PLANNING OPERATING-THEATRE SUITES

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Although the design of operating-theatre suites has been influenced by the needs of modern surgical and anaesthetic practice, the planning of theatres has been more dominated by tradition than most other parts of a hospital. Improvements in equipment and an increased appreciation of the methods by which infection spreads make it timely to consider whether the plan of a conventional operating-theatre suite meets present-day requirements or whether modifications in accepted plan relationships could contribute to asepsis and ease of working.

It is only in comparatively recent times that hospitals have set aside special rooms for surgical operations. At first operating-rooms were designed for demonstration and had tiered standings from which the students had an unobstructed view of the surgeon at work. Appropriately enough, they were called theatres and the name has been retained in this country. An adjoining anteroom in which patients were prepared was in evidence by the middle of the eighteenth century (Russell, 1957), and this basic plan remained for some 150 years (Tomes, 1873; Osborn, 1876).

Lister's (1867) paper "On Anti-Septic Principles in the Practice of Surgery" led to a growing understanding of bacteriological principles, and Burdett (1893) was able to cite existing operating-theatres which were isolated from the wards to avoid infection, which were provided with ventilators at high and low levels, and in which all finishes were smooth and impervious so that the whole room and its contents could be washed and disinfected. Sinks, slop-hoppers, and sterilizers were provided and the way was opened for the practice of aseptic surgical techniques. Thus the theatre became an easily cleaned multipurpose room in which the staff scrubbed-up, and the bowls, instruments, and materials were prepared and sterilized before an operation and were subsequently washed and stored. Such theatres built at the turn of the century are still in use to-day.

Between the wars surgeons came to recognize the advantages of removing subsidiary functions from the theatres to ancillary rooms to avoid the discomfort caused by steam from the boiling-water sterilizers and to reduce the noise as instruments were washed and trolleys prepared. A report was published (Ministry of Health, 1937) recommending that an operating-theatre suite should form an enclosed cul-de-sac off the main hospital corridor, that an anaesthetic room should lead into each theatre, and that a sterilizing-room, a sink room, and a scrub-up room should be directly accessible, without doors, from the theatre. It was pointed out that economy in staff and equipment could be achieved by sharing these ancillary rooms between a pair of theatres.

The research undertaken by the Nuffield Provincial Hospitals Trust (1955) did not lead to far-reaching

changes in operating-theatre planning, and *Hospital Building Bulletin* No. 1 (Ministry of Health, 1958) confirmed the general pattern which had been established. Most recent plans were based on the concept of twin theatres sharing sterilizing- and sink rooms. Sometimes the sterilizing-room was located on the outside in an attempt to reduce the effect of wild heat from the sterilizers on the theatre temperature and ventilation system. This meant that the only access to the sterilizing-room for both staff and sterile supplies was through the sink room or through a theatre. If, on the other hand, the sink room were beyond the sterilizing room (Fig. 1), staff and material for disposal

FIG. 1.—Twin theatres sharing sterilizing and sink rooms.

must pass through a cleaner area unless it were possible to provide an outside door. This could be done if the suite were at ground level, but such a door would allow unfiltered air, and even unauthorized persons, to enter the operating-theatre.

Williams *et al.* (1960) have emphasized the potential danger of cross-infection between theatres sharing ancillary rooms and recommend that an independent sterilizing and sink room should be provided for each. This would necessitate the installation of autoclaves (which should be duplicated in case of breakdown), an ultrasonic washer and other disposal equipment for each theatre, and an increase in the number of trained staff to supervise the preparation of the instrument trolleys. There were other disadvantages of siting this equipment immediately adjacent to the operating-theatre. Heat from the autoclaves, despite insulation and separate ventilation, raised the temperature and disturbed the planned air movement designed to carry infection away from the clean areas. Further, the automatic control mechanism was frequently not "flame-proof" and should not be fitted in an area where inflammable anaesthetics and surgical spirit were used. The washing of bowls and instruments remained a noisy procedure even with the introduction of mechanical appliances, and it was impossible to subdue the sound with the hard surface finishes which theatre hygiene demanded.

Central Sterile Supply Department

Accordingly a strong case could be made in favour of removing sterilizing-rooms and sink rooms from the vicinity of the theatres. It could be achieved by relying entirely upon a central sterile supply department to provide every sterile pack required, but it was generally agreed that while the central supply of sterile linen, dressings, syringes, and so on was acceptable, the selection of instruments for a particular case must be under the supervision of the theatre staff, as only they knew the individual preferences of each surgeon. Moreover, the difference between theatre instruments and those supplied to the wards and other departments would probably make it more convenient for them to be dealt with separately in the central sterile supply department, thus establishing a sub-unit. We believe that there is a case for such a unit, but that it should be divorced from the central department and sited in the clean zone of the theatre suite supplying the sterile needs of the theatres on the production-flow principle (Fig. 2).

FIG. 2.—Plan showing sterilizing and sink rooms removed from vicinity of theatres.

In this system a preparation room would hold the stock of theatre instruments and bowls and have direct access to stores of linen and presterilized packs which could be replenished from the "hospital" side. Lists of the day's cases in each theatre would be displayed and the instruments, bowls, linen, and dressings for each case collected on to a trolley. The preparation of the trolleys for all the theatres would thus be easily supervised. The trays or packs of instruments and bowls would be autoclaved and then taken on the trolley together with the presterilized packs of linen and dressings to the sterile supply room attached to each theatre.

Each sterile supply room would contain a stock of sutures, sterile fluids, and a number of spare wrapped instruments, previously sterilized, to replace a dropped or forgotten instrument without the delay necessary for resterilization. A telephone communicating with the preparation room would allow a theatre nurse to request other instruments should the case on the table require an unexpected surgical procedure, or should an emergency be introduced into the list.

At the end of a case the soiled articles are taken on the trolley from the theatre to the sink room. The instruments and bowls are cleaned in an ultrasonic or

mechanical washer and bags of soiled linen and material for disposal left for collection in a lobby opening from the sink room to outside the clean area. The trolley is disinfected and the cleaned instruments and utensils are returned on it to the preparation room.

The centralized sterilizing unit should be situated as close to the operating-theatres as possible, its position being influenced by the need to have access from the hospital to the stores adjoining the preparation room and from the disposal bay to the hospital circulation. These communications could be horizontal or vertical. To obtain a smoothly flowing circulation of sterile goods from the sterilizing-room to the theatre supply rooms, and of soiled articles back to the sink room, it is expedient to provide separate corridors (Fig. 2). One route could be along the theatre corridor and the other could be by a separate passage reserved for the movement of trolleys in one direction only. This passage could possibly be used for sterile goods to avoid the risk of contamination and shorten the journey to the theatre. Soiled articles would be returned to the sink

room by the theatre corridor; they should be covered to prevent the airborne transfer of infection while in transit and to conceal anything which might distress a patient on the way to an anaesthetic room. A sink must be provided near the exit from each theatre with storage space for materials for cleaning the operating-table and floor between cases.

Avoidance of Cross-infection

As there is a risk of cross-infection between theatres when sterilizing and sink rooms are shared, the circulation through the centralized sterilizing unit must be examined closely to ensure that this risk is not repeated. Cross-infection could occur if articles from one theatre were to move through the sterilizing unit and enter a different theatre without being properly cleansed. Instruments and utensils would always be autoclaved, but dressing trolleys are difficult to disinfect and we suggest that each trolley should have a label or identifying colour so that it could be reserved for a particular theatre. This would have the additional advantage that the arrival of a trolley in the preparation room during a list would indicate to the staff the theatre from which it came and they would then prepare the instruments for the next case in that theatre. Again,

when the trolley left the sterilizing unit there would be no doubt about the theatre to which it should be taken.

Another precaution is to restrict the movement of staff through the sterilizing unit, which could be achieved by fitting stable doors at the entrance and exit of the sink room, the lower halves normally being open to allow trolleys to be pushed into and out of the room. Indeed, it would be possible to regard the sink room as being outside the clean zone and to staff it by an orderly or porter who entered and left through the disposal lobby. At night, when a small staff is on duty, it is likely that one theatre only would be in use and the routine could be modified. Air movement between theatres is unlikely to occur through this unit.

One practical application of these proposals is a suite of two theatres (Fig. 3) intended mainly for thoracic

supply room. Since theatre 2 will have the larger number of cases, it adjoins the sterilizing unit, while theatre 1 is reached by a short corridor reserved for sterile supplies only.

After each operation soiled articles would be covered and wheeled down the main corridor to the wash-up room. The disposal lobby, linen store, piped oxygen store, and autoclave chamber, all open into the hospital corridor outside the clean area. The staff rest rooms have a pleasing outlook on to the garden and are sited near to the tea kitchen. The surgeons' rest room can be used as an overnight room by a doctor who wishes to remain near to a serious case in the adjoining recovery room. The recovery room will mainly serve theatre 1, but it is planned to be easily reached also from the angiocardiology room of the x-ray department and to have an outlet to the approach corridor.

FIG. 3.—Plan of two-theatre suite.

surgery. Theatre 1 is here enlarged to accommodate the special equipment required for this work and theatre 2 is primarily an endoscopy room. The approach corridor from the hospital leads through swing doors to the changing-rooms, patients' entrance, and the exit from the recovery room, so planned that the clean corridor can be reached only through the changing-area. In the lobby adjacent to the sister's office the patients' ward blankets are changed for blankets reserved for theatre use, and ward nurses and porters put on gowns and shoe covers before entering the clean corridor and proceeding to the anaesthetic rooms. In practice the patient enters the theatre on one side of the operating-table while the sterile trolleys arrive on the opposite side to reduce the risk of contamination. Surgical instruments, utensils, and linen are prepared in the sterilizing unit and wheeled on covered trolleys to the appropriate

room there is a wall-mounted instrument cupboard along one side with space for trolleys beneath, and at the end is a store for sterile packs of linen and gloves. From time to time this storage unit may be lowered for restocking into the central sterile supply department on the floor below. Three autoclaves are provided, having service access from below.

It is estimated that four instrument trolleys should be available for each theatre and these should be labelled so that they are not interchangeable. While one trolley was being used in the theatre, another would be prepared and left waiting in the supply room, a third might be in the sink room with the soiled articles from the previous case, and a fourth should be available if an additional set of instruments was required at short notice for the case on the table or to allow an adequate turn-round for a series of quick cases. Stable doors are

A Suite of Five Theatres

Another application (Fig. 4) shows five theatres clustered round the sterilizing unit. As before, the approach corridor leads to the changing-rooms and a patients' transfer bay adjacent to the theatre superintendent's office. The entrances to each theatre are arranged so that the patient enters on one side of the table and the sterile trolley and scrubbed-up staff on the other. Patients may be retained in the lobby outside a theatre for a short period after operation, and windows have been provided in the anaesthetic rooms to facilitate supervision.

In the preparation

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FIG. 4.—Plan of suggested five-theatre suite.

provided at the entrances and exit to the sink and disposal room, and a hoist and stairs communicate with the floor below. The theatres are lighted naturally by means of clerestory windows having double glass with blinds between. The plaster room is sited in a bank of rooms remote from the clean corridor to reduce the risk of contamination from old infected plasters; the recovery room adjoins and may be used for the intensive care of cases of respiratory acidosis from the wards as well as for post-anaesthetic cases.

Summary

The plans of conventional operating-theatres are examined in relation to economy of working and the prevention of cross-infection and certain deficiencies are noted. It is proposed that a centralized sink room and sterilizing unit should be provided in the theatre suite to serve all the theatres, and the organization and the circulation of staff and goods are considered in detail.

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The National Marriage Guidance Council has published a booklet, *Making Ends Meet*, with the aim of helping young couples to plan their finances. "It is very surprising," says the booklet, "how a financial tiff can turn into a domestic crisis." The booklet is obtainable from the Book-room, 58 Queen Anne Street, London W.1, price 3s. post free.