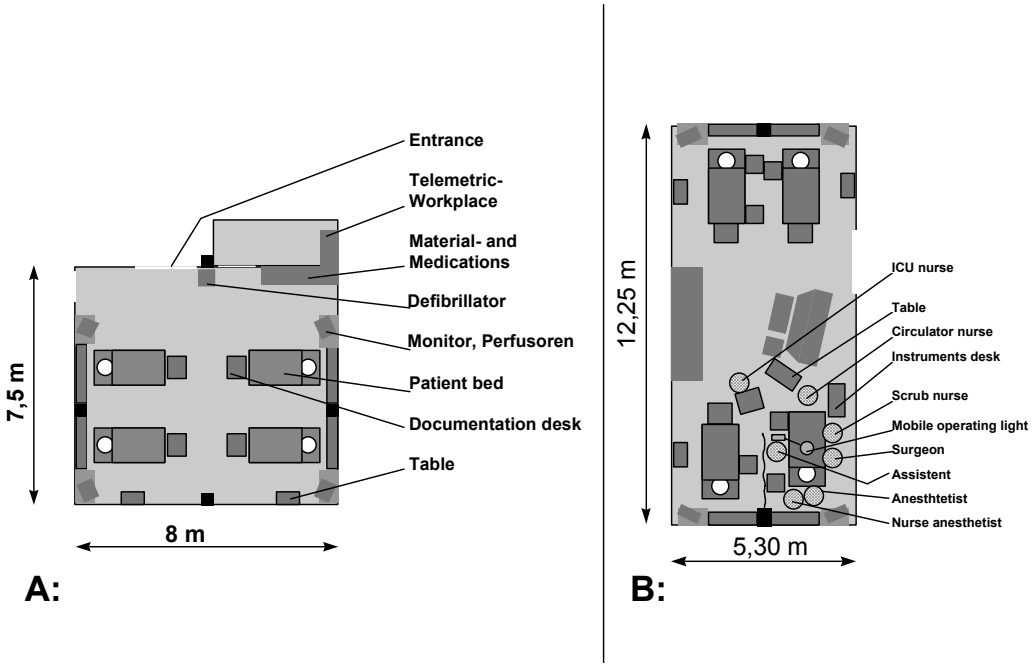

Figure 1: *Two of the three rooms of the old ICU. Room B shows the room space requiring situation of operating the patient directly at the ICU and while the patient lies in the ICU bed.*

The architect's plan showed a lack of detailed knowledge about the work procedures and errors in room layout and several mistakes in the architect's plan were found. One of them was the planning of too small rooms and the not reasonable positioning of the patient bed and their installations of devices. Figure 2 shows the room layout of the architect.

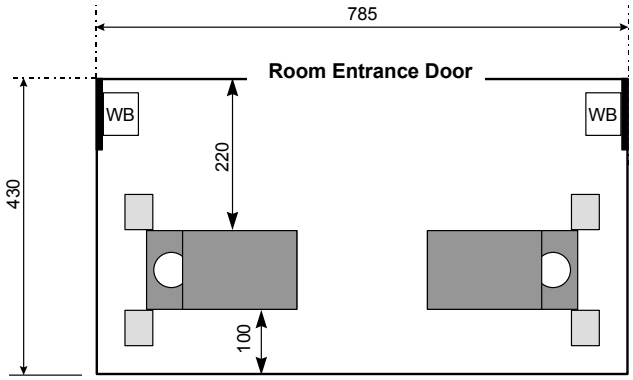

***Figure 2**: The architect's proposal for the layout of the new ICU rooms with two patient beds. Dimensions are in cm.*

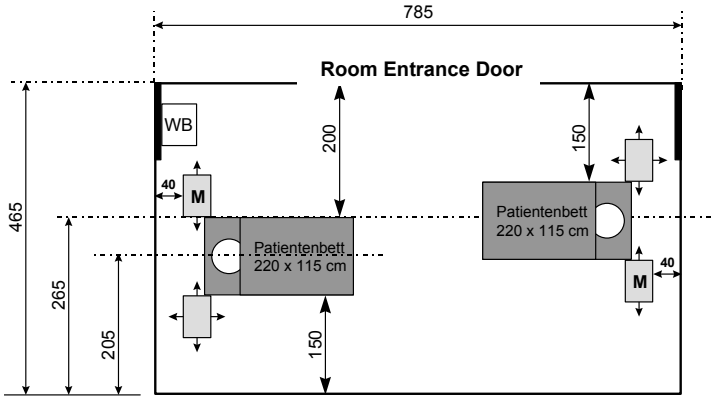

***Figure 3**: The final (after impact of ergonomic study) design of the new ICU room of two patient beds. Dimensions in mm. Comparing to the architect's plan the basic changes are the increment in room width, the shift in the patient bed face-to-face position and the removal of one of the washbasins (WB).*

4. Discussion and/or Conclusions

The evaluation of the architect's plan showed some serious errors in the room layout of the planed ICU facility. Those errors were detectable by applying task analysis knowledge to the architect's planing. Some of the mistakes built hindrances for example doors which did not allowed to enter a single patient separation room (purpose: to separate the patient) together with the patient bed. Some other mistakes and discussions showed the architect's to narrow focus on aesthetics for example a passage in a corridor control desk furniture element. It was planed due to aesthetic appearance exactly in the middle position of the corpus and therefore would lead to obviously unnecessary roundabout routes for all nurses (beside of this the planed passage was found as to narrow for the passing of two peoples).

Looking to the planing process the incorporated users were not provided with numerous of technical plans in numerous versions and in different scales but not with an appropriate visualisation. It was the work of the ergonomic professional to build a model of the new facility (figure 4) for to improve the understanding and user knowledge acquisition.

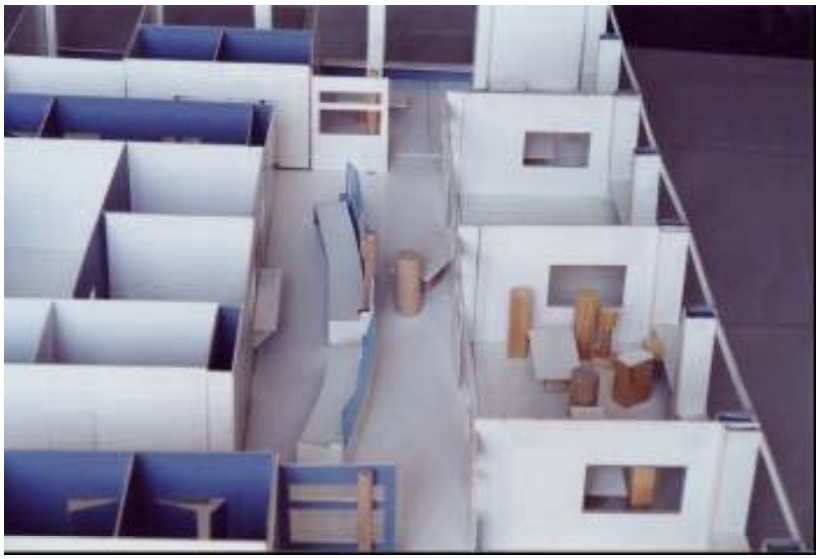

Figure 4: *The model (scale 1:25) built by the ergonomic professional to overcome the difficulties of both planers and users to understand and anticipate the new design solution; and to have a tool to support work process simulation and user participation.*

Detail knowledge of work processes is an urgent demand when planing hospital's facilities. For example: At ICU's the mobilisation of patients is a concept of importance to support the patient's therapy and to shorten the patient's stay at the ICU. But this mobilisation needs appropriate room space when using the procedure with a separate chair beside the patient's bed.

As seen in figure 4 the ICU is planed with a control desk in the centre of the corridor. In Switzerland those central control work stations are an often used concept when redesigning or new designing ICU's. But detail task analysis showed that communication about the patient's status and therapy takes a noticeable part of the work time and is done at the patient's bed. Thus it is not to recommend (but unfortunately realised at some hospitals) that the architectural ICU concept of a central control desk lead to smaller patient rooms. Because the work and time spent at the patient bed represents an important process learning and information knot in the system. The question about central control desk is furthermore the trade off between having a good surveillance from a large banana-curved desk and having a road block. Because the desk is standing between the patient rooms and the medication, materials, and device storage and preparation rooms.

5. References

1. SGI 1991. Directives pour la reconnaissance des unités de soins intensifs (USI) par la Société suisse de médecine intensive (SSMI-SGI).