Hospital Topics

Isolating patients in hospital to control infection*

Part IV—Nursing procedures

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The title of this part is not intended to imply that it concerns only nursing staff. The subjects considered in the next few paragraphs concern all staff who have to deal with patients.

Most precautions against transferring infection demand more effort, take more time, and directly or indirectly cost more than comparable procedures in normal circumstances. It is therefore desirable to eliminate unnecessary measures and to reach a work load that can be carried without strain by the available staff.

Precautions

BACTERIOLOGICAL SURVEILLANCE OF STAFF

Patients and staff with symptoms or signs of communicable disease should be bacteriologically investigated and isolated or put off duty perhaps during the investigation and certainly if pathogens are found; this should be allowed for when the staffing establishment for an isolation unit is being defined. The need to search for carriers among patients and staff who have no indications of infective disease is less clear. For patients admitted to general wards and for most staff experience suggests that routine cultures of faeces and of throat and nose swabs yield little or no measurable advantage. Intestinal pathogens are rarely found and symptomless excreters of these seem rarely to do harm. There are three main reasons why routine screening for nasal and skin carriage of *Staphylococcus aureus* is not profitable: carriers are so numerous that it would be impossible to isolate them all among the patients and to put off duty all carriers among the staff; the carrier state is so variable that swabbing would have to be repeated very often; and there is no reliable method of converting carriers into non-carriers. Routine precautions against cross-infection must therefore take account of the existence of carriers in the whole hospital population. During outbreaks due to pathogens of recognisable species and type routine screening may become justified.

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Opinions differ on the need for routine bacteriological checks on the staff of protective isolation units. Everyone has his own microbial flora, and for staff who attend patients in extreme states of immunodeficiency almost any organism can be regarded as a potential pathogen. Carriers of certain microbes or strains may, however, represent unacceptable risks. It is very difficult to exclude carriers of *Staph aureus* and in many units they are not sought; but several infections with a particular strain may justify a search for carriers of that strain and their treatment or exclusion from the unit. In departments where the facilities exist, it would be more economical of ward staff to screen them for dispersal rather than carriage of *Staph aureus* and to remove only the profuse dispersers from duty in the protective isolation unit.

Upper-respiratory-tract viruses may present a hazard in protective isolation units but screening of staff other than by evidence of symptoms is not practicable apart from special investigations. The difficulties of screening staff for these and other pathogens are many but, whether or not screening is performed, it should be a firm rule that staff who are unwell should stay away from the unit.

HAND WASHING

There are obvious reasons for washing hands before attending any patient, especially the highly susceptible, and after treating those known to be infective.[1]

It is well established that hands and clothing become contaminated during the handling of patients.[2] Although there is little direct evidence of the extent to which the contaminants are passed on to the next patient, inevitably this must occur unless hands and clothing are rendered free of the micro-organisms they have acquired. Washing of the skin quickly removes "foreign" organisms picked up by contact. Studies of hand washing by nurses and others have shown, however, that this is usually very inefficiently carried out[3]: more than half of those observed missed some part of the thumbs, and other parts of the hand also often escaped cleaning. As it is virtually impossible to eliminate the resident bacterial flora the value of prolonged washing is doubtful.

The use of disinfectants undoubtedly improves the cleaning effect bacteriologically, so long as the whole hand is effectively treated. Soaps and detergent emulsions containing hexachlorophane build a protective barrier in the skin against Gram-positive organisms. The discovery that this substance may be dangerous to infants[4] has led to a great reduction in its use, whether justified or not.[5] There is also the possibility of selectively encouraging Gram-negative organisms by the regular use of skin disinfectants that act mainly against Gram-positive organisms.[6] A hand-washing solution containing 4% chlorhexidine (Hibiscrub) is now widely used and is satisfactory.[7] A convenient and effective disinfectant for the hands is 70%

alcohol, with the addition of a little glycerine to avoid excessive drying of the skin.[8] Three ml of the alcoholic solution is rubbed over the hands until dry, ensuring that all areas are covered. Nevertheless, no method of chemical disinfection will produce a sterile hand; this can be obtained only by the use of gloves. Disposable polyvinyl chloride (PVC) gloves are available with good feel. Under non-sterile conditions gloves may be washed, on the hand, more quickly and effectively than the skin without the unpleasant effects on the skin of too-frequent washing.

Many wash basins are ill-adapted to nursing. Taps should not be hand operated. Elbow operation is mechanically poor and invites hand operation. Foot or knee operation is preferable, either by direct mechanical linkage or by solenoid operation; photoelectrically operated systems are now appearing. Washing in running water is essential. The most satisfactory system is a supply of water at the appropriate temperature direct to a low-velocity spray tap without mixing at the basin (a separate cold tap for drinking water or other purposes will often be needed). Basins should be relatively deep to contain splash and should not be fitted with plugs.

Drain traps and overflows acquire pseudomonads or similar organisms. Although there is some doubt whether these sources represent a real risk or only reflect their surroundings, they are best avoided. Heated traps have been produced for disinfection where the risk is considered relevant[9]; flushing at intervals with disinfectant is only moderately effective.[10]

CLOTHING AND GOWNS

Normal types of woven textiles offer little barrier to the passage of skin scales and other small particles. The skin flora of any individual will therefore quickly penetrate to the surface of the clothing, and may be dispersed from it. Similarly, any surface contamination of clothes will penetrate to the underlying layers of clothing and contaminate these. Only partial protection against contact transfer—direct or indirect—is therefore given by clean (or sterile) gowns or other clothing[11] unless these are made of material impermeable to bacteria-carrying particles. Closely woven cotton fabrics of the Ventile type have a low penetrability for such particles and can be treated so that they are water-repellent, which reduces the risks of bacterial transfer through wetting. Their low permeability to air and water vapour, however, makes garments of these fabrics uncomfortable to wear for long periods. Preventing dispersal also demands a coverall type of garment, closely fitting at the neck, wrists, and ankles, which accentuates the discomfort.

Simple disposable plastic gowns which cover the parts of the body that come in to the closest contact with the patient can probably reduce contact transfer substantially.[12] Many types of non-woven synthetic materials have appeared in recent years. They can be made with a full range of properties in terms of particle penetration and water repellency but there is no specification for a fabric and a garment that fulfils all the requirements of isolation nursing. The development of suitable specifications is of the first importance for improving isolation.

It will generally be better for nurses to have a clean dress daily than a daily change of apron over a dress worn for longer. More work is needed to produce clothing that is a satisfactory obstacle to bacterial transfer. At present it seems best to use plastic aprons for procedures with a risk of contact contamination in either direction. After use they can be washed with a detergent solution. Cheap disposable aprons with wall dispensers are now available.

CAPS, MASKS, AND FOOTWEAR

The risk of transfer from the hair or the upper respiratory tract is much less than that from the hands and clothes, but it cannot be ignored.

There is some evidence that hair picks up bacteria readily from the environment and that the head may be a site of *Staph aureus* carriage.[13 14] Because the head is often moved directly above the patient it should be covered when a high degree of patient protection is necessary. To be effective the covering must be impermeable to bacteria-carrying particles, such as a disposable plastic cap. If they are to have any use, caps must enclose all the hair but are justified probably only when there is an especially high risk. Facial hair is similar to scalp hair, so the precautions should also apply to beards and moustaches.

Masks can be worn to protect either the wearer or the patient. The wearer will be protected only if the mask fits the face closely; the use of masks for protection in industry has been thoroughly studied, and efficient designs that could be adapted for hospital use are available; the conventional surgical mask is probably of little value. Conventional surgical masks may, however, protect the patient against the larger particles dispersed from the upper respiratory tract. The infective agents that might most often be transferred in this way are the viruses of the upper respiratory tract and *Streptococcus pyogenes*. Exclusion of staff with respiratory tract infection or sore throats will reduce this risk. When masks are specified—and only certain classes of patient need this form of protection—a clean one should be used for each entry to the room and should be discarded on leaving.

The evidence that floors and footwear contribute anything significant to the risk of infection is tenuous. The pathogens most often introduced by shoes are probably the *Clostridia* but these organisms are introduced in many other ways more likely to transfer them to a patient, who, in any case, probably carries his own. It is, however, certainly desirable that isolation units should be seen to be clean, and in this respect change of shoes by staff and overshoes for visitors may be justified.

BATHING AND CHANGING

There is no evidence that shower bathing has any useful effect in reducing the spread of micro-organisms by an individual, and it sometimes has the opposite effect.[15 16] Because the skin remains colonised clean clothing put on by staff entering the unit is rapidly contaminated. To avoid accumulation of strains picked up on clothing from infected patients and to maintain the rule of "seen to be clean," a daily change of outer clothing (and donning of gown or coat by visitors) is good practice.

CLEANING AND TERMINAL DISINFECTION

Outside domestic staff should be excluded from the patient rooms in an isolation unit. The fewer individuals who visit the room the better, and those who must go in should be familiar with isolation procedures. Extensive cleaning is not usually needed during the stay of any one patient; damp dusting and floor cleaning are appropriate. Disinfectants are usually unnecessary. Stored damp cloths and mops can be highly contaminated and storage in disinfectant does not always prevent this. Disposable cleaning cloths are preferable; WC brushes should be stored dry.[17]

All textiles associated with a patient should be changed when he leaves. Impervious-surface tables, lockers, bed frames, etc, can be cleaned by wiping with a detergent and this is normally sufficient. Fogging is only a method of wetting all surfaces; it may reach places difficult of access that would be omitted from a "house-keeping" type of procedure but it may be less effective than wiping when there is heavy contamination. Most of the relatively inaccessible places such as ceilings are not relevant to any infection risk. For a few diseases, such as smallpox, anthrax, Lassa fever, Ebola fever, and Marburg disease effective terminal disinfection is important. Formaldehyde is then probably the agent of choice; the process necessitates sealing the room and ensuring maintenance of an adequate concentration

and humidity for an adequate period.[1] Unless the possibility of fumigation has been considered in the building design, sealing and containment of the vapour may be very difficult.

Supplies

It is sound policy to specify the procedures to be followed for all supplies to isolated patients. The facilities of a central sterile supplies department (CSSD) are assumed to be available.

Examination instruments such as stethoscopes,[18] sphygmomanometers,[19] etc, should be kept in each room and disinfected between each change of occupant.

INFECTED PATIENTS IN SOURCE ISOLATION

No special sterilising arrangements are necessary for supplies to infected patients. Under some circumstances, however, it may be more convenient to have uniformity in supplies for infected and for susceptible patients. Ease of disposal is a factor to be considered in specifying supplies for infected patients; disposable crockery, bed pans, urinals, etc, may therefore be advantageous. Some disposable items, such as bed linen, crockery, and cutlery are less acceptable for patients in isolation for long periods but may have substantial advantages for short-stay patients.

SUSCEPTIBLE PATIENTS IN PROTECTIVE ISOLATION

Supplies may be disposable or reusable. Reusable bedpans and urine bottles require a system of recycling and sterilisation or disinfection as well as storage space. This needs consideration in the planning of a unit.

Sterile supplies should be double-wrapped to avoid contamination of packages introduced into the patient area.[20] Bed linen and patients' clothing should be changed daily; this means carrying stocks large enough to contend with holiday weekends and industrial disputes. A relatively high ambient temperature reduces the requirement for bed linen. Disinfection of mattresses and pillows presents substantial difficulties. They may be fitted with impermeable covers that can be washed and disinfected; large ethylene-oxide plants or gamma radiation can be used but the expense is unlikely to be justified.

Most non-electrical hardware can be washed in disinfectant solution at entry to the isolation area. Papers, books, letters, and some items for occupational therapy and toys may be disinfected by hot air, ethylene oxide, or formaldehyde.[21 22] Pharmaceutical supplies virtually defy sterilisation and steps to prevent their contamination or use after contamination are important.[23]

Food

Sterile water should be available, but complete food sterilisation is not often required except for the most stringent germ-free conditions. It is difficult and expensive to attain. For many purposes it is sufficient to aim at freedom from pathogens and from gross contamination with other organisms.

A good "special diet" kitchen maintaining a high standard of hygiene may be a suitable source of food if combined with informed selection of foods in the ward, which requires specific instruction of the nursing staff regarding microbiological growth in foodstuffs. Bacterial contamination of food from central kitchens can be reduced by microwave irradiation, combined with conventional heat.[24] Suitable ovens are difficult to obtain and expensive to maintain.

A higher standard can be achieved at greater cost by preparing food in the ward kitchen. Clearly this has implications for the design and planning of units. The main limiting factor is the availability of cooks trained, or willing to train, in sterile techniques. In practice, responsibility for food hygiene has to remain with the nursing staff; preparation in the ward allows for greater flexibility in patients' preferences, which may be an important factor with ill patients.

Pressure cookers may be used with advantage in the ward kitchens but their use requires some knowledge. Ultraviolet irradiation does not penetrate food, and its efficiency is reduced by the humid conditions that are often present in kitchens. Gamma-irradiated and canned foods may be used exclusively or to supplement other forms of food and may generally be relied on to be sterile. Canned butter is not sterile, however, and may be heavily contaminated with staphylococci. Potato rapidly becomes heavily contaminated after mashing with butter and possibly with margarine.

Waste

In this section the term "waste" is used to include all items emerging from the isolation room.

A fundamental principle of source isolation is that items that have been in contact with the patient should not come into direct or indirect contact with other patients. Cheap plastic bags and better paper bags have greatly simplified and improved methods of disposal but care is needed to ensure that bags are closed properly.

Preferably goods should enter the isolation ward by one route and leave by another. This ideal is not always attainable but it is wise to define and provide facilities for all the main items in use. In some constructions specially designed entry and exit hatches have been used successfully. They must be operated in relation to the ventilation arrangements. Separate routes for entry and exit can be dispensed with only if bagging can be done effectively within the isolation area.

For some items there is a choice of disposable or reusable versions but the design of an isolation room may commit the unit permanently to one or the other. Because technological developments and shortages result in frequent changes in the relative merits of disposable and reusable goods it is not possible to give reliable guidelines. In general, disposable items require more storage space, but this may be partly offset by the fact that reusable goods require space for the cleaning and sterilising equipment. Disposable goods tend to work out more expensive than their reusable equivalents, but reusable items generally have higher capital costs and labour charges. Some disposable items, however, particularly bedpans and urine bottles, require special disposal equipment, which may be expensive and noisy. Providing toilets in each isolation suite does not obviate the use of bedpans and urine bottles because these are needed for patients confined to bed and for collecting samples for laboratory investigations.

Articles emerging from an isolation suite may be classified as: kitchen and food waste; bedpans and urinals; laboratory specimens; items for return to (*a*) CSSD via the laundry, (*b*) directly to CSSD; sundry waste for incineration.

In addition, personal effects brought or taken away by relatives or to be stored may require consideration.

WASTE FROM INFECTED PATIENTS

Waste from patients with some types of infection should be in clearly labelled sealed bags before leaving the unit. Double bagging should be used if the outside of the first may have been contaminated. The nature of the risk—for example, hepatitis—should be stated on laboratory request forms and items returned to the CSSD. Bedpans and food trays should not be handled by staff who are unfamiliar with the risks of contracting or spreading infection; their handling cannot be left to ward domestic staff.

With few exceptions faeces and urine from infected patients

are best disposed of via a WC pan in the isolation suite. Where this is not possible the bedpans and urinals should be bagged within the unit and passed through the exit hatch and taken to the bedpan or bottle washer. Bedpans and bottles should be sterilised by machines close to the washing unit. The only exceptions to the immediate use of the public drainage system for disposing of excreta from infected patients are the enteric fevers, smallpox, Lassa fever, Ebola fever, and Marburg disease. In such cases prolonged contact with a suitable concentration of phenolic disinfectant is essential before disposal.

Dead bodies of patients who have suffered from diagnosed or suspected smallpox, Lassa fever, Ebola fever, Marburg disease, or serum hepatitis should be dealt with by staff wearing gloves and impermeable protective clothing, and should be enclosed in a large plastic bag before being taken from the room in which the patient died.

Waste from susceptible patients does not usually need any special arrangements.

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Personal Therapeutics

Childhood epilepsy

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Although the following scheme for the drug treatment of childhood epilepsy expresses my own preferences, it has been arrived at over the years after much discussion with many colleagues who share an interest in the welfare of these children and after consideration of the written views of many others.

Recent years have seen the rise to popularity of some relatively new drugs such as carbamazepine and sodium valproate (the latter having been greeted by some as the greatest thing since Greta Garbo) and a consequent relegation of others such as phenobarbitone and primidone. Available evidence suggests that carbamazepine has an anticonvulsant potency equal to that of phenytoin or phenobarbitone and produces fewer undesirable effects.

Phenobarbitone and primidone are now used less often because of the well-known risk of behaviour disturbance and possible interference with learning in young children. For the prophylaxis of febrile convulsions phenobarbitone is the only drug about which a large volume of information is available and, even so, the evidence about its effectiveness is conflicting.

Phenytoin is an effective anticonvulsant drug that has been in use for a long time and still has many devotees, but its numerous side effects and the relatively small difference between subtherapeutic and toxic doses make it, in my opinion, inferior to carbamazepine.

Sodium valproate is undoubtedly a very effective drug and, so far, has shown remarkably little toxicity. Some would prefer it to phenytoin but I do not use it as a first-choice drug, preferring to keep it in reserve for the more resistant cases. Nausea and vomiting occasionally restrict its use.

Nowadays, no drug can be said to have had an adequate trial unless adequate serum concentrations have been achieved, and such measurements help to avoid an unwarranted rush into polypharmacy. There is no proof that in epilepsy two drugs are better than one. If it becomes necessary to use a second drug the first should be gradually withdrawn as soon as the epilepsy is controlled. Only exceptionally should it be necessary to use more than one drug in the long term. I offer the following as a practical guide.

Choice of drug

Drugs are listed in order of preference. Use only *one* drug if possible—controlled by estimating serum drug concentrations if necessary.

Major generalised seizures (*grand mal*)—carbamazepine or phenytoin,* sodium valproate, primidone, phenobarbitone, acetazolamide, or sulthiame.

*In adolescent girls particularly, carbamazepine might be preferred in view of the risk of gingival hyperplasia and hirsuties.

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