Organization of Intensive Care Medical and Surgical Aspects

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We all remember the times when, years ago, the number of Intensive Care units was small and the number of Intensive Care beds was insufficient, so that helicopters bringing patients with severe head injuries from road accidents could not find a landing place for patients. The reason for this unacceptable situation was rather the lack of understanding than insufficient budgets. Improved information about the value of intensive care subsequently led to an increase in the number of intensive care units and beds. However, exploding costs and restricted medical care budgets have in the last few years counteracted this development and led very recently, at least in my country, to an situation where intensive care units are being downgraded by the authorities, in an attempt to reduce the expense of technical equipment and staff.

The number of IC places predicted depends on the expected number of patients needing intensive care. Furthermore, there is the estimated intensive care activity of each bed or in other words the intensity of the therapies applied to patients. This activity or intensity will find its expression in the necessary level of technical equipment and the amount of intensive care staff. To define these parameters in a more transparent way, gradings are used today , as will be explained later.

What are now the factors influencing the costs of intensive care units? There is the size of the unit -influencing not only construction costs but also expenses like heating, air conditioning and maintenance. The number of intensive care staff is certainly the most cost-effective factor. The costs for technical equipment, however, are not high compared to those for staff. On the other hand, more technical equipment or excess technical equipment requires more staff and thus increases costs in two ways.

The physical area necessary for planning an intensive care unit can be described by the old principle that an intensive care unit always turns out to be too small rather than too big. The space required for one intensive care bed or chair is more important for the construction of elevators and corridors than for the ICU itself. Whereas a normal hospital bed requires about 2.5 m², intensive care beds - especially those using airfilled pillows - measure about 2.5 x 1.5 metres and require therefore an area of 3 to 4 m². The space around also needs to be big enough to allow the movement of the nurses and doctors under emergency conditions and the positioning and use of technical equipment. It should therefore be no smaller than 25 m² for one ICU position. Many hospital architects underestimate the space needed for side rooms. Rooms to store disposable and nondisposable articles, room to prepare medications, room for paper work or - today - for computer work and last but not least, room for the staff to relax for a moment, all require usually as much space as the intensive care positions. This is especially true if the intensive care unit is small.

Fig. 1

NIC for Neurotraumatology

IC - Staff

Grade of Care	Number of Nurses
VI	> 4.0
V	3.5 - 3.99
IV	3.0 - 3.5
III	2.5 - 3.0
II	2.0 - 2.5
I	1.5 - 1.99

The **number of nurses** employed is nowadays a very critical factor because this supposes with high costs. Over the years different kinds of calculations and algorithms have been used to define the right number of nurses for one intensive care position. Figure 1 shows the number of nurses needed according to different grades of intensive care treatment as used nowadays for Austrian hospitals. This ranges from grade I, which corresponds to intermediate care with 1.5 to 2 nurses per position, up to full intensive care grade V and VI with 4 and even more nurses per position. The grading depends on the one hand on the nurses available; if a certain number of nurses cannot be provided by the hospital organization then a certain ICU grade cannot be achieved. This also holds true for the number of qualified doctors during day and night. In addition to that, the activity of the intensive care unit and the intensity of therapies applied, documented in a scoring system, influences the grade of the IC unit. Figure 2 shows a selection of the activities scored. There are standard activities like monitoring, laboratory testing, medication and fluid substitution beside more specific activities like ICP monitoring, the use of svan ganz catheters or hemofiltration.

Fig. 2

NIC for Neurotraumatology

TISS Scoring (Selection)

Monitoring
ICP monitoring
Laboratory
Medication
Fluid substitution
Fluid balance Hemofiltration
Parenteral nutrition
Surgical dressing
Drains
Artificial ventilation
ZV line
Arterial line
Pulmonary line
Cardiopulmonary resuscitation
Therapy of metabolic disorders

Technical equipment is relatively low cost when compared to a nurse's yearly salary. Sophisticated technical equipment however needs nurses or doctors' time and creates therefore the need for more staff. The same is true for all patient data management systems currently used for electronic documentation. None of the currently used PDM systems saves nurses or doctors' time. Figure 3 shows a selection of standard technical equipment for IC-positions. IC-beds are available today with or without airfilled pillows for skin protection. Modern intensive care chairs allow the application of full intensive care to the patient in a sitting position, which is of special use in the subacute phase of the treatment. Monitoring systems are among the most traditional technical equipment for intensive care, used to collect and display data on cardiopulmonary functions, cerebral functions and general functions. Some cardiopulmonary parameters, such as transcutaneous saturation measurements of oxygen, are today a must for every patient. Some patients require invasive hemodynamic monitor-

Fig. 3

NIC for Neurotraumatology

Technical Bed side Equipment

IC-Bed (-chair)

Monitor-System

PDM-System

Respirator

Medication-Pumps

ing by the use of svan ganz catheters, monitoring pulmonary artery pressure, wedge pressure, cardiac index and other parameters. Other specific parameters give us information about the conditions of the brain; ICP (measured more effectively in the subdural space than epidurally) and its calculation to perfusion pressure are the basic parameters; spot or permanent recordings are possible from transcranial doppler sonography or other neurophysiological measurements, like evoked potentials. Microdialyses, while still at the experimental stage, will however will be a very interesting tool, supplying us with information about brain metabolism.

The final goal of all therapeutic activities on the brain is to improve brain perfusion and oxygenation. Unfortunately, the organizational and financial effort required to obtain bedside information on CBF is too high for most centers. Two bedside systems are currently available. One is the Gamma camera in its bedside version allowing the estimation of CBF of the whole hemisphere and the other one is the Licox system which gives information on parenchymal oxygen saturation of a single spot in the brain. Xenon enhanced CT scan or SPECT require patient transportation.

Beside equipment for cardiopulmonary, cerebral and general monitoring, there is other basic equipment such as the machines for artificial ventilation, medication pumps and computerized patient data management systems. Optional equipment is listed on figure 4.

Fig. 4

NIC for Neurotraumatology

Technical Bed Side Equipment

optional

TCD

Evoked pot. (SSEP, AEP)

EEG

Hemofiltration

Ultrasound

X-ray

Bronchoscope

Gastroscope

ECG / defibrilator

Pat. warming / cooling system

Before concluding, I would like to come back to the question of grading intensive care units by scoring intensive care activities. The calculation of points from a scoring system requires precise documentation. In the past and nowadays, documentation of patients' basic data, vital data and other complex and numerous data has been done daily or several times per day in a written way by nurses and doctors. Nowadays, systems are also in use where documentation takes place in a paperfree way by the use of computerized systems. Instead of writing on the patient's chart, the nurse uses a keyboard and monitor screen to document the patient's condition and all the activities which have been carried out. Many parameters are collected automatically and on line. Nevertheless, computerized documentation

systems on ICUs do not save time. To document a certain nursing activity needs at least the same time as it would if written down. However, recent developments in documentation necessities, especially the need for calculating quality control and intensive care scores, creates a strong argument for the use of PDM systems.

The data monitored online (cardiopulmonary, cerebral, general) are recorded by the PDM system automatically and online in a preselectable time frame. They can then be displayed retrospectively in a variable time axle from one hour to several days. All the medication given has to be recorded, showing the time of application as well as the signature of the responsible nurse or doctor. Fluid balances are recorded and calculated in detail hour by hour. Nursing is recorded describing parameters such as skin conditions during washing, cleaning and patient positioning. When the patient leaves the unit, a transfer record is printed showing the most important and recent parameters; other messages have to be written by the doctor who finally gives his signature. Patient data management systems such as the one shown here provide doctors and nurses responsible for the ICU with an enormous amount of information and allow, besides excellent "quality control", a very reliable scoring of the ICU activities, thus helping to keep the unit in the right grading and supplying information about the amount of budget, nurses and doctors necessary.

We should be aware that technical improvements offering new and promising therapeutic concepts on the one hand and budget limitations and restrictions of resources on the other hand may obscure the clear view of what should be the center of all our work in intensive care units. This is the patient, often in life threatening conditions, requiring not only the help and support of machines but also needing human care at every moment. **More** than all the recent technical developments and highly sophisticated equipment, ICUs stand for care in the proper sense of the word.

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