

The Anesthesiologist Views the Design and Function of the Delivery Room

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THE ANESTHESIOLOGIST should be consulted early in the planning stages of a maternity unit to determine design requirements for anesthesia facilities. Although some of the needs and problems of anesthesia for obstetrics are similar to those encountered in a general surgical suite, there are also anesthetic considerations unique to the delivery suite. The purpose of this paper is to offer a guide to functional relationships in planning new or remodeled labor and delivery facilities. A more complete guide may be found in two United States Public Health Service publications: "Planning the Labor-Delivery Unit in the General Hospital" (No. 930-15), published in 1964, and "Planning Nurseries for the Newborn in the General Hospital" (930-D-5), issued in 1962.

Location of Delivery Suite

It is generally recognized that the delivery suite should be adjacent to both the newborn nursery and the maternity nursing unit to minimize transportation distances for mother and infant and to utilize the obstetric and pediatric staff maximally. A design concept less widely recognized is that of locating the delivery suite adjacent to the general operating theater, thereby concentrating structural and mechanical features of both. Although strict separation of maternity patients from all other hospital patients has become standard practice since 1926,¹ recent evidence suggests that with rigid aseptic technique the admission of selected non-maternity patients to obstetrical units is medically safe and administratively sound.² It has been estimated that such a change "would make available for non-maternity patients at least 20,000 of the 40,000 obstetrical beds vacant on an average day in the United States, eliminate the need for almost a half billion dollars in new hospital construction and still permit obstetrical units to function at a comfortable 66.6 per cent occupancy."²

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Occupancy and Design Size

There is no generally acceptable rule for determining either the number or ratio of maternity beds to total bed complement in an institution. Maternity bed needs are determined by the number of obstetricians on the staff, the sizes of their practices and the length of stay per delivery, all of which may fluctuate yearly. Our method for determining obstetrical bed requirements is to multiply the number of anticipated deliveries by the anticipated average length of stay per delivery. The result will be the predicted number of days of patient care per year. This should then be divided by 365 and adjusted for 70 per cent occupancy to gain flexibility required for periods of high occupancy. More sophisticated methods have been outlined, using the law of probability and the "Poisson distribution method" of estimating needs.^{3,4}

The numbers of labor rooms and delivery rooms are based on the number of maternity (postpartum) beds. The ratio usually accepted is one labor room per eight beds and one delivery room per 16-18 beds.⁵ Sequential arrangement of labor, delivery and recovery areas within the delivery suite facilitates the accomplishment of recommended medical practices. Main connecting corridors with a minimum width of eight feet allow easy movement between labor, delivery and recovery rooms. Among the features of delivery rooms that have proved successful are connecting doorways that allow one nurse to circulate during two deliveries.

Interior Design

A well-designed delivery suite, which reflects a friendly atmosphere of domestic reassurance and warm, close personal relationships, should provide therapeutic benefits for patients in labor. Under such conditions the need for medication is reduced and the cooperation of the patient increased. Details about dimensions of furnishings related to area size, architectural divisions of an area, furniture arrangements, color schemes, choice of fabrics, wall covering and flooring, have been outlined by

Dorothy S. Allen, Chief, Interior Decoration, Housekeeping Division, Department of Medicine and Surgery, Veteran's Administration, Washington, D. C. This document should be helpful to anyone planning to build a new facility or refurbishing an older one.⁶

Labor Rooms

Single-occupancy rooms, preferable to most patients, should have a minimum area of 100 square feet, while multiple-occupancy rooms should have 80 square feet, minimum, per bed. A labor room designed for emergency delivery should have at least 180 square feet of area, and conductive flooring. Each labor room should be equipped with resuscitation apparatus such as an oxygen source and a suction device. In addition, a compact mobile anesthesia trolley which includes a device for intermittent positive-pressure respiration, as well as resuscitative drugs and airways, should be taken into each labor room before an epidural block is performed. The labor room bed should allow easy, rapid changes in body position from head-up to head-down. Electrically operated labor-room beds are now available. (Hill-Rom, No. 70, Retractable Bed; Hill-Rom Company, Inc., Batesville, Indiana.) These beds are expensive and have not been tested widely, but, theoretically, they offer extreme flexibility and ease of operation.

Labor rooms should have year-round temperature and humidity control. Construction of these rooms should prevent transmission of sound between rooms. Piped-in music might help to create a tranquil environment.

Ideally, each labor room should be equipped to monitor, either continuously or intermittently on demand, maternal arterial blood pressure and fetal heart rate. These observations are particularly useful during continuous epidural anesthesia or in patients with toxemia of pregnancy or fetal distress. The systems should convey these vital signs from bedside to a central monitoring system at the nursing station. The sphygmomanometer or tachometer should have an audible alarm with adjustable limits for both high and low pressures and heart rates. Fetal heart rate monitoring is still in the developmental phase; the ideal or universal system is not yet perfected. At present, the electrocardiographic technique of Hon shows the greatest promise.⁷ Direct arterial

blood pressure measurements require the placement of intra-arterial needles or catheters and obviously cannot be considered for routine use. Indirect devices using Korotkov sounds have been devised using compressed air or freon to inflate the sphygmomanometer at regular intervals (Air Shields Blood Pressure Monitor). This apparatus can be adapted for use with a recorder, but performance characteristics have not been fully evaluated.

Delivery Room

Basic considerations in designing and equipping a delivery room include immediate availability of equipment and supplies, built-in protection against anesthetic explosions, auxiliary electrical systems to obviate power failure, adequate air conditioning systems⁸ and finish materials that promote aseptic conditions.

Each delivery room should have a clear floor area of approximately 400 square feet to provide space for equipment and for personnel to move freely. A door width of four feet is recommended to allow the patients to be moved to the delivery room on a labor bed. A ceiling height of nine feet is required for an obstetrical or surgical light.

The floors of delivery rooms, adjacent connecting areas, and corridors for at least ten feet in any direction from the room entrance should be conductive and comply with the recommendations of the National Fire Protection Association.⁹ Several methods are used to connect the piped-in oxygen, nitrous oxide and vacuum outlets to the anesthesia machine. The most common, and one that creates a traffic hazard, uses flexible tubing across the floor from the wall outlets. Another uses an overhead boom to carry the tubing from the wall to a point over the anesthesia machine. This obviates the traffic hazard but is also difficult to clean. The best method is designed to extend the gas and vacuum outlets from the ceiling by either spring-loaded tubing or a telescopic metal unit. This method limits flexibility of positioning the patient but is easy to clean and keeps the tubing off the floor.

The anesthesia machine should be equipped with a jumbo-size carbon dioxide-absorbent canister and precision vaporizers for the administration of halothane, methoxyflurane and fluroxene.

Each delivery room should contain the basic

equipment for resuscitating the depressed newborn. This includes infant laryngoscope, supply of batteries and bulbs, endotracheal tubes and infant airways. In addition, each room should have a mobile or portable (delivery room to nursery) resuscitation apparatus such as a Kreiselman Unit. This apparatus should provide a simple but sufficiently large non-slippery surface on which to place the baby with easy access to oxygen and suction, and be adaptable to various modes of resuscitation including simultaneous positive-pressure ventilation and placement of umbilical vessel catheters for acid-base control and blood sampling.

The Ohio Kreiselman Unit¹⁰ is the resuscitator most frequently used in American delivery rooms. It has many, but not all, of the necessary requirements. A major deficiency in this apparatus is its inability to maintain normal body temperature of the exposed newborn. It is well documented that in modern delivery rooms the temperature of the newborn can fall precipitously after birth, with resulting increased oxygen consumption, metabolic acidosis and respiratory difficulties.¹¹ Ideally, a source of radiant heat should be mounted above each resuscitation unit. The energy output should be servo-controlled by a sensor taped to the infant's abdomen. Such a heater is available commercially (Air Shields Infant Warmer DR) but its performance characteristics await further evaluation. In the meantime, a simple infrared heating lamp may be used, with caution to avoid excessive warming of the infant.

The delivery room should have a timer which rings one and five minutes after birth to facilitate an accurate Apgar Score determination. A simple, compact but unnecessarily noisy unit is available commercially.¹² *

Recovery Room

A room adjacent and accessible to the delivery room should be fully equipped as a post-anesthesia recovery room. The United States Public Health Service suggests that a recovery room is warranted in any suite having three or more labor beds. It further suggests that the number of recovery beds provided should be from a third to half the number of labor beds,

adjusted to the practice of how long the patient is considered to be in need of such a service at a particular hospital. In some states, it is apparently mandatory that a recovery service be provided, even for the smallest suite. In other parts of the country, governmental authorities do not suggest, or in some cases, support, a recovery service unless an average of ten deliveries per day takes place in a suite. However, the decision is not whether the concept is worthwhile but whether it can be staffed satisfactorily. The recovery room allows close observation and special care required during the period after the mother has delivered, usually lasting two to three hours, and serves to free the delivery room for clean-up prior to the use by the next patient. There should be enough space to allow easy movement of beds and stretchers and for attending each patient from either side. At each bed or stretcher, oxygen, suction outlets, wall-mounted sphygmomanometers, and cubicle curtains are necessary. Ideally, there should be glass panels to facilitate observation from the nursing station and outside corridors.

Special Procedure Room

In teaching hospitals, a room of at least 100 square feet should be adjacent to the delivery room, to be used as a maternal or neonatal investigation area. The room should contain blood gas electrodes to be used for immediate analysis of maternal, fetal scalp and umbilical cord blood samples. Also, a polygraph recorder, carbon dioxide analyzer, strain gauges and other equipment for close patient monitoring might be included. This room can also be used by the pediatrician for acute care (ventilation, bicarbonate administration, exchange transfusion) of the severely depressed or less-than-1,500-g neonate.

Anesthesia Call Room

Sleeping accommodations for the anesthesiologist on call (as well as obstetricians and pediatricians) should be available adjacent to the delivery suite. Single-occupancy rooms are preferable, since they will accommodate either males or females. Because physicians may be required to spend many hours in this area, it should be both cheerful and comfortable, more or less resembling a hotel room. A separate lounge nearby with a couch, easy

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chairs, bookcase, desk, magazine table and television set provides a gracious atmosphere for relaxation and conversation.

Supplies and Equipment Storage

Gas storage rooms should not connect directly with the delivery room; they should have conductive flooring and gravity ventilation to the outside of the building. Electrical wiring and fixtures should comply with the N.F.P.A., Code No. 56.⁹ Small cylinders of a size to fit the anesthesia machines may be stored in horizontal pigeonhole racks; large cylinders should be stored in upright racks. Storage space for a 48-hour supply of gas is considered maximum.

Storage of airways, masks, sterile epidural and spinal block trays, anesthetic drugs, needles and syringes may require cabinets and drawers of special design. These facilities should be adjacent to the delivery rooms. In large units (more than 3,000 deliveries a year), an anesthesia workroom, similar to the one in the operating room suite, should be provided. Basic equipment includes wall shelves, a work counter, drainboard and sink for washing and checking accessories. In smaller units the operating room anesthesia workroom would be responsible for checking and furnishing the obstetrical unit with supplies daily.

Neonatal Intensive Care Unit

An intensive care facility for the neonate should be close to the delivery suite to shorten the journey for the infant from delivery to nursery care. A recent review by Segal¹² outlines the basic needs and is recommended for anyone designing or remodeling such a unit. Topics covered are: control of infection, piped and wired services, darkroom facilities, radiography, bedside laboratory facilities, oxygen analyzers and other patient monitors such as closed-circuit television, and automation of laboratory procedures.

Maternity Centers

Often in one community there exist several small hospitals, each with a maternity unit which handles fewer than 1,000 deliveries a year. Great efforts should be made to amalgamate these units into large maternity and child health centers, each with a minimum of 2,000 deliveries a year. Recent studies have indi-

cated that the size of the obstetrical services affects not only its average occupancy but also both direct costs of operation and investment costs.¹³ A review of 33 Connecticut hospitals indicated that maternity services with 2,000 deliveries per year or more profited, on the average, \$1.51 per patient-day, while those with services of fewer than 1,000 deliveries per year lost money at a rate of \$7.97 per patient-day. Also, with a large caseload it would be far more practical to provide round-the-clock coverage in obstetric anesthesia as well as equally important ancillary services such as pediatric neonatology.

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