

# OR & ICU: The Hospital Of The Future

## Introduction

The Operating Room (OR) and the Intensive Care Unit (ICU) are critical 'care areas' of a hospital, but expensive and difficult to plan because their required capacity can be unpredictable, and because they must be highly integrated with logistics, data management, and medical technology.

Better solutions must be developed prior to architectural planning by integrating all the fundamental elements. Industrial planning of the human care process, and 'production control' during the process, are essential and should not interfere with emotional, human obligations to the patient.

## Basics

Medical care has traditionally been divided into ambulatory care and hospital care. A new integration of these fields is now needed to increase care quality and effectiveness. The Electronic Patient Record (EPR), as a lifelong medical record, may become common for the physician in private praxis and in the hospital. Home care or supported home care opens up the hospital, such that only part of diagnostics and treatment will remain inside the hospital and in-patient treatment will remain only for the severely ill or for acute care patients who require observation.

At the other end of the spectrum are those treatments which are changing rapidly, where surgical intervention is switching more and more to interventional procedures such as cardiac revascularization, or the cases of lung or liver metastases, where laser or catheter related interventions are replacing traditional operations, giving the patient an overnight observation only and greatly reducing costs.

The architectural and design consequences of the above changes will be important. Hospital design and operations must change from the ground up since, there are no valid data to predict the shifts in patient care for the foreseeable future. Hospital design must be flexible, and components such as specialized intervention areas must be capable of being quickly altered.

## Hospital design

### Normal Wards

Design and operations must be extremely flexible. So any ward may be used depending on demand, for example as:

- A hotel (i.e. for patients not able to arrive in the morning, preinterventional)
- A hotel with electronic observation (e.g., wireless monitoring of cardiac patients)
- Observed care (maximum one nurse), i.e. for old people with mental disturbances; doors normally closed, patients under observation
- A normal ward with a centralized buffet area, so patients will mobilize much more to get food (minimal nursing activity, since nutrition, room care with preparation of beds etc. are done by 'hotel' employees)
- A normal ward, like those available today - only for immobilized patients
- A ward used for observation, or as an intermediate care area with movable work place

In this scenario, the bed is no longer for routine transportation, since it is primarily an early rehabilitation device. Cheap and quickly movable trolleys will do transportation. The bed will allow the patient to sit up without personal assistance. These types of beds may be rented for home care and will be used also outside the hospital.

The whole hospital will have wireless data access, so RIFI patient and personal detection and communication and monitoring will take place anywhere.

In traditional hospital wards, analyses of the nurse activity show that only 30% is related to the patients, so these changes must take place.

### **Ambulances**

All rooms will be multi-function, with some exceptions such as ophthalmology examination rooms. They will make use of electronic guidance for special purposes, such as tumor boards, pain services, etc.

If not pre-existed in the EPR, the data from case history and general examination will take place by nurses in centralized areas where required blood samples will also be taken, and coronary disease tests such as bicycle exercise will be performed. The specialized physician will focus on his main business, examine acute disease related topics, and take informed consent from the patient.

Physicians would stay only for rounds or for specialized circumstances on the ward, since those physicians with the best knowledge must see the patient at the beginning of his period in hospital, so as to determine the best clinical pathways for the patient as earliest as possible. There has been a study in Greifswald where 90% (!) of physicians' activity on a normal ward could be redirected to the ambulatory area.

### **OR**

Since centralized care in a region may change dramatically, and the nature of intervention may also change faster than is easily predictable, architectural design has to be extremely flexible.

Maximum flexibility will be possible if there is a primary hall with supporting electricity and gas mains, etc, sited in the ceiling of the hall. The operating room theatres will be separate 'islands' in this hall, getting their energy at connections in the roof/ceiling. This concept encompasses the option of replacing a traditional OR with, for example, a cardiovascular intervention theatre (island) within one day. The composition of the theatres can be guided by workflows or emergency situations. A vascular surgery OR may be placed side by side with some radiological intervention theatres, or the cardiac OR may be next to the cardiac labs, so transferring the patient in emergency situations can be carried out without any loss of time.

Additional, preparation prior to, and observation after an intervention may take place with the same logistics and within the same area, in the neighbourhood of the OR facility.

The economic pressure to achieve more efficiency in the OR (typical in Germany at now are about 60% of a daylight work shift is surgical activity which is much worse than data in industrial work places) is also valid for the other interventional or diagnostic workplaces inside the hospital. Therefore, a common headquarters to coordinate control of the processes will be established. Here the availability of patients, their successful preparation, and safe care process will be guided and observed. Centralized monitoring of patients in wards or in interventional areas (such as in endoscopies, where sedation with the danger of hypoxia can occur) will be carried out, and emergency personal will be sent to a given patient as necessary.

## **Holding Area**

Availability of patients, their preparation and – if necessary – regional or general anaesthesia will take place in this area, so a well prepared and stabilized patient will arrive in the OR/intervention theatre just in time, as happens in industrial work flow. Postoperative/post intervention observation will take place also in this area. By computer simulation the exchange of a patient from the end of intervention to the start of the next intervention will be performed in less than 10 minutes, increasing the OR efficiency for 1 hour procedures from 60 to 83%.

Privacy or required isolation for patients in the holding area facility may be given by small tunnel-like 'islands', placed where needed in the area. Supplies will arrive as for the OR, from the top of the room via a flexible tube.

The concept of such a holding area is also a buffer for the ICU`s, and could give the hospital the required capacity for disaster situations, where 20 or 30 patients may arrive and need care in addition to already occupied ICU beds.

## **ICU**

The ICU will see the same basic concept like the OR area, only the 'islands' will be smaller. The single patient island is the future of the severely ill patient, since patient disturbance of sleep or stress due to activity in his bed area (such as reanimation of another patient) prolongs the care process and reduces immunological activity. Transfer of bacteria will also be reduced by standardized hygiene procedures throughout the hospital, so patient isolation will increase safety. Older patients with co-morbidities will stay longer in the ICU, so this is another reason to switch to single room islands. The island must be small, but with patient access to window space, to wall-mounted TV, or the the door in order to contact staff.

The patient related ICU technology is to be focussed on a a mobile trolley, which would include all patient support and could accompany the patient to CT-scan etc. without any interruption to the care process. This arrangement is evaluated and effective.

## **Logistics**

### **Patient Transportation**

For all patients who are unable to get to hospital on their own, there will be a special transportation service, staffed by older paramedics who can thus continue in employment and carry on using their knowledge and experience to care for patients. Transportation will make use of trolleys.

### **Used Technologies**

Monitoring, ventilation and fluid management will be standardized throughout the hospital. In Acute Care areas like the OR and the ICU there will be trolleys collecting all the needed technology for the patient care, supported by a patient-related computer at the trolley. This provides an opportunity to use virtual instruments and to make use of technology that enables algorithms directing medical care at the bedside.

This acute care workplace will be identical in the OR and the ICU and in emergency settings, so training and experience of acute care personnel is guaranteed.

### **'Drawer Concept'**

The availability of a common logistical module throughout the hospital is another important step to increase effectiveness. This module will remain in a cabinet (ISO) well prepared with,

for example, material for and wound revision. The same module is capable of serving as a support device to the ICU for one shift or for an anaesthesia procedure in the OR. In addition, this module may serve as a bowl for washing the patient or, with a cover, as an bedside table next to a bed or next to a trolley for ambulatory surgery.

## Status Of The Development

University Hospital Greifswald is a complete new build, to be finished in 2008/9. The main principles of this vision will be integrated; some, like the holding area and transportation concepts, are realized now. We are preparing the previously described introduced Hospital Information System as a regional concept. Some technological solutions are still in development and in a secret stage of industrial cooperation.

Since Greifswald County has a low density of population, as in a lot of other European areas, those concepts with additional regional emergency concepts may be of interest.

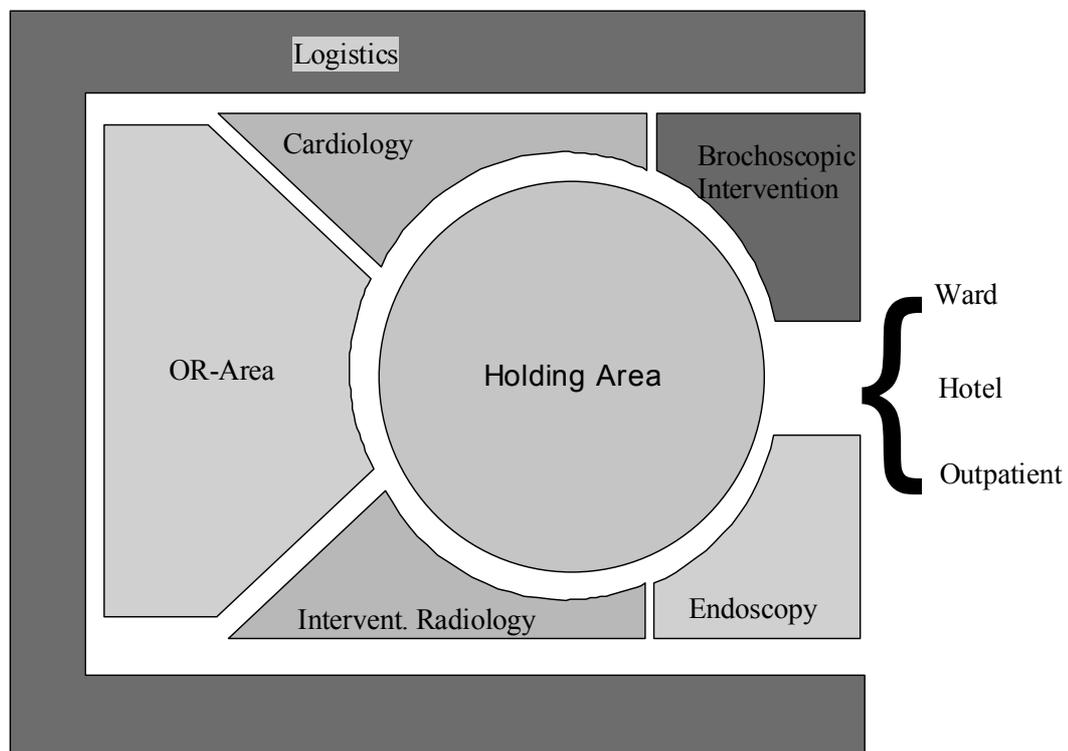


Figure 1: The concept of a holding area as a service area for interventional / diagnostic procedures

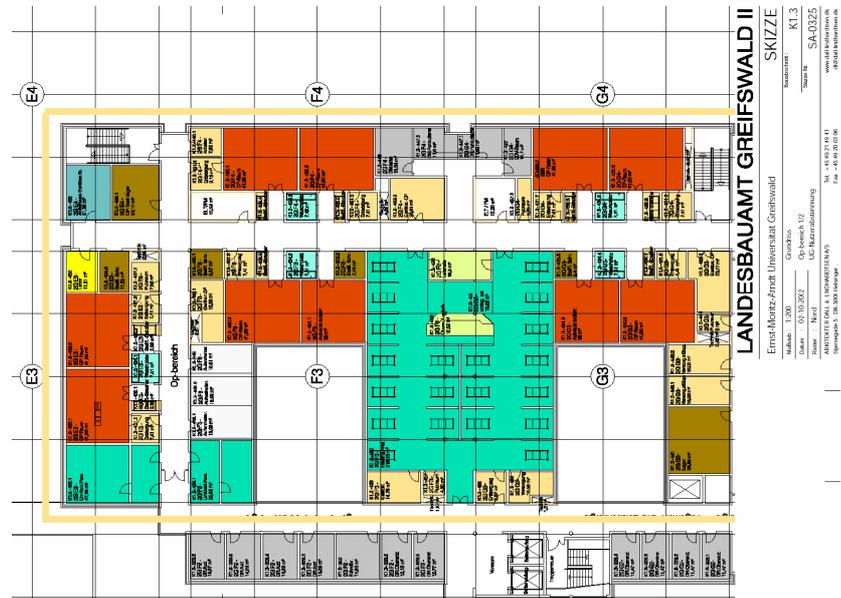


Figure 2: Holding Area and flexible wall OR`s in the new University Hospital

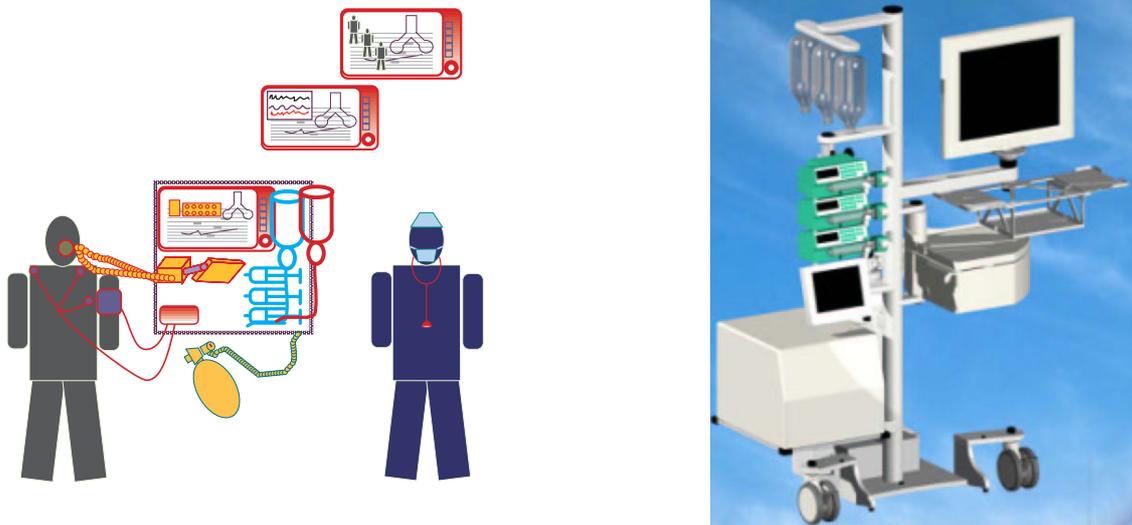


Figure 3: Theoretical concepts for the Virtual acute care Work place, early design prototype

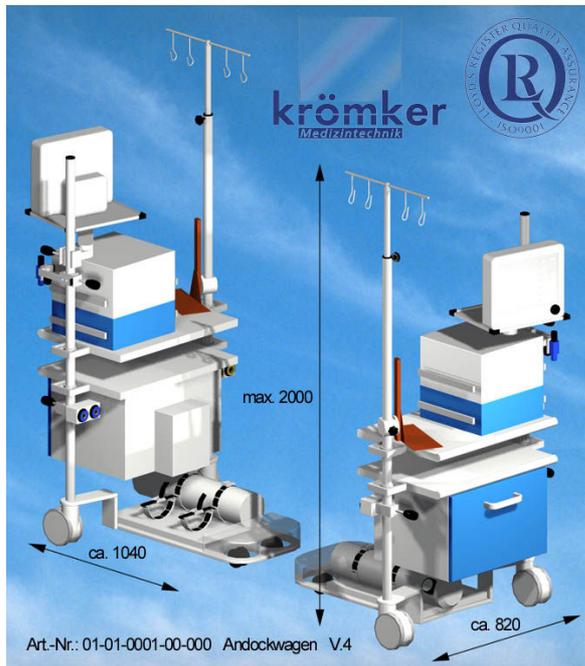


Figure 4: Another prototype and the current working model using currently available equipment