ARCHITECTURE AND HEALTH CARE

There is not probably any other profession in the world that can be called more humane than human healing. To fight for the life of man, for its most basic functions in a wide-ranging battlefield extending from the tiniest cell to the incomprehensible mental functions. It is an alloy of science and skill, the only subject of which is MAN.

The beauty and delicacy of Hungarian language is well demonstrated by the fact, that it derives the concept of mental-physical well-being from the word „egész" („whole"). Wholeness assembled from innumerable parts and elements is like a straight line that a convergent curve can approximate but can never reach. Perfection, wholeness are relative terms which we look at as a guiding light while skirting the obstacles rising in front of us, and sometimes failing to observe, that we are walking in one place or even stepping back.

The issue of health concerns everybody, wherein a little can be done by all but much can only be done by a few in respect of it. We architects belong to the select few, because our responsibility is to shape our artificial environment the effects of which create the fundaments of wholeness.

Based on the above line of thoughts this chapter could be well about the wholeness of architecture, but of course, this is not the case, I merely tried to illustrate the depth of our professional responsibility on the pretext of this title. Why here, in connection with healthcare buildings does this question arise? The answer can be sought in the human psyche.
When do we get in contact with a healthcare building?
A few random examples:

- when we are born, or
- when we die, or
- when we are in pain, injured or ill,
- when we prevent illness,
- when our child is born,
- when one of our kin dies,
- when our loved one is in pain,
- when we care for somebody.

In each of these cases we are in an elevated mental state, sometimes under positive but most likely under negative influences. Every people is much more sensible, much more vulnerable in such state, this fact does not need to be scientifically demonstrated. Its physiological trigger is stress the effects and triggering factors of which is the subject of an independent discipline, called psycho-neuro-immunology. No architect should be scared away if encountering this tortuous jumble of words, because this discipline is our support first of all, and its findings are advisable to be made use of, especially when designing healthcare buildings.

Before beginning to practice their profession, doctors take oath according to Hippocrate's aphorism, which binds them throughout their life. „Life is short, art is long, opportunity is quick, experiment is dangerous, judgment is hard. And it is necessary, that not only the doctor should contribute to doing what is needed, but the patients, the *environs* and the *external conditions* too*."*

I believe and admit, that the oath has also relevance to us, because the one who is shaping the environment of healing activity, himself becomes part of the process. According to Maslow's pyramid theory, as long as the basic necessities of human life are not satisfied we can not even address the functions being at a higher level. And the basic

necessities do include most expectations towards an artificial environment, whereas healing activity is situated on a step higher. Thus, our responsibility is enormous. A fresh graduate architect stands just as helplessly in front of a hospital planning program as his doctor colleague does over the labyrinth of an open surgery area. There is not any other types of public building where so many restrictions, written and unwritten laws would guide the architect as in case when designing a hospital, and yet the outcome should be much more than a mere compliance with these. To achieve this, talent alone is not sufficient, much learning, experience and empathy were also needed.

Health care buildings

The table below shows all kind of typically healthcare institutions, but this note primarily engages only in hospitals, that consist of everything, which in the others is present only in parts.

Users	**Type**	Versions	Characteristics	Samples	Architectural aspects
Only out-patients	**Surgery**	Family doctor, dentistry, private service	1-4 surgeries, family-house scale		Waiting room, separated infectious entrance
Only out-patients	**Polyclinic**	Local, or part of hospital	Multiprofessional, independent		Spacious waiting rooms and corridors
In- and out-patients	**Hospital**	Local hospital	100-400 beds min. 4 departments		Relatively large service area
		Territorial (County) Hospital	~800 beds	Herlev Hospital Copenhagen	Heavy duty,
		Private hospital	Multiprofessional	Mayo Clinic	Top service and comfort in hotel function (for fee)
Under 14, in- and out-patients		Childrens' hospital	Multiprofessional		Interior design specially for kids, suites for parents, special dimensions
Soldiers or civils in need		Emergency hospital	Primary life-saving care	Military camp-hospitals	Modular system, transportable
In- and out-patients	**Special clinic**	National Institutes	Monofunctional head institute of its profession,		Large diagnostical and therapical basis, scientifical and educational functions
		University Clinic	Educational medical institute		Independent clinics with educational and scientifical functions (lecture hall, campus)
		Private Clinic	Monofunctional institute for special needs	Maternity, and plastic surgery clinics	High comfort, very economical design
		Rehabilitation Institutes	Long term care institute for rehabilitable patients		Handicapped patients, training fields, rooms
Out-patients		Day-care institutes	Daily treatment	Oncology Psychiatry	Home-like, non-hospital environment
Only in-patients	**Nursing hospital**	Nursing hospital for long term care	Long term care intstitute for incurable patients		Very human enviroment, hospice units

Healthy elderly people		Third age home	Appartments with basic medical services		Healthy, barrierless enviroment, large garden
Only in-patients		Sanatorium	Monoprofessional institutes based on special local values (thermal spring)		Natural enviroment, high comfort, spacious
Consumer	**Pharmacy**	Shops and laboratories	Public shop, closed chemical lab.		Commercial units with safe and clean background labs.
Users	**Type**	Versions	Characteristics	Samples	Architectural aspects
Donors	**Blood bank** **Organ bank**	Blood donation institutes National blood reserve Organ transplantation system			Donation stations are public Laboratories, cache system are strictly closed Emergency traffic system
None	**Scientific institutes**	Laboratories Anatomic institutes			Closed for public, Strict safety and security policy High-tech systems
Emergency	**Ambulance stations**	Ambulance cars, helicopters, boats, aeroplanes	Duty stations		Garage, helipad, little airport

History - short

Age	History of medicine	Famous fellows of medicine	building type	sample	Conclusions
Ancient Egypt	anatomy observations	Imhotep - father of medicine	Mamisi - maternity facilities		connected to temples
Ancient Greece	- irrational medicine - rational medicine	Asclepius Hygeia Hippocrates	Asclepion Iatreon	Island Kos	First quote of Hippocrates
Ancient Rome	anatomy internal medicine surgery	Galenos Antyllos	Xenodichium Taberna Medica Valetudinaria	Eastern Roman E. Vetera II. Xanten	Treatment area in Valetudinaria Hygiene
Ancient India	Ayurveda	Atreya of general medicine Dhanvantary of surgery	hospital temples	MihintaleSri Lanka	holistic medicine
Ancient China	based on 5 elements no bloody interventions	Huang	no hospitals		preferred prevention
Middle Ages Persia and Arab world	summary and development of ancient experiences	Avicenna Abu'l Casim	Bimaristan	Damascus, Aleppo Devrigi	today's science is based on their books (Canon)
Middle Ages Europe	medicine="turpis curiositas" prohibited limited science in universites	St Cosma and Damian Mondino dei Luzzi	hospitals lazarets monastery infirmary	Siena Beaune, Tonerre Nürnberg Rome Toledo	only nursing, work of mercy
Renaissance	anatomical research, training blossoming universities	Vesalius Ambois Paré William Harvey Paracelsus	large hospitals mad house,spa pharmacy anatomy theatres	Milan Greenwhich Padova Barcelona	separation of diseases real treatments
18th C French Revolution	crowded hospitals diasaster of Hotel Dieu in Paris pneumatic principles		new plans of Petit, Poyet, Tenon, Leroy	New Hotel Dieu, in Paris	separation of pavilion wings good ventillation large wards Block Comb System
19th C	discovery of asepsis, narcosis Xray	Semmelweis Pasteur, Lister Fl. Nightingale Morton Röntgen	large hospitals on the periphery of towns	Paris Berlin Budapest	System of Isolated Pavilions
1900-1945	vaccination ECG Antibiotics Nuclear medicine	Fleming Einthoven Curie	USA:: block hospitals Europe: one-corridor type	New York, Boston Clichy Basel, Stockholm Paimio Budapest - Kútvölgyi	Ernst Kopp: Low of shortest routes block hospitals, Sanatoriums
1945-1980	developing imaging and chemical medicine CT, MRI		Mega-clinics Breitfuss hospitals Snail type Policlinics	Amsterdam Copenhagen (Herlev, Hvidovre) Aachen	advanced medical technology, impersonalization, heavy duty logistics
1980-	detailed imaging technology, robots		wings connected by a main axis 1-2 bed patient rooms	Skejby - Aarhus Toulon Toulouse Madrid	humanization of hospitals Structured system, maternity institutes
future	personalized therapy		concentrated tehnology, short term care, telemedicine home care,	Scandinavia	high tech centres for intensive therapy, home-like nursing

Five main functional areas

1. HOTEL
(in-patient departments, nursing units)
2. DIAGNOSTIC AND TREATMENT
(imagery, chemical, physical, ER, operation, maternity, rehabilitation, nuclear, etc.)
3. POLICLINIC
(out-patient services)
4. ADMINISTRATION
(management, education)
5. SUPPLY
(medical - pathology, autopsy, pharmacy, logistics, desinfection, social, energy, maintenance, etc.)

1. HOTEL

The basic unit of hospitalization is the *nursing unit,* which consists of 15 – max. 30 (in some special cases 35) beds. The essence of it is, that the unit must be supervised by one nurse station and it should be specified medically. The nurse station is the nerve-centre of the unit, all the information arrives here and every activity starts from here. It is usually designed as an open reception desk, the nurse sitting behind the counter must have clear overview on the corridors, and it is favourable being closed to the entrance. Around the nurse station are the most important service rooms (clean and dirty utility rooms, teakitchen, desinfection room), the wards of patients who need more attention (in Hungary we call this rooms subintensive), and the living room, where the patients can have social intercourse. Each unit have still examination and treatment room, extra bathroom – where patients are washed by paramedical staff, staff room, toilets for visitors, cleaner's room

4.01. Department with 3 nursing units + intensive unit, Detroit Receiving Hospital, USA (1979)

4.02. Nurse station, Szt Imre Hospital Budapest (2001), Arch.: SCHRAMMEL Z.

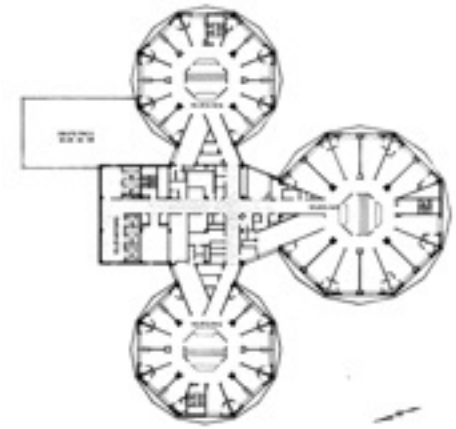
1.1 Plan types of nursing units and departments

One longitudinal corridor plan

Most spread standard since 1930. It provides cross ventilation and natural light for each room, it is clearly arranged, flexible, but the internal distances are very long.

Double corridor plan

This system is far more efficient from the point of view of internal routes, but the rooms in the core need permanent artificial ventilation.



4.03. Compact circular plan, Scott and White Memorial Hospital, Texas (1964.)

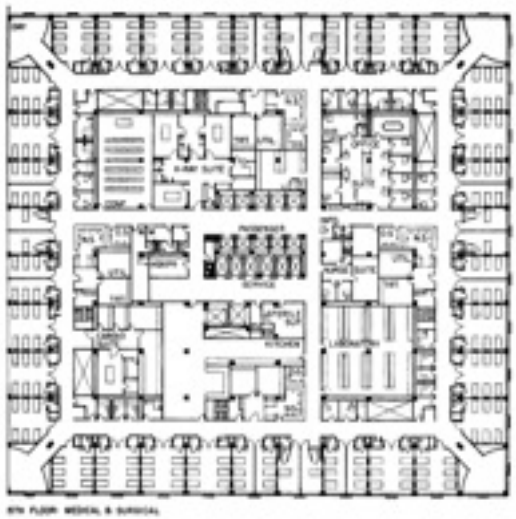
4.04. Double corridor plan,Szt Imre Hospital, Budapest (2008.) Arch.: SCHRAMMEL Z.

Compact circular plan

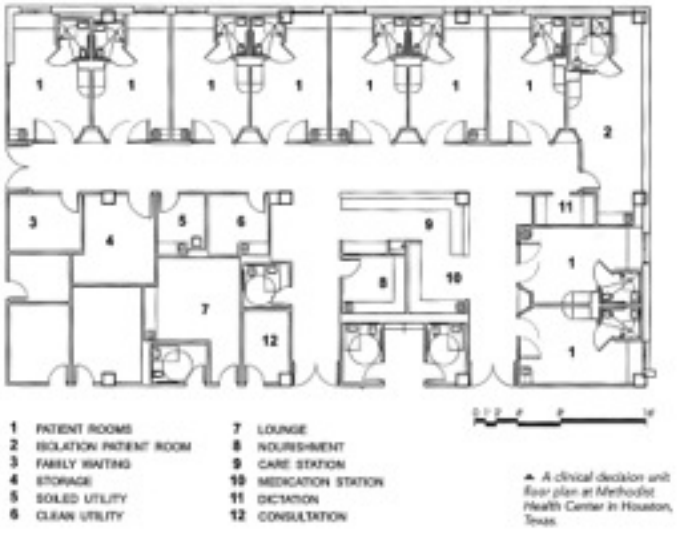
The form of units is very characteristic, which may influence the general design approach of the whole hospital. However the efficiency ratio is good, and the distances are minimal, this system appears very seldom in the international practice, because the flexibility is low, the rooms can be furnished only extraordinary.

Compact rectangular plan

With a little worse ratio this arrangement gives larger flexibility and needs cheaper constructions. “Bedtowers” can be hardly tolerated by general architectural aspects.



4.05. Typical hotel floor plan of an American high block hospital



4.06. L shape nursing unit

L shape one corridor or cross system

It is originated from the longitudinal corridor system. The efficiency ratio is increased with placement of nurse station into the elbow from where she has a good overview. The simplicity, flexibility and low costs are the advantages of this system, which can be multiplied in different ways – cross, row of L-wings, T-shape, etc.

1.2. Progressive Patient Care

The most up-to-date way of caring is the Progressive Patient Care, which influences the plan of nursing units too. The essence of it is, that each patient has to get the most effective – intensive medical service, but immediately when his or her status allows the patient is sent to a lower rank of caring – which provides more comfort. PPC has 6 levels:

I. – **intensive** (patient needs continuous monitoring and personal observation in the bed, primary life functions need artificial external support, immediate interventions has to be available in-situ, full-service nursing, possibility of separation).

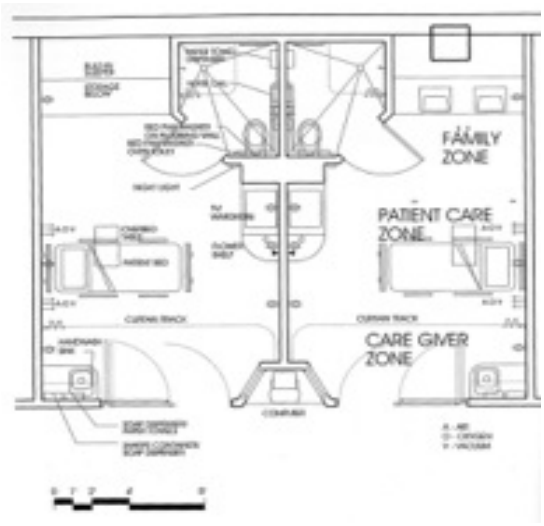
Intensive care unit (ICU) is always an independent department provided with full mechanical support (sterile HVAC, medical gases, energy back-up system).

In case of *open system* beds are placed around the nurse station, from where the nurse may observe each patient visually. The isolation can be solved only with curtains, the max number of beds is 10-12. The intimacy of patient area is hurt.

The *closed system* is supported by heavy electronic systems, which transmits all the physiological information from the bed to the nurse station – this is the full monitoring. Patient lies in one-bed room. Gases, air, vacuum are provided from a movable service column hung to the ceiling. Closed system needs larger apparatus and staff.

The most spread solution is the mixed, large intensive room (min 12 sm/bed) extended with one bed rooms – each min 12 sm. The unit is separated from the general corridors by a *sluice* system.

II. **normal** (patient needs continuous monitoring and occasionally personal observation in the bed, primary life functions need to be checked, full-service nursing, possibility of separation, in Hungary we call it sub-intensive care).



4.10 . Milford Hospital, Arch.: TRO.

4.11. Plan of a one-bed-ward, USA

III. **Self-care** (the most common level, the personal observation is occasionally, the nursing service is according to the needs).

Wards are provided with bathroom WC and a niche with table and armchairs for living activities (family zone). Direct access to the garden or terrace is favourable. HVAC is not required, but increases the comfort. Floor area is 8 sm/bed, in case of single bed room 12 sm. Beds have to be accessible from three sides.

IV. **Long-term-care** (for patient with chronicle diseases, who are in most cases old and handicapped. Personal observation is occasionally, the service is according to the needs).

Wards are provided with bathroom WC and a niche with table and armchairs for living activities (family zone). Direct access to the garden or terrace is favourable. HVAC is not necessary, but increases the comfort. Floor area is min. 8 sm/bed, but the space for wheelchair traffic has to be assured. Beds have to be accessible from three sides.

V. Home-care

VI. ***Out-patient care****,* which employs only the diagnostical and therapeutical services of the hospital. Primary treatment is available at the polyclinic. Special nursing units

1.3 Special nursing units

Pediatric Patient Units require design of appropriate scale for children. Designing rooms that contain nooks and crannies, areas in which kids can play, hide, and feel secure, can help to allay fears and reduce boredom. Views of the outdoors, scenes of nature and various colours enhance healing and feelings of well-being for the child, as well as for the parents. One of the most overlooked areas of pediatric unit design is the impact on care providers. Nursing staff, for example, must have the ability to keep patients both entertained and quiet. Both needs are affected by design. Providing nursing staff with the necessary visibility to pediatric beds is critical.

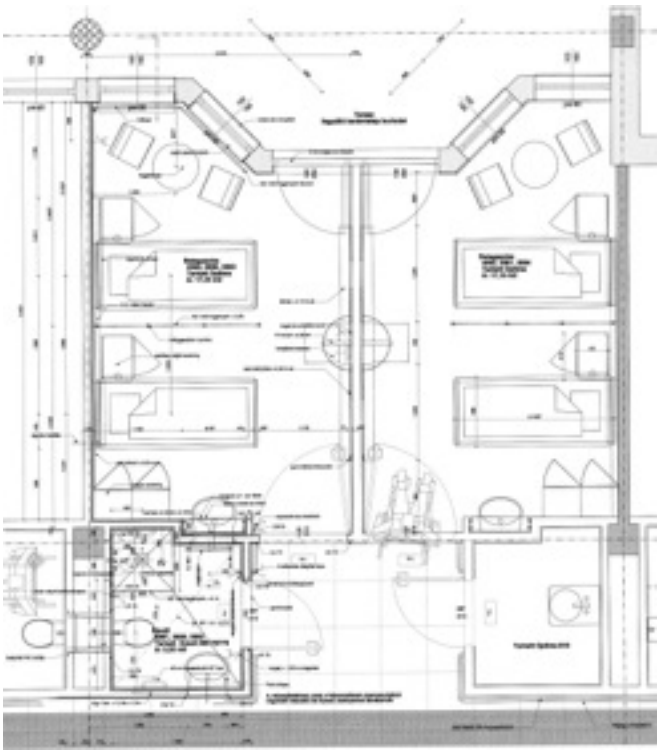
4.12. Hasbro Children's Hospital, Rhode Island, USA (1994) Arch.: SHEPLEY, BULFINCH, RICHARDSON, ABBOTT

4.13. Centre of a pediatric unit, Children's Hospital and Health Center, San Diego, USA Arch.: NBBJ

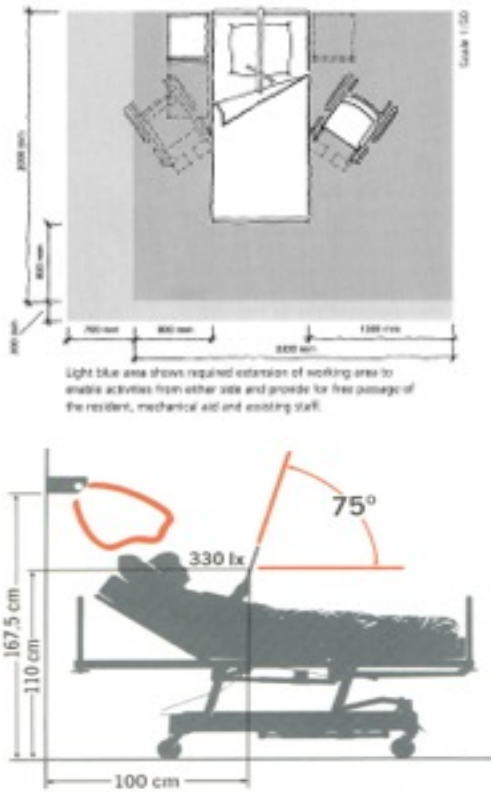
The higly stressful nature of pediatric nursing also requires planning for staff areas that enable caregivers to “regroup”. Providing nursing staff with areas that have access to the outdoors or to views of nature is a highly effective means of ameliorating stress and reducing burnout.

Nursing units for cancer, AIDS and infectious diseases
The need for these nursing units has been changed very often in space and time as well. In Europe, and in the developed countries until 1980s infectious diseases seemed to be terminated, when AIDS became recognised as an epidemic. Consequently, inpatient unit design design must provide a small percentage of rooms with positive air exchanges in order to protect at-risk patients. Positive airflow means that the air pressure in the ward is positive in relationship to the air pressure in adjacent rooms.
Rooms of infectious patients need opposite – negative airflow, which is exhausted directly to the outside of the building (after filtering). All these rooms need anterooms – sluices for visitors/staff to change clothing, and desinfectioning hands.

The patients while in hospital are accommodated in *patient rooms (wards)* in which regard there is disagreement over the optimum number of beds. The old, multi-bed wards in the Fifties and the Sixties were replaced by six-bed (3 on each side) and later, as comfort increased, by 2 to 4 bed patient rooms where the depth decreased because of the adjoining sanitary block.



4.14. Two-bed-wards with bathroom opened from entrance bay, Szt. Imre Hospital Budapest, (2001) Arch.: SCHRAMMEL Z.



4.15. Space requirement around the bed
4.16. Down: optimal illumination (Trilux)

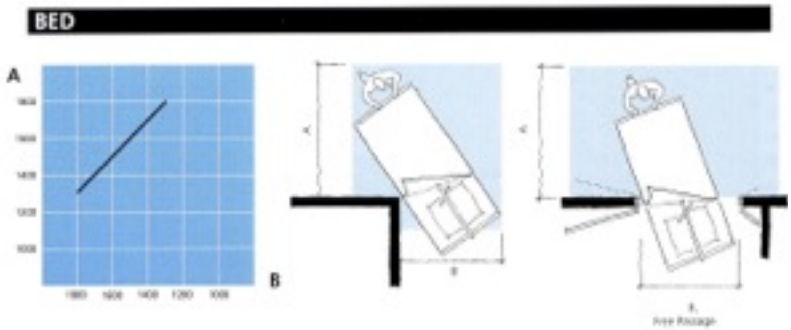
The *patient room* is the patient’s temporary home, hence attempts should be made to create a humane environment besides satisfying nursing and healing needs. Architecturally, in addition to positioning the beds, an active zone or corner must be

defined preferably near the window. Each room has a wardrobe to accommodate the patients' cloths and a wash basin, which belongs to the staff! Above the beds runs a *bed-rail* concealing the energy and medical gases drawing sites and the lighting.

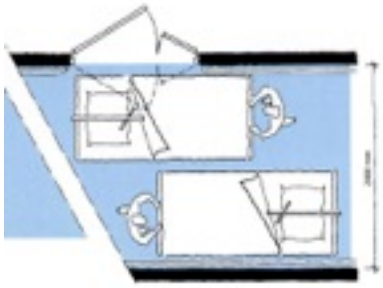
Pediatric patient rooms require a separate paragraph. Children, in accordance with their age require different care. New-born and infants lay in incubators or in very small cribs, small children lay in high railed cots or small cots, bigger children (up to the age 14) in normal hospital-beds. With the exception of intensive care, part of the rooms should be devised so, that the parents can stay there continuously (sleeping on pull-out beds), and a larger than usual active zone must be defined. For the nursing units transparency among the rooms and an atmosphere that improves the children's mood (playrooms, corners, decoration, etc.) are a requirement. The interior designs should pay attention to reducing danger sources (height of sockets, handles, safety locks, water and heating water temperature, etc.) to the minimum.

4.17. Hasbro Children's Hospital, Rhode Island, USA (1994) Arch.: SHEPLEY, BULFINCH, RICHARDSON, ABBOTT

4.18. Rainbow Babies and Children's Hospital, Cleveland, USA Arch.: NBBJ



4.19. Free passage measurements for moving with beds (Arjo Guide Book)

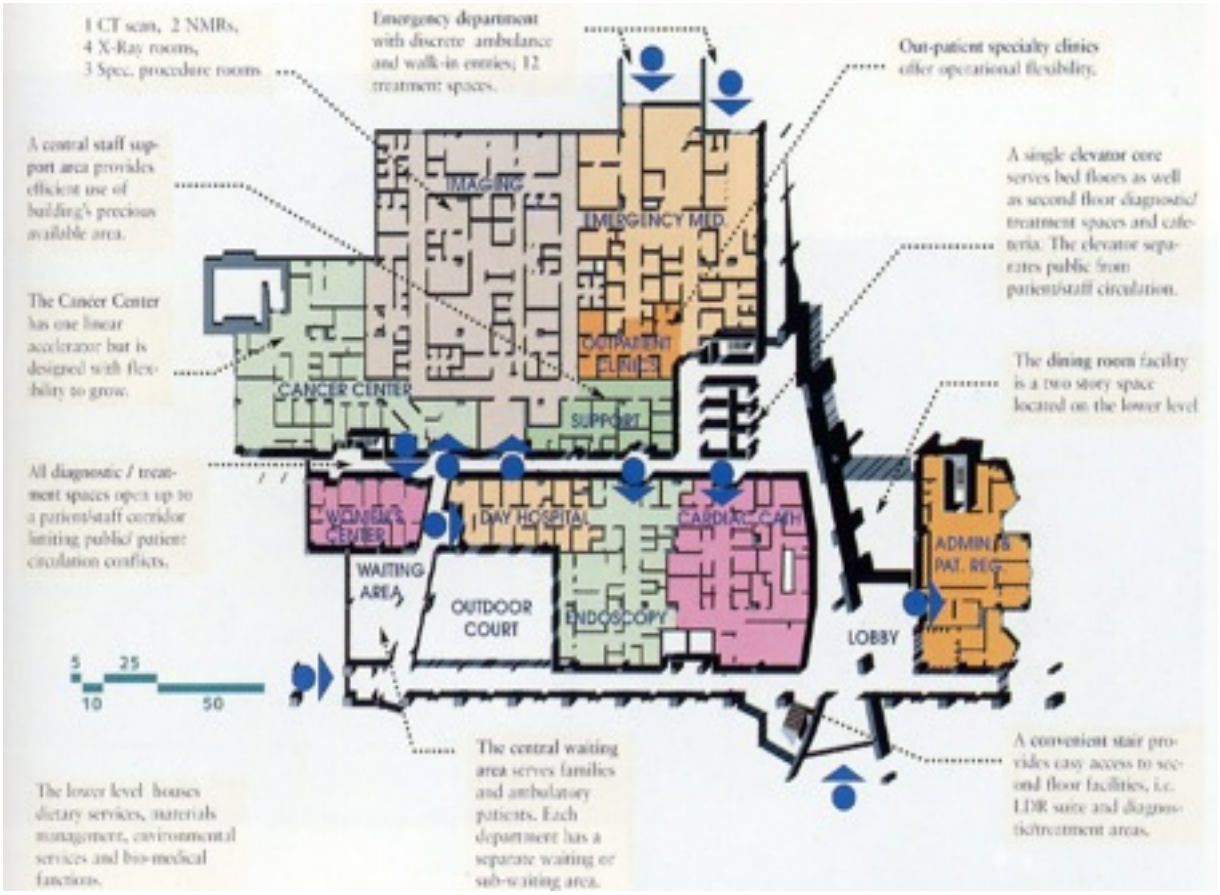


4.20. Minimum free passage size in corridor of hospitals (Arjo Guide B.)

2. DIAGNOSTIC, INTERVENTIONAL and THERAPY UNITS

These departments are critical to the provision of quality patient care. They are equipped to provide various diagnostic tests and evaluations and both invasive and non-invasive therapeutic procedures, often on a 24-hour basis. The diagnostic, interventional and therapy units operate as a technical hub to the in-patient and out-patient functions of the health facility. These departments are typically grouped together to provide integrated service.

Because of the highly technical aspect of the functions, elements should be housed in spaces concerning the technological demands. The area needs greater spans of the loadbearing structures and floor-to-floor dimensions to incorporate the myriad utility and equipment requirements. But not to forget, that in the focus stands the human, with his or her feelings, emotions, fears.

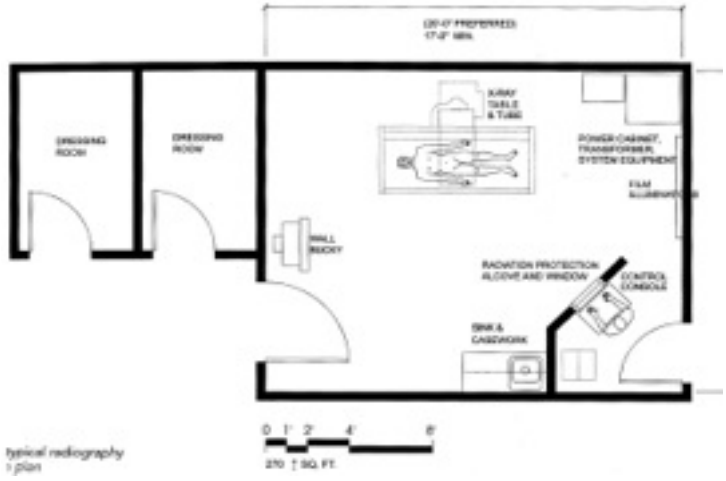


4.21. Cullmann Regional Medical Center, USA (1995) Arch.: TROrg.

Basic departments:

- **Diagnostic imaging**
  - traditional X-ray (radiography, fluoroscopy)
  - computer tomograph (CT)
  - nuclear scanning
  - ultrasound diagnostic
  - magnetic resonance imaging (MRI)

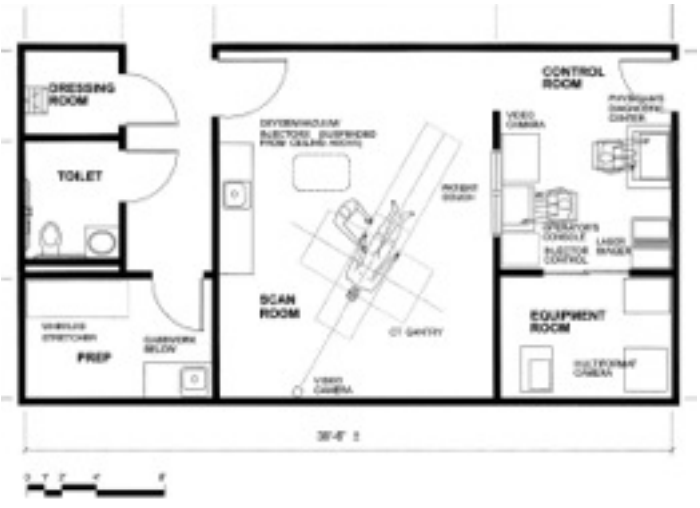
The diagnostic imaging apparatus spreads over a large area between the in-patient and the out-patient zones, therefore it is advisable to separate these traffics. The best place for it is the ground floor near the emergency department. A service corridor between the examination rooms serves the functional area where the preparation, medical certification and administration are taking place. The separated waiting rooms are spacious, fit with lots of information, a reception is there to welcome and direct the patients to find their ways over the huge area. Dressing rooms are situated in pairs between the waiting rooms and the examination rooms serving to speed up patient turnover.
The *traditional X-ray* equipment includes the *screening - fluoroscopy and exposed radiography* apparatus. The minimum sizes for the premises are specified in standards. The examination rooms are premises with danger of radioactivity, hence their walls must have a protection equivalent to 1 mm thick sheet lead – e.g. 12 cm thick solid brick. Staff works behind the protection of lead glass and doors lined with sheet lead. Equipment is usually heavy, so 4-5 kN/m^2 useful load must be calculated.



4.22. Radiography unit, USA

4.23. Evaluation room, Blekinge (S) (1992)

C*omputer tomography* needs independent procedure and control room. Examinations take as long as 15 to 30 minutes, part of the patients must be rested afterwards. The weight of the equipment is approx. 10 kN and there is radiation danger here too. Because of its high value it works continuously for 24 hours.



4.24. Computer Tomography unit, USA

4.25. CT and control room

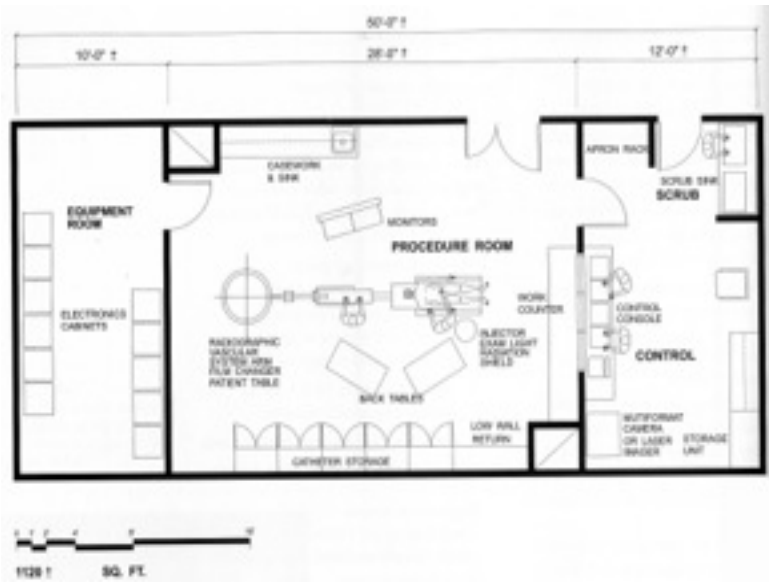
The *nuclear diagnostic laboratory* requires extraordinary careful planning, because each "inoculated" patient is a potential radiation source to be protected from contact with the surroundings. In the strictly isolated „*hot laboratory"* takes place the mounting of the isotopes, this zone is separated by a sluice system from the other parts of the building. Ventilation and the drainage system for the radioactive areas must be separated from the others. The examination rooms are designed like in case of the X ray unit, the equipment work as a detecting camera, they weight approx. 12kN each. The imaging is performed by special scanners, like: SPECT (single photon emission computed tomography), Gamma camera, or PET (positron emission tomography).

Ultrasound equipment is not radioactive, its needs an examination room that can be darkened, with dressing rooms.

The most up-to-date, patient-sparing examination method is the one that works on the principle of *magnetic resonance imaging*. MRI is performed by placing the patient in a powerful magnetic field that aligns the magnetic spin of atomic nuclei. It is not a radiation equipment, but highly valuable, and because of the extremely powerful magnet inside its weight is also enormous (approx. 100 kN). It needs a control room and a machine room with special cooling equipment.

- **Interventional diagnostics**
    - endoscopy:
        - upper gastrointestinal (GI) studies – via mouth
        - lower GI studies – via rectum
        - upper endoscopy combined with fluoroscopy images
        - bronchoscopy studies – for pulmonary breathing system
    - biopsy (sampling through needle-catheter)
    - cardiac catheterization under X-ray angiograms

Interventional diagnostics are called all those procedures, where the imaging system, or a part of it penetrates into the patient's body. Therefore the requirements of the procedure rooms are high, almost like in case of an operation theatre. Between the endoscopy procedure rooms has to be provided a desinfection room for the special instruments.



4.26. Typical special procedure angiography room at Medical Center East in Birmingham, Alabama, USA

4.27. Angiographical intervention

- **Clinical laboratory**

Most quantitative information about the status of human body is acquired from studies conducted by clinical laboratory and pathology services.

- chemistry (urin analysis, toxicology, etc.)
- haematology (blood analysis)
- blood bank (preparation and storage of blood)
- microbiology (bio-hazard, infectious!)
- immunology

In the *central laboratories* blood and urine examination takes place in different arrangements. Sampling may occur on the spot – in the out-patient department and on the wards. In this latter case the specimen are collected centrally by the laboratory staff. Patients are not allowed to stay inside the central laboratory. Spacious waiting rooms, WC boxes with a specimen-collecting window and blood taking rooms with crouches should be designed for the outpatients. Laboratories perform heavy material and administrative traffic. The *microbiology* section must be locked off by a sluice, here bacteria and fungi are cultivated, so the danger of infection is high. Today's laboratories are fully automated, these require large spaces, but *making diagnosis* also needs qualm workplace for the doctors. The unit must be fully air-conditioned.

4.28. Plan of clinical laboratory, Brooke Army Medical Center, San Antonio, Texas

4.29-30. Manual and automatical procedures at a laboratory, Blekinge, Sweden

- Histopathology analysis of tissue samples gained by biopsy, or operation.
- clinical histology
- forensic medicine

- **Noninvasiv diagnostics** -
- ECG (electrocardiogphy – observation of cardiac system)
- echocardiography (combined with ultrasonography)
- exercise stress testing
- EEG (elektroencephalography – observ. of neuro-system)

- **Special diagnostics**
- ophtalmology (examination of eyes)
- audiology (examination of hearing)

Ophtalmological examination rooms need darkness and special size. One dimension should reach min 5.0 m for visual tests.
Audilogy is most effectively supported diagnostically by two-compartment sound-isolated booths. In the booths patients are accurately tested for hearing loss, as well as the effectiveness of prescribed hearing devices. Booths are built as a house in house. The need for space is significant.

- **Emergency – recovery Department (ER)**
In the modern hospitals the ambulance takes the patients to the emergency unit where after the restoration and securing of the primary life functions. Transparency and a generously designed traffic system is essential. The centre of the unit is the dispatcher's counter, whose functional requirements are similar to those of the ward nurses' stands. The emergency units usually include *observation rooms* with 6 to 8 beds, which can be overseen from the counter. The unit is always situated between the *ambulance entrance* and the imaging diagnostic area and the proximity of the *intensive care unit* is also an advantage. The whole area requires full air-conditioning and medical mechanical background.

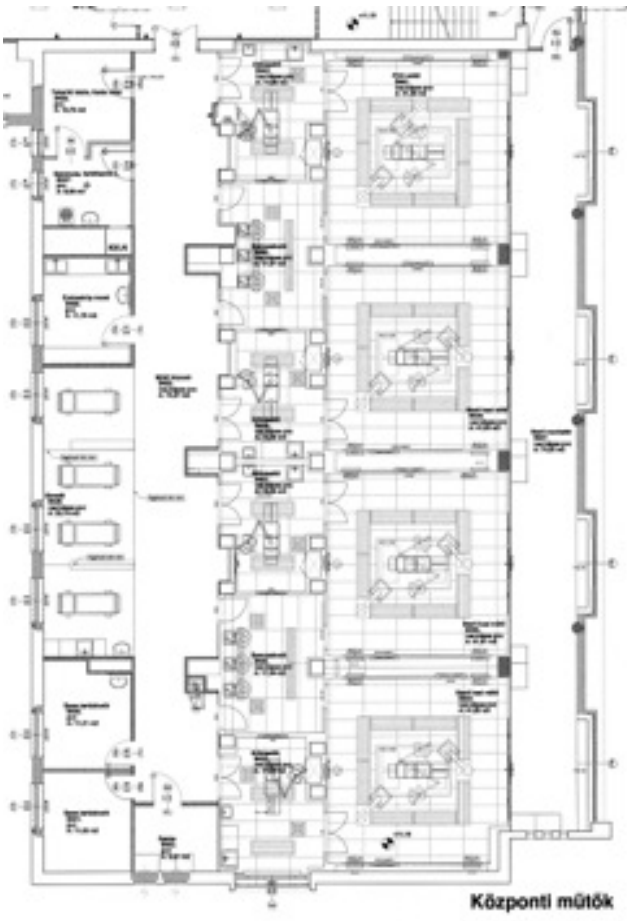
4.31. ER, John Muir Medical C., Walnut Creek,USA (1994)

4.32. Primary treatment room, John Muir Med. C., Arch.: THISTLEWAITE Architectural Group (1994)

- Central Operation Unit

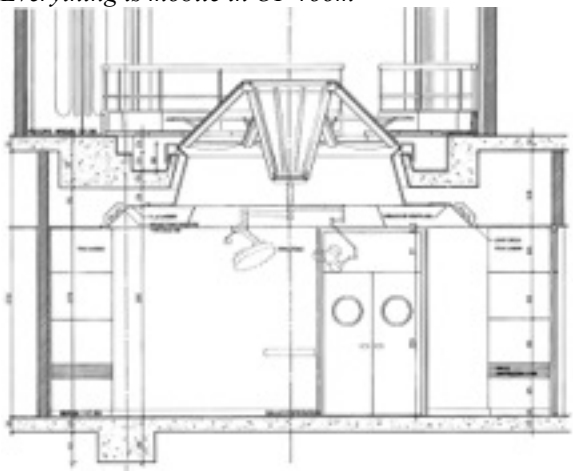
The surgical block can be entered by the staff only through a black -white, i.e. white-green system of dressing *sluice* and the patient is being shifted to the inside stretcher in a separate closed traffic area or, in better case, directly to the mobile operating table. In this latter case care must be taken to clean the table surfaces and arrange their temporary storage, which requires lots of spaces. For the surgeons there is a *scrub up* in the foreground to the operating theatre to wash and disinfect their hands and then there is an independent room for administration. A separate route must be provided for the sterile materials to reach the *nurses' workroom* from where the instruments and the surgical dressings are handed out directly to the operating theatre before and during surgery. Soiled instruments and textiles from the patient must be removed in the shortest possible way from the operation unit, for which the best solution is a little service elevator starting from a separate premise in the unit's centre of gravity.

In the operation unit the main consideration in the choice of materials is that they can fully be cleanable and disinfectable, but it should not be forgotten, that here people used to work who attend to one of the most concentration-requiring and responsible work whose surrounding must be spacious, clear and relaxing. The theatre block needs overpressure and sterile air-conditioning, the floors should be conductible and the illumination above average.



4.33. Four OP-rooms built of prefabricated panels, (Opitz und Flierl) Szt Imre Hospital, Budapest (2002) Arch.: SCHRAMMEL Z.

Everything is mobile in OP-room



4.34. Above: OP-room, Blekinge, Sweden
4.35. Down: Section of OP-room with viscopy –"roof-window" L'Hopital Paul Brousse, Villejuif (F) Arch.: C. VASCONI

- **Maternity unit**
  - delivery room
  - obstetrical operation room (for abdominal delivery)
  - neonatal unit

The maternity ward is the only place in any hospital where both, the patient and the visitor go with joy, consequently its architectural language also differs from that of other areas. The patients admitted here are not ill, and although require attention, hygiene, medical care, the main thing however goes by itself. Labor rooms today are open, i.e. they did not differ from a single room, what is more, everything is allowed from the aspect of interior designing that does not hinder the function and is hygienic. The newcomers must be made to change dress at the unit's border and from there can move about unhindered, only the *cesarean section room,* which forms the emergency background, is isolated. The maternity section is directly connected with the confinement rooms and the newborn care - *neonatal section*. During the day the newborns are with their mothers in correspondingly spacious and well equipped rooms (*rooming-in*), they are collected only for the night that they spend in a central „lodging". In Neonatology there is separately an *incubator* area for slightly endangered babies. Severe cases are treated in independent specialized unit, this is the neonatal intensive care unit „*NICU*".

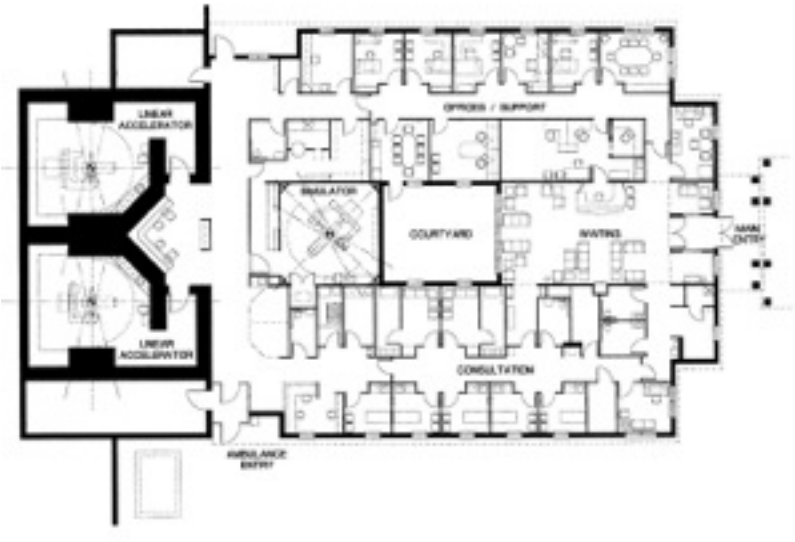
4.36. Flexible transferable maternity room, A. Arundel Med. Center, Maryland, USA, Arch.: RTKL Ass.

4.37. Maternity unit, Szt Imre Hospital, Bp. (2002) Arch.: SCHRAMMEL Z.

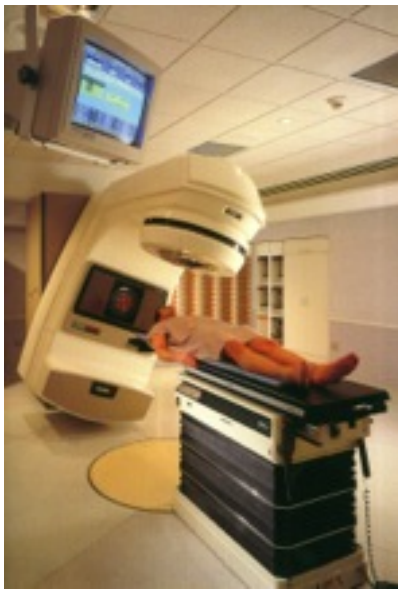
- **Oncological therapy unit**
- - radiation therapy (linear accelerator)
- infusion therapy

The unit specialized in the treatment of cancer patients primarily receives ambulatory patients, therefore the space starts with a large waiting room. *Infusion rooms after all are single bed boxes*. The unit's core is the *radiation apparatus* that uses radioactive rays to destroy the cancerous cells. Naturally, these rays are extremely dangerous to every living cell, therefore the operator must be surrounded with thick reinforced concrete walls and roof which demands a very exacting planning and implementation. The value of the apparatus itself is manifold of the building, hence this area (too) is one where technological requirements must be fulfilled without compromise. But during the interior designing of the service areas and the waiting rooms the state of mind of the patients is the determining factor which is no easier to pay attention to than technological requirements.

Radiation apparatuses are mostly accommodated in independent specialised institutes that handle regional care, therefore patient turnover is big. In Hungary Budapest, Debrecen, and Kecskemét have *oncology therapy centers*.



4.38. Bloomington Regional Cancer Center, USA (1994)
Arch.: BSA Design



4.39. Linear accelerator

Physical medicine and rehabilitation

- physicotherapy (physical, electrical, magnetical, thermal)
- gymnastics
- hydrotherapy
- psychotherapy
- occupational therapy (activities of daily living)

The essence of modern patient care is that patients receive intensive or acute care only for the possible shortest period of time and are ushered to the path of rehabilitation as soon as possible. This is not only an economic need but the need of the patients, who after the time spent passively in nursing are getting slowly activated during rehabilitation.

Rehabilitation areas require strong machinery background, especially hydrotherapy units, which need a separated system because of the strong vapour load.

4.40. Rehabilitation unit, Louise Obici Memorial Hospital, Suffolk, Virginia, USA

4.41. Swimming pool and gymnastic room, Plémet, F. (1997), Arch.: J. GUERVILLY

Units serving for the rehabilitation of irreversibly disabled persons and psychiatric patients are found in independent specialised institutions. In the former ones patients are being taught the basic acts of everyday life, the latter ones work like *day hospitals* where the patients attend group sessions.

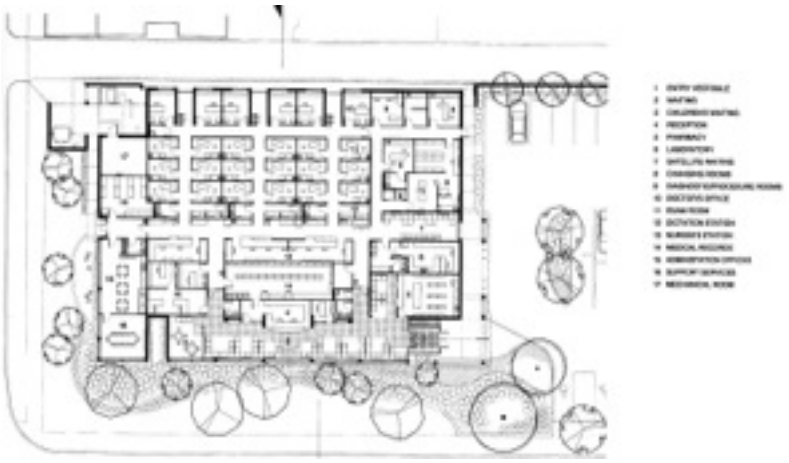
Part of the *psycho and ergotherapy* is carried out in flat-like spaces, while certain rehabilitation treatments are carried out in various workshops or in artificially devised microenvironments. These are not common in general hospitals, more likely to occur in specialised institutions.

- **Special therapy**
  - nephrolythotomy pounder (ultrasound+X-ray)
  - respiratory care – inhalation therapy (infection!)
  - renal dialysis (artificial kidney)

The apparatus serving to crush kidney stones can be built-in or can be transported there for a length of time. In both cases radiation protection must be ensured because X rays are emitted during therapy.
Inhalation therapy is mainly used by out-patients among whom many are contagious, hence division and separation of the unit is an important point.
Dialysis stations are generally independent units working besides the hospitals, handle acute toxicological cases and ambulatory care. Patients regularly turn up after every 4 to 5 days on a given date, therefore heavy traffic of ambulances and cars must be reckoned with at the gate. The centre of the stations is the dialysis room where the 3-4 hours long intervention is being carried out on 10 to 20 beds arranged in sitting or laying position. During this time the patients require supervision and entertainment. Mechanical background is considerable because the dialysis solution is being prepared on the spot by automatic equipment that require large space and material.

3. POLICLINIC

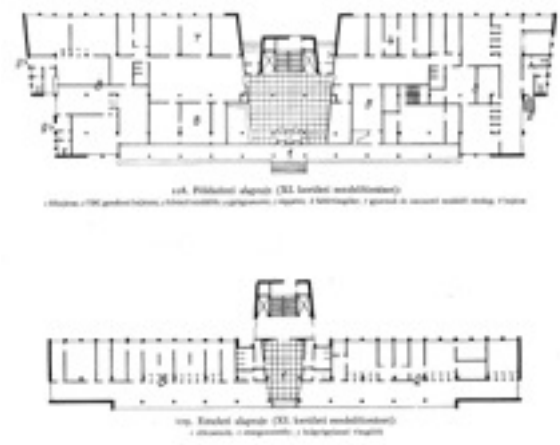
The policlinic serves for out-patients. The new deal of health care increases the role of ambulatory care, which is supported by economical and human aspects. With the help of new technologies more and more disease, defects can be treated ambulatory, when the patient may go home between the medical interventions or examinations and does not need to stay at an unfamiliar sphere.



4.42. American system of ambulatory care, Denver Health C., Tulsa,USA (1994) Architect: SELSER SCHAEFER Arch.

4.43. Waiting room, Lutheran General H., Park Ridge, USA, Arch.: LOEBL,SCHLOSSMANN&HACKL

Policlinics are usually provided with independent entrance, lobby, and reception desk. The localisation is determined by the necessary close connection to the diagnostic area, because both in-patents and outpatients use the same facilities. The crossing these two kinds of traffic is to avoid, therefore the diagnostic facilities should have two access sides with separated waiting rooms. The interiors of ambulatory care environments play a key role in providing patient comfort and reducing anxiety and help differentiate them from typical inpatient facilities. Furnishing, finishes, fixtures, natural light, colours, decorations or even special features (such as music or water) help outpatients to find solace during periods of stress, which is very important from medical point of view.



4.44. Polyclinic, Budapest. XI. Fehérvári út (1949) Ground and general floor plan Designer: SZENDRŐI J.

4.45. Polyclinic, Újpest (1951) Designer: KISS T., MIKOLÁS T.

The interior lay-out is not very complicated, most of the surgeries need uniformed size and equipped rooms (et. in Hungary 18 sm). According to the European standard the surgery consists of two rooms, in the first one the administration and some basic examinations are managed with the help of an assistant, in the second one the physician can speak with the patient or his/her relatives in private. In the American system the administration is solved centralised, at the small surgery room stay only the doctor with the patient during the examination. For consultation are extra spaces. This system is more economical than the traditional one.

4.46. Polyclinic Centro de Salud, Ordes, A Coruna (2000.) Designer: Gabriel Santos ZAS

4.47. Waiting area Centro de Salud, Ordes (2000.)

It is very important in the layout that the waiting patients have to be separated according to special conditions. First of all children need separation, but the healthy (arrived to consultation or vaccination) and sick kids mustn't stay together too. Plus, who is infectious has to use isolated entrance with its own sanitary block and waiting room, connected directly to the examination room. Children generally need larger space and a corner with toys. The waiting area is provided with special sanitary blocks, which includes pamper room and kid-WC too.

The adult patients need also some separation, et. healthy (waiting for dentist, control, etc.) people shouldn't be mixed with ill patients. Some surgeries need even more privacy, like psychiatry, dermatology, and venereal diseases. By waiting rooms of laboratory has to take the jerky overstrain into consideration.

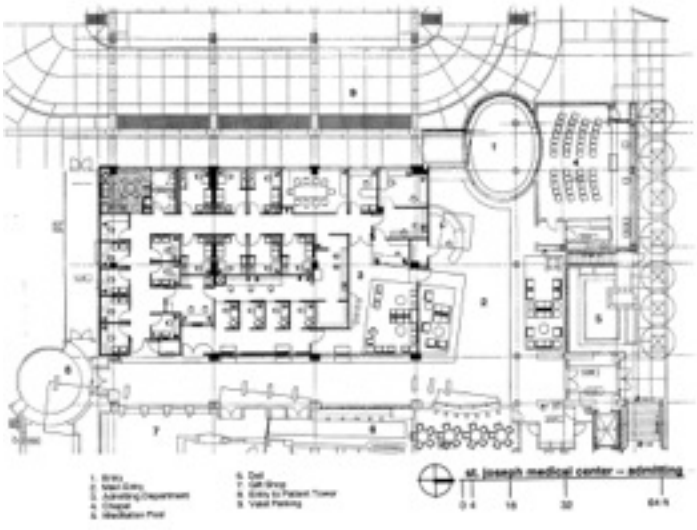
Outpatient departments often appear as individual public buildings independent of hospitals, in this case they have only diagnostic and therapeutic units serving out-patients for which the earlier mentioned designing aspects hold true. Their size varies in wide ranges, from simple private medical practices to complex district outpatient clinics and their architectural language should correspondingly be licentious or clear.

In both cases the enormous demand for parking is an important location planning aspect, the parking need may account to half of the hospital's total parking need.

4. ADMINISTRATION

Administrative departments are typically grouped together to support operational efficiency and cross-utilisation of personnel. The general office spaces include suites of offices for statistical administration, public relations, personnel and related functions. Other such departments typically include the following:

- admitting and discharge (near the main lobby),
- business office and financial services,
- medical records (secret files! – safety)
- data processing and information systems (server room)
- library, resource and educational centre (conference room, lecture hall).”



4.48. Admitting Department, St Joseph Med. Center, Tacoma USA (1993) Designer: BUFFALO Design, Inc.

4.49.Pathological auditorium, Lodz (Pl)

5. SUPPLY DEPARTMENTS

It is the most industrialised zone of hospitals, but from point of view of design can not be neglected, because it provides the general supply for every kind of activities.

5.1 Social area: **- staff changing rooms**

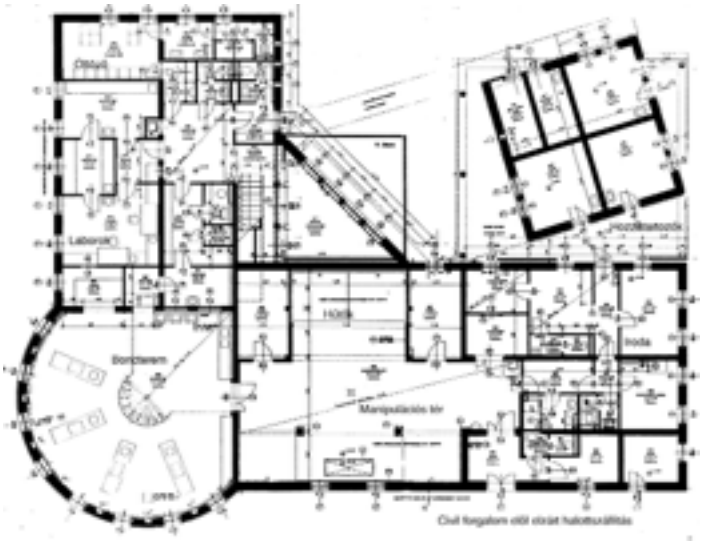
Clinical staff need separated changing rooms according to hygienic grade. Physicians have got it by sexes, but the nurses and assistants rather in different units. Who works for laboratory, X-ray unit, nuclear medicine, infectious department – need separated rooms and sanitary blocks. The kitchen and cleaning staff occupy their own facility too. In the changing room each person has got a black-white locker, where the in-door and out-door clothes are stored separated. The number of showers, WC-s is prescribed by national standards.

- staff canteen

Opportunity should be provided for the staff to have meal in the territory of the hospital. This can be in the form of a restaurant that visitors can also use and which mostly features self-service. The restaurant can be attached to the central kitchen but requires an intermediate space due to the difference of serving.

5.2 Medical backup: **- pathology**

Pathology department's activity consists of two parts. At the post mortem area (*prosectura*) the autopsy and refrigerated storage of the deceased patients take place. During autopsy tissue samples are taken from the organs that after proper preparation are examined under microscopes in the laboratory unit. Administrative and in certain countries piety duties related to the dead are also carried out on the post mortem area. During designing care must be taken to hide the dead body transportation route and to tastefully design the rooms for the next of kin. But laboratories examine tissue samples not only from dead but from living people, often with great urgency. Nowadays this investigation method is becoming increasingly vital, as it has decisive role in tumor diagnosis also.



4.50. Morgue of Károlyi S. Hospital, Pathological Dept., Újpest, (1996) Architect: SCHRAMMEL, Z.

4.51. Semmelweis Univ. Budapest, Forensic Institute disection room. A.: SCHRAMMEL

- pharmacy

Hospital pharmacies on the one hand receive, store, sort and dispense the manufacturers' preparations to the wards, on the other hand they manufacture special preparations in the magisterial laboratories. They also have a public sale unit attached to the lobby.

4.5.3 Logistical support departments: **- kitchen**

Hospital kitchens are usually huge, large scale facilities, because they cook not only for in-patients but for the populous personnel. Basic units for kitchen technology: receipt of raw material, segregated storage, preparation, cooking, serving, then in a separate lane dish washing, collection and treatment of waste. These mean separate spaces arranged in a strict order. The diet for the patients is overseen by dietetics and in major hospitals there is often need to cook 20 to 30 kinds of dishes daily. This and the individual tray system demands very exact administration and organization. Dishing up is done on conveyor belts, the closed rays are carried to the wards in heated, insulated rolling containers. In major hospitals enormous spaces are required by the kitchen area for the container traffic. Kitchen staff must compulsorily use the segregated black-white system changing room (two rooms!), an

independent cleaning base and service entrance. For kitchen designing basic aspect is that clean and dirty routes should not meet. The technology is planned by a specialist, who defines not only the routes and the links between the premises but also the installation requirement for the equipment. Kitchens require extraordinary intensive ventilation and full mechanical background (water, gas, previously stream, drainage with special pre-treatment areas, etc.). The enormous supply traffic necessitates due foresight taken in their positioning.

4.52. Dietary kitchen, Mercy Health Center, Laredo, Texas

4.53. Kitchen with skylight. Down: Kitchen, Bronovo Hosptal,

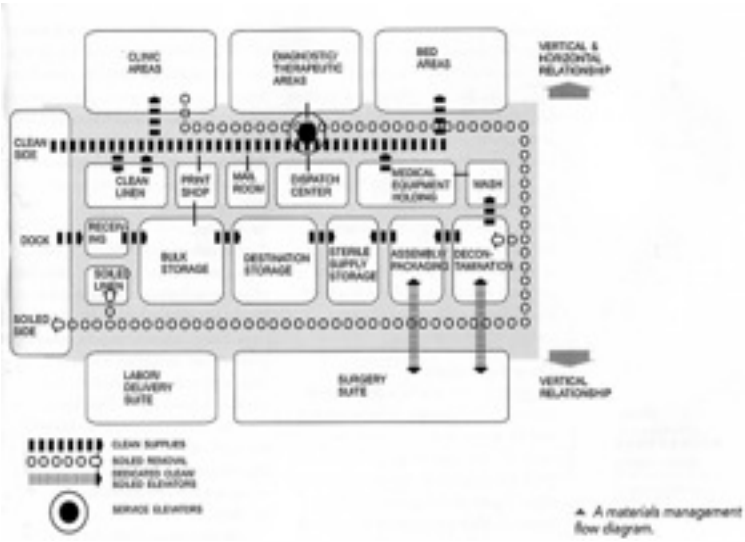
- laundry

By being uneconomical hospital laundries are winding up, their place is taken by modern dirty and clean cloth collecting-selecting premises, whereas washing is done by outside entrepreneurs.

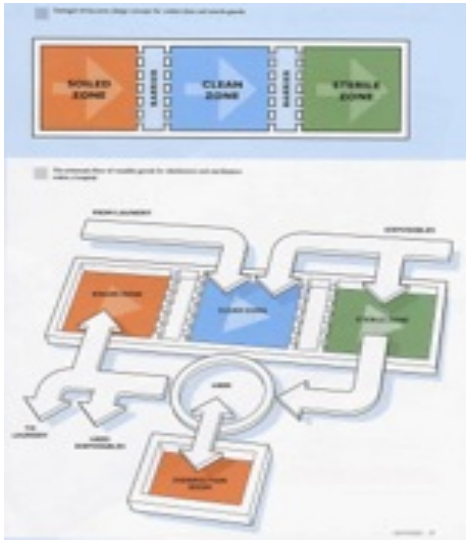
- central storage

Hospitals handle enormous material traffic. The more a country is underdeveloped, the larger spaces are required by storage functions because of the need to have large inventories. The various materials must be stored separately, additionally, they must also be separated according to their hygiene classification (general, clean, sterile). Storerooms where large quantities of burnable materials are stored are regarded inflammable. Additionally, inflammable and explosive materials should be stored in premises designed by strict specifications, mostly with direct access from the outside. The premises of the freight service also belong to the logistic background where the transport means and the containers are cleaned

repaired and overhauled. Owing to heavy traffic the corridors around the storerooms must be minimum 3m wide.



4.54. Material management flow diagram to the Central Sterilization Unit



4.55. Management flow inside the CSU (Getinge)

- central sterilization

The central steriliyer does the sterilization of surgical instruments and textiles. It is directly attached to the surgical block but the disposable sterile instruments also end up here from the outside. The unit has three cleanliness zones: the most soiled, the receiving and the washing, from where the instruments get to the next clean packaging space through transferring washing machines. There the instrument trays are made ready, then packed and put into a likewise transferring disinfecting apparatuses (that can operate on steam, formalin, hot air or cold plasma), whose other side is already sterile space. Dressing sluice and cleaning place is needed between each zone. The sterilizer's machinery requirement is on the same level with the operating theaters.

4.56. Axonometric scheme of CSU (Getinge)

4.57. Central sterile processing, McKay-Dee Hospital, Ogden, Utah

- bed central

In modern hospitals, after the patient left, the bed along with the mattress is cleaned, disinfected and stored in a unit especially designed for this purpose. The bed is returned to the ward only when new patient is admitted. The disinfecting apparatus and the store demand huge spaces, transportation requires wide corridors.

- maintenance facilities

Rapid troubleshooting for each hospital service must be in place, especially in hospitals on the periphery. Mechanic, carpenter, blacksmith, plumbing, electric, and heating repair workshops are needed most. Separate changers must be in place for the staff.

- technical and engineering management

The building machinery network of modern hospitals is composed of such complicated systems that require central supervision and occasionally intervention. The computer of the central dispatcher receives every operation data from the building machinery systems, electric networks and water alarms, security system, but it can assume the role of a telephone exchange too. The dispatcher is a well trained, skilled man working in 24 hours shift, who in direct touch with the intervening organ. He needs an own social premise.

- energy central

Hospitals consume enormous energy and with technological development, growing need for comfort, this trend is to continue. Safe operation necessitates independent electric feed or a diesel engine emergency electric source. This latter is extremely noisy, and is being installed together with the hospital transformer in most cases. Heating and hot water is arranged from an independent boiler house, producing also steam for the sterilizers, kitchen, air conditioning, and others. The increasingly extended use of air conditioning necessitates a central cooling system with the boiler house utilizing its waste heat.

- medical gas central

From among the medical „gases” vacuum and compressed air are produced in compressor rooms. Their extreme noise emission requires special attention. Anaesthesiological gases are obtained from cylinders, oxygen is usually drawn from a tank installed in the garden. Their transportability and the possibility to be filled should be ensured, so should be the strict fire protection regulations.

- waste

The great material traffic is accompanied with huge amount of waste forming, whose disposal is regulated by strict rules. Storage containers are always inflammable and contagious areas from hygienic aspect. Hospital *biohazard waste* must be stored in isolation, in closed space until they are removed by a specific service refuser from the hospital. Those that handle the waste must have a separate black-white changing room. Cleaning and desinfection of the storage vessels must be also taken care of.

- helipad

Landing pad for ambulance helicopters need direct link to Emergency Unit (ER). Approach and landing zone needs barrierfree zone. Standard size of pads are min. 18x18 m - placed usually on top of buildings.

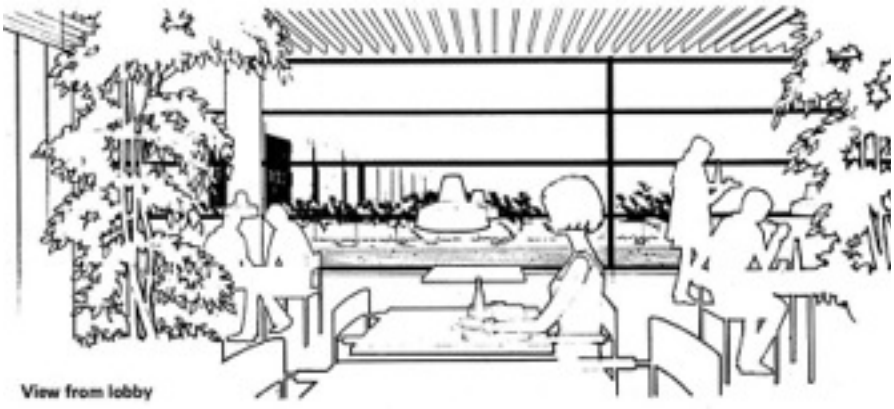
5.4 Public service areas**:**

- shops

In keeping with today's needs hospitals must ensure procurement of basic commodities for patients that can walk and for the visitors. Their design aspects are as for the canteen, their size also greatly varies.

- canteen

They are usually connected with the lobby or the main communicating routes, their sizes range from small standings-only to coffee houses. During planning the independent social block and the filling routes used to be problem.



4.58. Lobby canteen, Hvidovre Hospital, Copenhagen (1971)

4.59 Canteen, Jönköping Ryhov (S)

- parking

With the growing number of urban planning regulations hospital gardens are flooded by cars. The full parking need of any hospital must be arranged within its own plot, which on the long term is possible only with basement garages. Fortunately, the great structural span required by hospital functions is beneficial for the situation of the parking lots (~7,5m).

- other services

Patients but personnel too benefit from accessing certain services on the spot, which increases their feeling of comfort. Such are the banking, postal services, hair dresser, beauty parlor, etc. Strange thing to rank it here because its weight can not compare with these but spiritual services are also rated here. Today, an *ecumenical chapel* is an indispensable feature of a hospital perhaps complemented with a meditation room. The chapel must fulfill the liturgical need of every religion and must be constructed at such a place that both, disabled people and visitors can access it without difficulty.