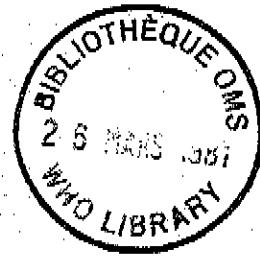




**WORLD HEALTH ORGANIZATION
ORGANISATION MONDIALE DE LA SANTE**

INDEXED



**PRACTICAL GUIDE
TO THE PREVENTION OF HOSPITAL-ACQUIRED INFECTIONS**

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1. INTRODUCTION

Hospital hygiene will be dealt with here in its narrow sense: the prevention of hospital-acquired infections.

A hospital infection is an infection acquired in hospital by a patient who was admitted for a reason other than that infection.

Before the advent of antibiotics most hospital infections were due to micro-organisms of external origin (salmonellosis caused by infected food, bacterial gangrene, etc.) or to micro-organisms not present in the normal flora of the patients (diphtheria, tuberculosis or any other infectious disease in the conventional sense), but this has now changed. Nowadays hospital infections are caused by micro-organisms which are normally present in our personal flora, but in such small quantities that they are not pathogenic under normal circumstances. When an antibiotic is administered, however, it acts not only on the pathogenic micro-organisms that are the target of the therapy but also on the whole of the patient's personal flora which it treats selectively.

The main causes of hospital infections are:

- (1) antibiotic therapy;
- (2) the increase in the number of hospitalized patients susceptible to infection (newborn infants, old people, malnourished or diabetic subjects, etc.);
- (3) use of increasingly violent techniques for diagnosis (catheterization) and therapy (immunosuppressive steroids, implantation of foreign bodies);
- (4) increase in the number of people dealing with the same patient;

- (5) increase in patients' movements within the hospital;
- (6) hospital staff not adequately trained in the prevention of infections;
- (7) unsuitability of architectural design and sanitary facilities.

2. EPIDEMIOLOGY OF HOSPITAL-ACQUIRED INFECTIONS

Two types of infection must be distinguished:

(1) The "wild", natural or non-hospital infection with which the patient enters the hospital. This is due to pathogenic micro-organisms which produce either an infectious disease or septic lesions.

If the disease is clinically apparent at the time of admission, the usual precautions (for isolation and precautions see section 8) should be taken immediately so that the disease is not transmitted within the hospital. These infections are due to non-hospital micro-organisms, generally susceptible to antibiotics, unless the patient contracted the infection during a previous stay in another hospital.

(2) The hospital infection, which is contracted in hospital and makes its appearance either during hospitalization or after the patient is discharged.

2.1 Sources and vehicles of infection

Hospital infections are derived from:

The patient's own flora: self-infection. The micro-organism concerned is not pathogenic under normal conditions, but inadequate procedures or simply antibiotic therapy may enable it to reproduce, spread and implant itself at a site where it may produce an infection.

The flora of another patient: cross-infection. In such cases the micro-organism concerned is transmitted:

- (a) by direct contact between patients (saliva droplets, patient's hands);
- (b) by air (dust from fabrics carrying a patient's flora);
- (c) by the staff:
 - who collect the micro-organisms directly on their hands or clothes and transmit them to another patient,
 - who cultivate the micro-organisms on the mucosa of their own respiratory and intestinal tracts, for example, where they reproduce and are transmitted - rarely by air, more often by contact (micro-organism carriers);
- (d) by inanimate objects:
 - contaminated by the patient himself: hospital equipment (sanitary installations, blankets), medical equipment (endoscopes, catheters, vesical probes, aerosols, etc.);
 - contaminated by the hands of any hospital staff in any part of the hospital (kitchen, laundry, treatment room, etc.);

- contaminated by visitors;
- contaminated by staff who are ill or are carriers of micro-organisms;
- contaminated by food or infected water.

Man therefore occupies a central position:

- (1) as reservoir and source of micro-organisms;
- (2) as disseminator (communication routes);
- (3) as recipient or target, thus becoming a new reservoir.

2.2 The pathogens

The hospital pathogens are:

- in rare cases protozoa (Pneumocystis);
- sometimes fungi and yeasts (Candida, Aspergillus, Cryptococcus);
- more frequently viruses (hepatitis, herpes, influenza);
- most often bacteria, or their impaired forms, the appearance of which is encouraged by antibiotic therapy. The bacteria with resistance transfer factors are the most dangerous.

(1) The telluric, anaerobic micro-organisms, the Clostridia, causative agents of gangrene, were the most common pathogens until the discovery of antibiotics. Nowadays they are rarely a source of hospital-acquired infection as the sterilization of equipment has brought them under control.

(2) Among the Gram-positive cocci, Staphylococcus aureus is still a formidable pathogen. Originating from an infected patient it colonizes the staff, especially in hospitals where routine hand-washing is not the rule (nasal carriers of Staphylococcus aureus). These micro-organisms readily acquire resistance to antibiotics.

Staphylococcus aureus found in hospitals has been subdivided into different types on the basis of lysogenicity (phage types) or antigenic characteristics (serotypes), which means that epidemiological studies can be performed in the hospital.

Streptococcus pyogenes seems to be less common nowadays in hospitals. However, it will produce infections whenever the basic procedures are defective. The group B streptococci remain a threat in obstetric and paediatric departments.

Streptococcus faecalis is one of the pathogens of the intestinal flora which, in association with other agents, will often produce faecal infections (in patients with urinary infections, abdominal surgery patients).

(3) The enterobacteria are at present the micro-organisms most frequently responsible for severe hospital infections, which they produce particularly readily when they have resistance transfer factors.

Escherichia coli heads the list of agents responsible for urinary infections (25% of infections). The enteropathogenic colibacilli are transmitted in wards for young children if hygiene is not strict.

The Klebsiella are selected by the use of certain semisynthetic penicillins. They have invaded hospitals, where they produce urinary and respiratory infections.

The Proteus micro-organisms, often naturally resistant to antibiotics, are responsible for urinary infections, particularly on indwelling catheters.

The enterobacteria that have recently appeared in hospital flora include Enterobacter, Acinetobacter, Citrobacter, Serratia, Alcaligenes and Campylobacter.

(4) The Pseudomonadaceae have long been a hospital problem.

Pseudomonas aeruginosa is still an active pathogen, particularly in patients with burns and multiple injuries.

Moraxella can produce a septicaemic pathogenic action, particularly in intensive care units.

The pathogens are therefore involved with varying selectivity in specific situations.

These hospital pathogens are supplemented by all the conventional pathogenic micro-organisms whose presence in a patient may lead to their spread within the hospital: Salmonella and Shigella are often involved, Listeria less commonly.

2.3 Mode of transmission and ways of interrupting it

2.3.1 Mode of transmission

There are four main routes of infection that have to be watched in hospitals:

- (1) the aerial route,
- (2) the oral route,
- (3) the contact route, especially the "hand-borne" route,
- (4) the parenteral route.

In the sequence of transmission the following factors must be taken into account:

- (1) the pathogen;
- (2) the reservoir or substrate for the pathogen;
- (3) the exit point;
- (4) the transmission route;
- (5) the point of entry into the host;
- (6) the susceptibility of the host.

2.3.3 Interruption of transmission

Efforts must be made to break this sequence at its most vulnerable point, which differs from one case to another.

It is possible therefore:

- (1) in rare cases to destroy the pathogenic agent (specific antibiotic therapy; examples: syphilis, gonorrhoea);
- (2) to control the reservoir (isolation of infectious patients, e.g. measles, chickenpox, extensive burns);
- (3) to control the exit point (disinfection of excreta and infected material);

- (4) to control the transmission route (washing of hands, disinfection of equipment, change of working clothes);
- (5) to protect the recipient host (protective isolation, e.g. agranulocytosis, leukaemia);
- (6) to increase host resistance (vaccination and serotherapy, e.g. diphtheria, tetanus, tuberculosis and poliomyelitis).

Some tasks are more easily performed by doctors, others by nurses, by the maintenance staff or by the hospital engineer, and others again by the central supply department.

3. PREVENTION: THE CONCEPT AND THE METHOD

The prevention of hospital-acquired infections comprises first of all the erection of a certain number of "barriers" in order to prevent the transmission of micro-organisms from one patient to another, from the staff to the patient (or vice versa), or from equipment to the patients. This approach is preferable to that of simply recording clinically apparent infections, isolating them, treating them, and then studying the route of contamination afterwards.

Taking into account the predominant importance of the contact route in the transmission of bacteria, and in the light of local conditions, the procedures to be applied have to be defined. They will cover four main points:

- (1) surveillance, treatment and notification of any incipient infection or any evident superinfection;
- (2) reduction of person-to-person transmission to the minimum;
- (3) elimination of contamination by equipment;
- (4) regular routine decontamination of surfaces and the working environment.

A single form of action, however perfect, which aims to eradicate one or more infections from a hospital is often fruitless. Action should therefore be directed at all hospital departments and should form a consistent whole requiring everyone's collaboration.

In order to avoid the dissipation of resources and goodwill it is extremely important to set up a Hospital Hygiene Committee capable of setting priorities, selecting the methods and coordinating the measures to control hospital infections.

Hospital Hygiene Committee

The Hospital Hygiene Committee should be an official body including the staff responsible for the following services: medical staff, nursing staff, cleaning and general services (kitchen, laundry, etc.) administration, laboratories. It should meet regularly (once a month) during working hours even if there seem to be no urgent problems. In the event of an emergency the Committee should meet immediately.

The Hospital Hygiene Committee should consider:

- (a) ways of promoting the standardization of working methods in relation to hospital hygiene;
- (b) ways of supervising the implementation of measures for the control of hospital infections; if necessary it should supervise them itself;
- (c) ways of educating the staff and keeping them informed by arranging appropriate and regular symposia for specific groups or departments;

(d) whether the modification of a technique or piece of equipment, or especially of a product for cleaning or disinfection, is acceptable to the general services, the services looking after patients, and the administration;

(e) whether the acquisition of a new item of equipment is compatible with the establishment's facilities for disinfection and/or sterilization;

(f) whether the infections notified to the Committee's representative by the various physicians could be prevented by applying measures of a general nature.

Application of the Committee's decisions will be greatly facilitated by the assistance of specialists: medical hygienist, hospital hygiene nurse, hospital hygiene technician.

3.1 Surveillance and notification of all incipient infections or obvious superinfections

The aim of the surveillance and notification programme is to detect and record methodically all hospital-acquired infections.

3.1.1 Notification of infections

The programme involves the completion of a notification of infection (see page 9) for each patient. For the purposes of this notification it is advisable to define hospital-linked infections and to select criteria for recording them.

Definition of hospital-linked infections

A distinction is made between:

- infections developing in a hospitalized patient which were neither present nor incubating on admission;
- infections acquired during an earlier stay in hospital;
- new clinical sites of infections already present on admission;
- the appearance of a new micro-organism in an infection present on admission, if this bacteriological change is accompanied by deterioration of clinical condition.

Criteria for recording hospital-linked infections

Four kinds of infections predominate in hospitals. Specific criteria need to be drawn up if they are to be recorded meaningfully.

(1) Urinary infections:

The urinary infections may be symptomatic (fever, dysuria, lumbar pain) or asymptomatic. Their recording depends partly therefore on the microbiological tests performed. Hospital urinary infections are considered to comprise all infections with over 10 000 micro-organisms/ml (midstream urine samples) or a positive culture (catheterization samples) in a patient whose urine was previously either sterile or infected with a different micro-organism.

(2) Infections of the lower respiratory tract:

The clinical signs of infection (coughing, pleural pain, fever and above all phlegm) are enough for these infections to be recorded, even if no chest X-ray or bacteriological tests have been performed. Superinfections of pre-existing conditions must be recorded if a new pathogen is cultivated in the phlegm and if clinical and radiological findings indicate aggravation of the disease.

NOTIFICATION OF HOSPITAL-LINKED INFECTION

Surname:	
First name:	
Sex:	Age:
DEPARTMENT:	
Date of admission:	

1. DIAGNOSIS

2. HAD THE INFECTION APPEARED AT THE TIME OF ADMISSION? YES NO

3. IF NOT, date of onset of infection

4. CLINICAL HISTORY

5. TYPE OF INFECTION (check appropriate box)

- | | |
|--|--|
| <input type="checkbox"/> systemic | <input type="checkbox"/> communicable disease |
| <input type="checkbox"/> urinary | <input type="checkbox"/> miscellaneous (specify) |
| <input type="checkbox"/> lower respiratory tract | |
| <input type="checkbox"/> post-operative | |

6. IF OPERATION PERFORMED, specify its nature (surgical, intravenous catheterization, etc.)
.....

Performed by Date

7. BACTERIOLOGICAL SAMPLING YES NO

<u>Type</u>	<u>Date</u>	<u>Results</u>
.....
.....
.....

8. ANTIBIOTICS ADMINISTERED

9. TYPE OF ISOLATION PERFORMED:

- total respiratory enteric skin/wounds protective

DURATION: from to

Signature of nurse in charge:

10. COMMENTS:

Signature of responsible physician:

(3) Post-operative infections:

Any surgical wound which results in a purulent discharge must be regarded as a hospital infection. Whether the bacteria are of endogenous or exogenous origin is not taken into account.

(4) Systemic infections:

A positive haemoculture revealing a known pathogen, or at least two haemocultures revealing a micro-organism reputed to be non-pathogenic, must be taken into account and listed as hospital infections.

The notification of infection is drawn up by the doctors and nurses responsible for the hospital department.

3.1.2 Processing of information collected

The information collected in this way is processed, as appropriate, by the medical hygienist or epidemiologist or by the hospital hygiene nurse. A weekly report, or preferably a monthly report, makes it possible to compile statistics on infections by department and for the hospital as a whole, for each type of infection.

Incidence rates and period prevalence rates should be worked out:

- The incidence rate corresponds to the number of new cases recorded in a given period in relation to the number of patients who passed through the department during the same period.
- The period prevalence rate corresponds to the number of new and old cases recorded during a given period in relation to the number of patients who passed through the department during the same period.

When it is difficult to obtain notifications of infections regularly, a sample can be taken on a given date. The prevalence rate can be compiled on the basis of the information collected; this corresponds to the number of cases recorded on the given date in relation to the number of patients in the department on the same date. This rate, also known as the instantaneous prevalence rate, has only an indicative value.

In the event of an epidemic an attack rate can be worked out; this corresponds to an incidence rate for an unspecified period. It is of course only possible to talk of an epidemic when biotyping of the micro-organisms responsible has demonstrated their antigenic similarity.

Analysis of these various rates by the Hospital Hygiene Committee will reveal the true dimensions of the hospital infection and make it possible to direct control operations and to develop the most effective possible strategies of action.

The trustworthiness of all this information should be checked, in particular by making comparisons with the results of bacteriological analyses of pathological specimens (which constitute a useful second route of notification), with the consumption of anti-infectious drugs (antibiotics) and with the data provided by spot surveys.

3.2 Reduction of person-to-person transmission

Every effort should be made to control the contact routes, the most important of which are hand-borne transmission and transmission through the working clothes of staff.

3.2.1 Hand-washing

Hand-washing is of cardinal importance. It should be governed by standard rules throughout the hospital adjusted to the different risks of infection.

Selection of substances to be used for washing

(a) The substances must be clean. The use of cakes of soap is inadvisable. Sealed soap dispensers should be recommended. Powdered soap often yields poor results, because it is irritant and often forms residues; it is therefore preferable to use liquid soaps or disposable soap in soluble wafers.

(b) The substances must be non-selective, i.e. active against both Gram-negative and Gram-positive micro-organisms.

(c) The substances should be sterile in certain cases, e.g. operating theatres.

Two (or at most three) types of substances should be selected for the hospital:

- A substance containing no germicidal ingredient, for general use. It should have good cosmetic properties, be slightly acid and provoke no allergic reaction. This kind of washing produces its effect mainly through mechanical action, eliminating the transient microbial flora.
- One or two substances with germicidal action, effective against both Gram-positive and Gram-negative micro-organisms, for specialist use (operating suite, delivery room, intensive care unit, premature babies unit, isolation wards, etc.). A germicidal soap is preferable to an alcoholic solution; the latter should be provided when hand-washing is not always possible (intensive care, for example).

Choice of equipment

It is better to use running water than soaking procedures; the equipment should include:

- running water;
- a washing agent;
- a method of drying.

Adequate equipment should be selected, as follows:

(a) a wash-basin of adequate size made of a non-porous material, with no overflow, and with a trap that is easily dismantled and tolerates decontamination;

(b) readily accessible taps provided with an anti-splash device and which ideally can be operated without contact by the hands (by the elbow, knee or foot);

(c) brushes, when considered necessary, which are soft, sterile and for personal use;

(d) washing agent dispenser that is easily cleaned, wall-mounted, made of materials compatible with the washing agent selected, easy to refill, and ideally elbow- or foot-operated (with no air intake). Dispensers with a nozzle that has to be activated by hand to obtain the product are contaminating;

(e) drying the hands is important; it should be done with individual towels, if possible of paper, so as not to create additional germ reservoirs. The drying procedure should not in itself be a spreader of germs (do not permit hot-air driers).

When to wash the hands

Hospital staff should wash their hands:

- on starting work;
- when their hands are dirty;

- after going to the toilet;
- after blowing the nose;
- before eating;
- on finishing work.

Medical, nursing and paramedical staff should also wash their hands:

- between contact with two patients or two beds;
- after fitting or touching a mask;
- before touching the mouth or face of a patient;
- before an aseptic procedure;
- after handling dirty equipment (urinal, bed-pan, linen, etc.);
- on entering and leaving the room of a patient in isolation or intensive care.

Hand-washing technique

(a) Surgical washing of the hands includes: mechanical washing, rinsing, soft washing, further rinsing, followed by drying with a sterile towel. The duration of these operations (3-10 minutes) and whether or not a brush is used will depend on the kind of washing agent. It should be noted that if soap containing a germicidal agent is used, scrubbing can be limited to the nails.

(b) Hygienic washing of the hands takes two forms:

1. On starting duty (basic washing):

- wash the hands, the wrists, and the forearms up to the elbow (about one minute);
- pay special attention to the cuticles and the spaces between the fingers;
- rinse thoroughly;
- dry carefully by dabbing with an individual towel (paper).

2. Between two patients or before a sterile procedure:

- wash the hands and wrists quickly (10-15 seconds);
- rinse;
- dry by dabbing with an individual towel (paper).

Alternative for unsoiled hands: application of an alcoholic substance.

3.2.2 Clothing

Working clothes

The staff should wear a working outfit, worn so as to cover all other clothes and jewellery; for men it consists of a pair of trousers and a short-sleeved gown, for women it consists of the same outfit or a short-sleeved dress. The longer the dress, the more protection it will give.

The working outfit should be made of an easily decontaminated fabric.

Staff should put on a clean outfit every day, or at least two or three times a week.

It is desirable that nursing staff should put on clean underwear every day.

Nails, hair, shoes

Nails should be clean and cut short.

Hair should be worn short or pinned up.

Beards and moustaches should be kept short.

The hair should be brushed every day and washed frequently (once a week for example).

Female nursing staff do not have to wear a head covering (except in protected sectors where the hair of all members of the staff should be completely covered by a close-fitting cap).

The shoes worn by the staff attending to patients should be easy to clean.

Rings, watches

While the wearing of a smooth wedding ring is permissible, any other object decorating the hands or wrists should be removed when attending to patients.

Handkerchiefs

It is advisable to use disposable handkerchiefs or towels. Repeated use of a fabric handkerchief should not be allowed.

The hands should always be washed after blowing the nose.

3.2.3 Mask

Choice of mask

A mask made of paper or a synthetic material (polypropylene or fibreglass) is an effective barrier against the micro-organisms emitted by the wearer's naso-pharynx and against the micro-organisms present in the ambient air.

The protection provided by paper masks is of limited duration (30 minutes), especially if they become damp.

Masks of synthetic material, even when wet, preserve their full filtration capacity for several hours (5 on average). Masks of cotton-wool or gauze are ineffective.

Wearing the mask

- (1) Fit the mask to the face very carefully. It should cover the nose and mouth.
- (2) Wash the hands after putting on the mask.
- (3) Do not touch the mask while wearing it (substantial risk of contaminating the hands).
- (4) Dispose of the mask immediately it is removed; a mask should never be put into the pocket to be used again.

- (5) Wash the hands after removing the mask.

N.B. It is a mistake to leave a mask hanging round the neck, dangling under the chin, or to leave an isolation ward, operating suite or delivery room while wearing a mask.

Indications for wearing the mask

- (1) For the patient's protection:

- while working in the operating suite;
- when attending to and treating patients who are highly susceptible to infections;
- during punctures of body cavities;
- when moving a patient susceptible to infections; the patient himself should wear a mask.

- (2) For the protection of the staff:

- when attending to a patient suffering from a disease that is communicable by the aerial route;
- when dressing infected wounds;
- when performing bronchoscopies or similar examinations;
- when moving a patient who has a disease that can be communicated by the aerial route.

3.3 Elimination of contamination by equipment

In order to reduce to the minimum the transmission of micro-organisms by the equipment used, before it becomes a reservoir of micro-organisms and contaminates the staff and the patient, methods are needed for cleaning, disinfection and sterilization.

3.3.1 Cleaning

Cleaning should not be a contaminating procedure. In most cases it is advisable to combine it with disinfection in so far as the agents are compatible.

3.3.2 Disinfection

Disinfection is a controlled elimination of micro-organisms which is intended to prevent the transmission of certain undesirable micro-organisms by impairing their structure or metabolism, regardless of their physiological status.

Its area of application covers equipment which does not need to be sterile, used equipment before it is cleaned and disposable equipment which cannot be incinerated.

The disinfection procedure must meet precise requirements:

- (1) It must be effective:

- active against undesirable micro-organisms;
- having a surfactant effect;
- not inhibited in its action by the number of bacteria present, the chlorine in the water, the degree of hardness of the water, or the presence of soap and proteins.

- (2) It must be easy to use;
- not volatile;
 - not harmful to the equipment;
 - free from any unpleasant smell;
 - acting within a known time, compatible with the work of the hospital.

For recommended examples see Table 1.

Decontamination by humid heat has many applications, e.g.:

	<u>Temperature</u>	<u>Duration</u>
(1) Sanitary equipment	80°C	45-60 seconds
(2) Crockery, etc.	80°C	1 minute
(3) Linen	70°C	25 minutes
	95°C	10 minutes
	160-180°C	15-16 seconds

3.3.3 Sterilization

Sterilization is the destruction of all living forms, particularly all micro-organisms in their vegetative or sporulating forms, whether pathogenic or otherwise.

The concept of sterility is relative: statistically speaking, it is not possible to kill all bacteria, but the number of survivors can be reduced to an extremely low level. A set of objects is considered to be sterile when only one object in a million is contaminated (or the micro-organism count is 10^{-6}). It is easier to achieve a count of 10^{-6} when an object is clean than when it is dirty, which accounts for the importance and necessity of prior cleaning.

The area of application of sterilization covers:

- all objects entering the body by force;
- all objects entering sterile body cavities;
- certain objects entering non-sterile body cavities (e.g. feeding bottles and teats in the hospital).

To be effective, the sterilization process must be preceded by very careful cleaning. The equipment must be wrapped. Only a wrapped sterilized object should be described as sterile. Objects not wrapped before the sterilization process are called "sterilized".

Materials available for wrapping:

- (1) fabric which, even if tightly woven and doubled, permits the culture and reproduction of certain airborne fungus spores along its fibres and only maintains sterility of the wrapped equipment for three to four weeks.

In preference to fabrics it is advisable to select:

- (2) paper, which does not permit contamination if intact, maintains sterility for a long period, can act as a sterile field, can also be used to wrap dirty materials;

TABLE 1. DISINFECTION: RECOMMENDED EXAMPLES

Decontamination	Agent	Concentration	Action time	Comments
(1) Excreta of unrecovered objects	- Chlorine derivatives	1000-10 000 ppm active chlorine	Stools: 8 hours Urine: 6 hours	Example: Lime wash obtained by sprinkling one part of quicklime with one part of water, then slowly stirring in three parts of water
(2) Infected medical equipment (before washing and sterilization) and used equipment not sterilized before re-use	- Synthetic phenol derivatives with detergent - Aldehydes if appropriate - Activated glutaraldehyde - Chlorine derivatives	1% 2% 1-2% 2% 1000-10 000 ppm active chlorine	Immersion 60 minutes 15 minutes	To be repeated at least every month Their evaporation requires daily replacement Replace every fortnight Dilute at time of use Quaternary ammonium bases act only in an acid pH, exert little action on Gram-negative bacilli and no action on <u>Pseudomonas aeruginosa</u>
(3) Dirty surfaces and fixed or mobile accommodation equipment	- Synthetic phenol derivatives with detergent - Aldehydes if appropriate - Chlorine derivatives	0.5-1% 0.5% At least 100 ppm active chlorine		Only for application immediately after dilution Dilute at time of use
(4) Equipment probably contaminated but not visibly dirty	- Same as (3) - Alcoholic solution of products mentioned under (3) in spray form - Alcohols - Organic mercury compounds - Iodophor			Spores not killed
(5) Equipment for respiratory resuscitation and anaesthesia Isoletten	- Application of formal, followed by neutralization with ammonia and washing with compressed air - Alcohol, oxygenated water		Variable depending on technique applied	Inadequate disinfection
(6) Laboratory equipment	- Chlorine derivatives - Formaldehyde - Activated glutaraldehyde - Phenol derivatives	1000 ppm active chlorine 4% 2% 2%		
(7) Premises (a) Terminal disinfection (b) Continuous selective disinfection	- Formal with neutralization by ammonia - Hexylresorcinol sublimation		6 hours 2 hours Continuous	In controlled humid atmosphere, 60% relative humidity and 24°C Availability of automatic equipment Is better at reaching the gross particles carrying potentially pathogenic germs of human origin than the saprophytic germs in the air Useful activity in the vicinity of excretions of hospital microbes or patients under antibiotic with assisted respiration <u>Not permitted:</u> Ultra-violet rays, essential oils alone, ozone

(3) plastics: should be selected depending on the sterilization procedures; for example, only polyethylene and polypropylene are suitable for sterilization with ethylene oxide.

The normal methods of sterilization and testing are presented in Tables 2 and 3.

N.B. Drums can be used only if they contain material intended for a single treatment procedure for a single patient. They should be provided with a filter and a valve, which must be checked regularly.

3.4 Regular routine cleaning of the hospital premises

Since the introduction of micro-organisms into the hospital by patients is continuous and inevitable, the hospital premises must be cleaned regularly and systematically.

3.4.1 "Domestic" cleaning

The hospital must issue instructions for the cleaning of walls, floors, windows, beds, curtains, screens, fixtures, furniture, sanitary installations, etc.

The methods must be adapted to the level of contamination of the premises or the desired level of asepsis. Accordingly, the hospital can be divided into four zones:

- Zone A: administrative sections, or sections where there is no contact with patients.
- Zone B: sections for the care of patients who are neither infected nor highly susceptible to infection.
- Zone C: sections for the care of infected patients (isolation wards).
- Zone D: sections for the care of highly susceptible patients (protective isolation) or protected areas such as the operating suite, delivery room, intensive care unit, premature baby unit, casualty department and haemodialysis unit.

Zone A can be kept clean by the normal methods of domestic cleaning.

Zone B should under no circumstances be cleaned by a procedure that raises or spreads dust. Dry sweeping or the use of vacuum cleaners, even if provided with special filters, are inadmissible.

The use of a detergent/disinfectant solution improves the quality of cleaning.

Zone C should under all circumstances be cleaned with a detergent/disinfectant solution, using separate equipment for each room.

Zone D should be cleaned sector by sector, using a detergent/disinfectant solution and separate equipment.

All horizontal surfaces in zones B, C and D and all sanitary installations should be cleaned daily.

The results produced by routine bacteriological testing of the environment do not justify its general application. Such testing should only be carried out:

- when a new method of cleaning or a new cleaning agent is introduced;
- when an epidemic breaks out;
- whenever there is a wish to motivate or inspect the staff.

TABLE 2. NONVIAL METHODS OF STERILIZATION

		Methods			Applications	Recommendations	Drawbacks
Agent	Means	Temperature	Time				
Dry heat	Flaming oven	Red hot 160-180°C	130-45 minutes	Glass and metal Metal and glass, oil and talc	Frequent checks	Not suitable for fabrics, variations depending on filling, air pockets Spores and viruses not destroyed	
Humid heat (method of choice in hospitals)	Boiling Autoclave under steam saturation	100°C From 121°C to 134°C	From 20 minutes to 7 minutes	Does not constitute sterilization Glass and metal, fabrics, rubber, all items tolerating 120°C	Good idea to create a vacuum several times before starting, insist on complete steam saturation and perfect drying	Evaluation of air from packets is difficult if evacuation pump is inadequate (old equipment)	
Ethylene oxide	Pure or mixed	20-53°C	Depending on equipment and procedure	Items not tolerating 120°C or excess humidity	Special packaging Aeration necessary for items made of adsorbent materials	Toxic and inflammable gas; expensive procedure	
Formol	Formol autoclave (steam)	60-80°C	Depending on equipment	Items not tolerating 120°C	The wrapping should permit penetration of formol	Low penetration capacity, high relative humidity of about 90%	
Gamma rays	Linear accelerator or cobalt-60 bomb			Plastics manufactured in industrial series	Disposable items	Useful for industrial manufac- ture, resterilization problematic	

Pasteurization and tyndallization are not forms of sterilization, but simply reduce the number of micro-organisms.

TABLE 3. TESTING OF STERILIZATION

Agent	Tests			Bacteriological ^c
	Physical	Chemical		
Dry heat	Maximum thermometer ^a	Heat-sensitive dyes Brown's tubes ^b		Mixture of sporulating and non-sporulating strains
Humid heat	Recorder of: pressure temperature duration ^a	Heat-sensitive dyes under steam saturation ^b		Spores of <u>Bacillus stearothermo-</u> <u>philus</u>
Ethylene oxide	<u>Idem</u> + hygrometry if applicable ^a	Chemosensitive dyes ^b		Spores of <u>Bacillus pumilus</u> or <u>Bacillus subtilis v. Globigii</u>
Formol	Recorder of: pressure temperature duration ^a	Chemosensitive dyes ^b		Spores of <u>Bacillus subtilis v.</u> <u>Globigii</u> or <u>Bacillus stearothermo-</u> <u>philus</u>
Gamma rays	Dosimetry	Radiosensitive dyes ^a		<u>Streptococcus faecalis</u> statistical tests

^a For each programme.

^b Daily.

^c Monthly and after each overhaul or repair of the equipment or steam supply circuit.

These tests are valid only if carried out by a specialist laboratory, using culture media containing neutralizing agents for the disinfectants employed.

3.4.2 Architectural considerations

Regular routine cleaning of the hospital premises can be carried out much more efficiently if the design of the buildings is adapted to their function. The important aspects are the surface materials, the movement of people, the movement of equipment, and ventilation.

Surface materials

Except in zone A the floors and walls should be surfaced with smooth materials. The ceilings in high-risk treatment sectors (delivery room, operating theatre, premature baby department, intensive care unit) should be smooth and impervious.

Movement of equipment and people

An appropriate architectural design will avoid the risk of dirty equipment coming into contact with clean equipment. Consequently "clean" routes should be separated from "dirty" routes in space or in time. However, this separation is not necessary if clean or sterile items are hermetically sealed and if used equipment is decontaminated or wrapped at the place of use.

Mechanical transport makes it easier to distribute the equipment and reduces the movement of people, who sometimes spread germs.

Trolleys, appropriate for the type of transport, must be enclosed, used only for the appointed purpose (clean linen, food, sterile equipment, waste products, dirty linen, etc.) and should if possible be decontaminated daily.

Ventilation

In hospitals the essential purpose of ventilation equipment is to keep the inflow of fresh air and the temperature, humidity and purity (dust, micro-organisms and gases) of the air within the prescribed limits.

Table 4 summarizes the conditions to be fulfilled by ventilation equipment with regard to bacteria count, minimum and maximum temperatures, relative humidity and minimum replacement of air for five classes of premises found in the hospital environment.

The procedure used for humidifying the air should not be a source of contamination.

Periodic bacteriological tests (e.g. every six months) should be carried out by hospital staff who have had proper training in bacteriology (e.g. a hospital hygiene technician), particularly in class I and II areas.

The same applies when air filters are changed or when the ventilation circuits are altered.

4. TECHNIQUES FOR PATIENT CARE

4.1 Basic techniques

4.1.1 Patients' towels and toilet gloves

Towels and toilet gloves are for personal use. After use they should be hung up so as to dry as quickly as possible. They should be replaced at regular intervals.

TABLE 4. CONDITIONS TO BE MET BY HOSPITAL VENTILATION EQUIPMENT^a

Class of premises	Micro-organisms per m ³ air (bacteria count) ^b	Type of room	Minimum temperature (°C)	Relative humidity ^c (%)	Maximum temperature (°C)	Minimum air replacement x/h
I. Premises with very low bacteria count	Up to 10	Operating theatres ^c	19 ^{f, g}	45-60	24 ^{f, g}	1
		Rooms for special purposes ^d	24 ^f	45-60 ^f	26 ^f	1
		Special laboratories ^e	21	35-60	24	1
II. Premises with low bacteria count	Up to 200	Operating theatres, aseptic or otherwise (unless in class I)	19 ^g	45-60	24 ^g	15
		Emergency operating theatres	19 ^g	45-60	24 ^g	15
		Other rooms in operating suites	22	45-60	24	10
		Post-operative recovery rooms	22	45-60	24	10
		Premature babies and perinatal care unit	24	35-60	26	10
		Plaster room (if in operating suite)	19 ^g	45-60	24	10
		Intensive care unit	24 ^f	35-60 ^f	24 ^f	10
		Delivery rooms	24	45-60	26	15
		Infant wards	22	35-60	26	10
		Central sterilization unit ("clean" side)	22	35-60	30	10
III. Premises with normal bacteria count	200-500	Hospital wards	22 ^f	35-60	26 ^f	4-6
		Bathrooms	24	-	30	-
		Examination and treatment rooms	22	35-60	26	6
		Cloakrooms	22	35-60	26	8-10
		Radiology unit	22	45-60	26	8
		Lounges	22	35-60	26	5
		Corridors	22	35-60	26	4
		Radiotherapy unit	24	35-60	26	6
		Rooms for minor operations	22	45-60	26	8
		Communal and physiotherapy baths		max. 60		-
		Massage rooms	24	35-60	26	6
		Gymnastics rooms	18	35-60	26	6
		Rest rooms	22	35-60	26	3
		Central bed store	18	35-60	26	7
		Dissecting rooms	16	35-60	20	10
		Sterile store-rooms	18	35-60	26	3
Laboratories	22	35-60	26	6		
Kitchen, laundry and related premises	22	35-60	30	-		
IV. Premises with contaminated atmosphere	-	Contagious diseases department	<u>h</u>	<u>h</u>	<u>h</u>	<u>h</u>
		Isotope unit	<u>h</u>	<u>h</u>	<u>h</u>	<u>h</u>
V. Other premises	"	Humid premises (toilets, cleaning store, waste disposal unit)	22	-	-	-
		Dirty linen store	22	35-60	-	-
		Mortuary (without cold room)	16	35-60	20	-
		Container store	-	-	-	-

^a Based on: Directives for the construction, use and supervision of mechanical ventilation equipment for hospitals (Bull. No. 4, Swiss Hospitals Institute).

^b Applicable to normal activities in the sector concerned.

^c For example, transplants, cardiovascular surgery, orthopaedic surgery.

^d For example, protective isolation.

^e For example, preparation of perfusion fluids and solutions for injection.

^f Exceptions possible, depending on medical requirements.

^g Year-round adjustment possible.

^h Same as class III premises used for the same purpose.

ⁱ If air-conditioned.

^j Outflow returned at low turbulence (0.25-0.45 m/sec).

Comments

(1) Rooms should be at excess pressure if procedures not involving infection risk are performed there and under partial vacuum if procedures involving infection risk are performed there.

(2) In class I and class II premises, mechanical ventilation equipment should be equipped with suitable and effective filters at the air intake point.

(3) In class III and class IV premises, when mechanical ventilation is provided, suitable and effective filters should be fitted at the air intake point.

(4) In class V premises, ventilation equipment should be equipped with suitable and effective filters at the air intake and extraction points.

4.1.2 Tooth glasses and spittoons

Tooth glasses should be for personal use, either disposable or disinfected when the patient is discharged.

Sputum should be collected in containers with lids, which should be incinerated after use or disinfected by immersion (cf. Table 1).

4.1.3 Thermometers

Thermometers should be for personal use; failing that, they should be soaked in a disinfectant solution, rinsed in water and dried (see Table 1) every time they have been used.

4.1.4 Urinals, bed-pans and lavatory bowls

Bed-pans and urinals are for personal use. They should be decontaminated before being transferred from one patient to another.

Decontamination should be carried out with hot water, using equipment that rinses, then disinfects with steam or hot water at a temperature of at least 85°C for one minute, or by immersion in a chemical product (cf. Table 1).

Disposable cardboard bed-pans for crushing are inadvisable.

4.1.5 Kidney dishes

It is preferable to collect pus, vomit, etc. in disposable kidney dishes which can be incinerated.

Kidney dishes for repeated use should be autoclaved, boiled or immersed in a disinfectant solution immediately after use (cf. Table 1).

4.1.6 Enema equipment

Enema equipment should be disposable or disinfected each time it has been used.

4.1.7 Shaving equipment

Shaving equipment should be personal or disposable or disinfected after each patient.

4.1.8 Dressing trolleys

Collective dressing trolleys must not be permitted. The necessary equipment should be prepared separately for each patient.

4.1.9 Blankets

Each patient should be provided with a clean blanket on admission.

Each patient should be given a clean blanket at least every three weeks (preferably every week).

After a surgical operation every patient should be put in a clean bed (sheets and blanket).

It is advisable to select blankets that can be washed in hot water (minimum 70°C).

4.1.10 Mattresses

Mattresses should have a washable covering and should be clean and disinfected after each patient.

4.1.11 Pillows

Pillows should be washable or should have a washable covering and should be cleaned and disinfected after each patient.

4.1.12 Quilts

Quilts should meet the same criteria as blankets and should undergo the same treatment.

4.1.13 Bed sheets, pillow slips

The normal washing procedures in which a temperature of at least 80°C is reached are adequate for disinfection.

4.1.14 Patients' linen

All clothing worn by a bed-patient should be washable at at least 80°C.

Every patient who is to undergo a surgical operation should be provided with an operation gown before being taken to the operating suite.

4.1.15 Babies' napkins

Preference should be given to paper napkins.

Dirty cotton napkins should not be rinsed through in the ward; they should be placed in a special bag and sent to the laundry as they are.

4.1.16 Ward linen cupboard

If woollen blankets are used, a separate cupboard for these blankets should be provided in the ward.

If linen is stored in the ward it is more likely to become contaminated; it is therefore recommended to arrange for a daily supply of linen.

4.1.17 Transport of clean and dirty linen

Clean linen and dirty linen must be transported on separate trolleys, which can easily be decontaminated, by separate teams at different times.

The dirty linen should under no circumstances be sorted.

When bed-linen is changed the dirty linen should be collected and put in a bag within the ward itself. This bag should be closed before making up the clean bed.

If infected linen needs to be disinfected before washing it should be placed in a special impervious bag.

In laundries there should be a complete separation between the area for linen awaiting washing and the area for washed linen.

Linen chutes have a number of drawbacks with regard to hygiene, quite apart from their danger in the case of fire.

4.1.18 Crockery and cutlery

All crockery and cutlery should be rinsed in water at a temperature of at least 80°C or disinfected (see Table 1).

4.1.19 Flowers

It is recommended that flowers and live plants should not be taken into protected sectors.

It is desirable to entrust the task of attending to flowers to the "housekeeping" staff and not to the nursing staff.

The hands must be washed after attending to flowers.

4.2 Special techniques

4.2.1 Injections

Sterile equipment must be used.

Each injection should be carried out with an individual sterile syringe and needle.

The skin must be disinfected with 70° alcohol or with a tincture.

Either removes grease but does not disinfect.

Rubber stoppers of multiple-dose bottles should be disinfected with 70° alcohol or with a tincture.

After the injection the needles and syringes should be placed in a rigid container which cannot be pierced by the needles.

If no disposable sterile equipment is available, the syringe and needle must be rinsed immediately after the injection (use of a disinfectant solution protects the staff), then washed and sterilized (see section 3.3.3 and Table 2).

It is a mistake to preserve the equipment in an aseptic liquid or to boil it (hepatitis B).

4.2.2 Venous puncture (for blood samples)

Use a sterile needle and syringe for taking each blood specimen. Disinfect the skin with 70° alcohol or with a tincture.

4.2.3 Other punctures (e.g. lumbar, pleural, medullary punctures; needle biopsy)

Any puncture is an aseptic procedure (wearing of mask, surgical scrubbing of hands, wearing of sterile gloves, use of drapes).

The skin must be disinfected with 70° alcohol or with a tincture.

It is easy to arrange everything necessary in the form of a sterile set.

4.2.4 Perfusions

An intervenous catheter should be fitted only in essential cases. It should not be used when oral therapy can suffice or to keep a venous route open simply for medical convenience when there is no specific therapeutic necessity.

The perfusion should be continued only as long as is strictly necessary. Needles should be preferred to catheters whenever possible. Nevertheless, the use of catheters may be indicated for safety reasons, for long-term treatment, or for installing monitoring devices (blood pressure measurements, for example).

Whenever possible it is preferable to fit the catheter to the upper limbs rather than at any other site.

Fitting the catheter:

The fitting of a catheter is an aseptic procedure (wearing of mask, surgical scrubbing of hands, wearing of sterile gloves, use of drapes).

Use drapes and wear a sterile gown when fitting a subclavian catheter.

Disinfect the skin by rubbing it for 30 seconds with 70° alcohol or with a tincture (at least twice), allowing it to dry between applications.

After insertion, the catheter must be properly secured so as to prevent any to-and-fro movements that might lead to contamination of the puncture site.

Cover the puncture site with a sterile occlusive dressing.

Care after fitting:

The dressing should be renewed daily. If necessary a disinfectant ointment containing no antibiotic should be applied.

The site must be carefully inspected every day under aseptic conditions and administration of fluid should be stopped as soon as any signs of phlebitis or inflammation (redness, pus) are discovered. In such cases it is essential to withdraw the catheter and to change both the perfusion site and the catheter.

A catheter may be responsible for septicaemia even if there are no local signs of inflammation. If during perfusion any signs indicating a septicaemia should appear (high temperature, shivering, generalized malaise, etc.) a haemoculture should be performed by a different route and the perfusion stopped. If necessary, another site may be selected for setting up a further perfusion, and the catheter may be cultured.

When a catheter is fitted the date and time of fitting should be recorded.

It is advisable not to leave a catheter in place for more than 48 hours.

The perfusion tubes should be changed at least every 48 hours. Any perfusion bottle or bag should be changed at least every 24 hours.

If the site is changed, the tubing and drip-feed apparatus should be replaced by fresh equipment.

The bottles should be examined so as to eliminate any that display cracks, turbidity or a precipitate.

Bottles containing several additives should be prepared aseptically at the time of use (preferably under a laminar-flow extractor).

When an air intake is necessary it should consist of a bacteriological filter or at least of non-carded cotton-wool.

Each bottle should be labelled with the patient's name, specification of the substances added, and the time of preparation.

Removal of the catheter, the perfusion tubing and the perfusion fluid:

The catheter should be removed aseptically and the end of the catheter cut off under sterile conditions for culture.

In the event of shivering or suspicion of septicaemia, it is necessary to have the perfusion fluid and the tubing analysed.

4.2.5 Parenteral feeding

Parenteral feeding is carried out by means of solutions administered by a catheter fitted at a point with high blood flow (e.g. subclavian vein).

The perfusion fluid should be sterile and apyrogenic.

All the strict asepsis instructions given above for fitting the catheter and for care after fitting must be scrupulously followed.

To avoid any contamination, the feeding system must not be used for any other purpose, such as measurement of central venous pressure, blood sampling, injection of drugs.

The drip-feed solution should be changed at least every 24 hours, as should the entire perfusion circuit if possible.

4.2.6 Urethral catheterization

Urethral catheterization should be performed only when strictly essential (never for reasons of medical convenience).

A urethral catheter is rarely needed for a bacteriological test or for analysis of urinary sediment; it is preferable to take a mid-stream sample.

Urethral catheterization should be carried out only by a doctor or by specially trained nursing staff, in accordance with precise instructions.

In some cases it may be beneficial to replace catheterization by suprapubic puncture.

Fitting of urethral catheter:

The fitting of a urethral catheter is an aseptic procedure (wearing of mask, washing of hands, wearing of sterile gloves, use of drapes).

It can be performed aseptically only if the operator is assisted by an aide.

Sterile gloves, drapes provided with holes and slits, sterile compresses, a disinfectant solution for peri-urethral cleaning, a sterile lubricating fluid and a catheter of appropriate size must be available.

The fitting of an indwelling catheter requires the use of a closed-circuit drainage system. A bulb catheter connected to a sterile disposable plastic bag of 1000, 1500 or 2000 ml is therefore used.

After the catheter has been fitted it must be fixed correctly so as to avoid any to-and-fro movements or traction; it is then immediately connected to the drainage system, which is provided with a tap so that the bag can be emptied or a sample can be taken without disconnecting the bag from the catheter, and with an anti-reflux valve which prevents backflow of urine into the bladder.

In some cases it may be beneficial to replace the indwelling urinary catheter with a suprapubic catheter.

Care of the drainage system:

These procedures must be performed by experienced staff.

The junction between meatus and catheter should be cleaned once or twice daily with a disinfectant and an antiseptic cream should be applied at the junction.

Drainage of the bladder should be discontinued as soon as possible.

The closed-circuit drainage system, with the tap for emptying, should be disconnected only for irrigation or for unblocking the catheter. In such cases a strictly aseptic technique must be used.

If frequent irrigation is needed to keep the catheter permeable, a three-channel catheter permitting continuous irrigation should be used.

If urine excretion is good there is no point in bladder irrigation except for removing blood clots; the solution used should be sterile; the equipment should also be sterile and replaced after each rinsing.

Small amounts of urine may be obtained for culture by puncturing the distal portion of the catheter with a fine needle and a sterile syringe. The catheter must be carefully disinfected before the puncture is made.

Samples for chemical testing may be taken from the collecting bag.

Continuous drainage should be maintained at all times. This presupposes:

- that the discharge outlet is not clamped;
- that the collecting bag is regularly emptied;
- that any partially obstructed catheter is replaced;
- that the collecting bag is always below the level of the bladder.

Any closed-circuit collecting system that is contaminated in error (accidental disconnection, leakage, etc.) must be replaced immediately.

If bladder drainage lasts less than two weeks there is no need to change the catheter unless it becomes obstructed or contaminated or does not work properly.

For patients with permanent indwelling catheters, replacement of the catheter is indicated only if calculi become palpable or if there is an obstruction.

It is important to organize repeated training sessions for the staff. Walking patients should also be instructed.

As far as possible, patients with urethral catheters should not be put in the same ward.

4.2.7 Sterilization and disinfection of endoscopes

Cystoscopes should be very carefully cleaned each time they have been used, then dried and sterilized either in formol at 60-80°C or in ethylene oxide.

If sterilization between several repeated uses is impossible (because of the length of the procedure), the cystoscope should be stored aseptically between the procedures and should be disinfected between each use by soaking it in an upright position for at least 10 minutes in a 2% solution of activated glutaraldehyde or a 4% solution of formaldehyde (commercial formol, 10%), then rinsed thoroughly in sterile distilled water.

Similar instructions apply to gastroscopes, duodenoscopes, colonoscopes, bronchoscopes, etc.

4.3 Special instructions

4.3.1 Operating suite (delivery suite)

There must be written house rules governing the running of the operating suite and delivery suite.

Personnel

Anyone entering the operating suite, including visitors, must wear clothes strictly set aside for this sector. Clothing for the operating suite should preferably be made of cotton (less than 10-nanometer mesh). It should be compulsory to pass through a changing room:

- to remove town clothing;
- not to take a shower only minutes before an operation;
- to put on a short-sleeved coat (with elastic at the cuffs) and a pair of trousers (preferable to a dress for female staff) with elastic at the bottom (at least one clean garment every day);
- put on special footwear set aside for the operating suite and easily decontaminated;
- wear a cap covering all the hair;
- wear a mask covering the nose and mouth (staff working in the operating theatre should not be allowed to wear long beards and moustaches).

Everyone entering the operating suite should wash his hands on starting work, following the basic washing technique.

Surgical scrubbing of the hands should be performed in accordance with the instructions (see section 3.2.1).

Surgical gloves should preferably be made of latex and disposable, with tightly fitting sleeves.

No one suffering from a skin infection may enter the operating suite.

It is desirable to restrict comings and goings and the number of people in the operating theatre.

The patient should pass through a transfer area at the entrance to the operating suite.

A patient's bed must not be brought from a ward into the operating suite.

The patient

The site of the operation must be shaved just before the operation, the same day if possible, using sterile equipment.

After very careful removal of fat from the skin, the operative field should be disinfected by centrifugal application of two or three layers of a disinfectant substance in an alcohol solution. A useful substitute for fat removal is to wash the operative field with a sterile disinfectant soap.

After the operation the patient should be placed in a completely clean bed, with clean sheets and blankets.

When drawing up the operation schedule:

- put patients susceptible to infection at the head of the list;
- put infected patients at the bottom of the list.

4.3.2 Anaesthesia

If a patient has an acute infection of the upper respiratory tract it is preferable to postpone the surgical operation until this infection has been cured.

The anaesthetist should wash his hands before each anaesthetic procedure. He should wear a gown and sterile gloves for a spinal, epidural or regional anaesthesia.

Anaesthesia must be carried out with disinfected equipment and sterile instruments.

The anaesthesia apparatus, like the furnishings of the operating theatre, must be cleaned and disinfected daily.

The reservoir bag, the corrugated tubing and the connexion to the mask or endotracheal tube should be replaced after each narcosis procedure and disinfected (see Table 1).

Endotracheal tubes and cannulae should be disposable or sterilized each time they have been used.

The laryngoscope must be disinfected after each narcosis procedure (see Table 1).

The lubricant for endotracheal tubes should be supplied in small sterile packs, for individual use.

The tracheal aspiration catheters should be disposable or sterilized each time they have been used.

4.3.3 Physiotherapy - rehabilitation

The regulations for staff in contact with patients also apply to this sector, with regard both to clothing and hand-washing.

Treatment couches and exercise mats should be covered with material that can be easily washed and disinfected. If possible, the treatment couches should be covered with paper (changed after each treatment).

Pillows should be covered with paper or enclosed in a plastic cover and cleaned or disinfected after each treatment.

External electrodes should be disinfected or sterilized each time they have been used. Internal electrodes should always be sterilized before use.

Baths should be cleaned after each treatment and disinfected (see Table 1).

The water in treatment pools should be treated and checked regularly (at least once a month) for the total number of micro-organisms and the absence of coliform organisms.

It is desirable that every patient should take a shower before entering the bath or pool.

Apparatus and equipment for respiratory physiotherapy should be disinfected after each patient and periodically for the same patient (see Table 1).

4.3.4 Laboratories

The hospital should protect laboratory staff by using a system of "danger" labels for products that are contaminated, especially with hepatitis virus.

The laboratory authorities should issue written instructions in order to protect the staff, especially: do not smoke or eat on the laboratory premises, do not breathe in any substance through the mouth, disinfect the hands, etc.

4.3.5 Radiology and radiotherapy

The regulations for staff in contact with patients also apply to this sector, with regard to both clothing and hand-washing.

Lead gloves and aprons, of smooth material and suitable for cleaning with water, should always be cleaned every day at the end of work and disinfected (see Table 1).

Radiology couches and pillows should be covered with paper, which must be changed after each patient.

The top of each couch should be disinfected at least once a day at the end of the treatment programme (see Table 1).

4.3.6 Intensive care

The regulations for staff in contact with patients also apply to this sector, with regard to both clothing and hand-washing.

Working clothes should be changed daily. The hair should be covered with a cap.

Respiratory therapy apparatus and equipment should be disinfected after each patient and periodically for the same patient (see Table 1).

Sterile ultrasonic aerosols should be supplied with a sterile solution by means of a closed system. They must be changed between patients and every 24 hours for the same patient.

The rules for isolation must be scrupulously observed (see section 8).

Visitors are permitted only after extremely strict checks and after passing through a changing room.

4.3.7 Maternity unit

The regulations for staff in contact with patients apply also to this sector, with regard to both clothing and hand-washing.

Infants should be changed on a special changing table, which must be disinfected after each child (see Table 1).

The equipment needed for the care of newborn infants must be for individual use.

Feeding bottles and teets must be sterile. Feeds should be prepared aseptically as required or stored at 4°C for not more than 24 hours.

The staff of the unit for newborn infants should wear special uniform. The hair must be covered by a cap.

The isolettes (baby incubators) must be disinfected after each child and periodically for the same child (see Table 1).

Visitors are not permitted to enter the nurseries of the maternity unit (see section 5).

4.3.8 Dialysis, transplant and cancer centres

The regulations for staff in contact with patients apply also to this sector, with regard to both clothing and hand-washing. Moreover, drinking and eating in the unit are prohibited.

Special precautions must be taken to prevent viral hepatitis B.

A special blouse, gloves and a mask should be worn for handling items soiled by blood, an arteriovenous shunt, or a fistula in a patient who is a carrier or infected.

Every new patient must be regarded as a possible carrier of HBsAg. Monthly checks should be performed on patients undergoing treatment so as to detect and isolate any carriers. Separate health installations should be provided for infected patients.

Disposable equipment must never be re-used.

For cleaning and disinfecting the dialysis equipment the staff should wear an impermeable blouse and gloves. Blood specimens which may contain HBsAg should be handled with gloves and labelled. Any wound must be vigorously washed and disinfected with a chlorinated product.

Any dirty marks on equipment, furniture or the ground should be disinfected with a chlorinated product or with activated glutaraldehyde (see Table 1).

5. RULES FOR VISITORS

Since visitors may constitute a source or vector of infection, rules are absolutely essential to control hospital infections.

5.1 General regulations

The following list may serve as a guide for drawing up rules for visitors:

(1) Persons not admitted

People with a disease of the respiratory tract or any other sign of a communicable disease should not visit patients in hospital.

The minimum age of children allowed to visit a patient is normally fixed at 10 or 12 years; some hospitals have set the age limit at 15 years.

(2) Forbidden areas

Visitors should not be permitted to enter the nurseries of the maternity unit, the operating theatres or the post-operative recovery wards.

They should not be permitted to enter the delivery suite or the intensive care unit except after extremely strict checks and passing through a changing room.

(3) Visiting hours

Preferably visits should not be permitted during the periods when the hospital staff are busiest. In general visiting hours are fixed for well-spaced periods of one to two hours.

(4) Conduct of visitors

Visitors (preferably not more than two or three per patient at one time) must not interfere with the work of the hospital staff. They must not make a noise and must observe bans on smoking.

Visitors must not collect in treatment areas and are not allowed to sit on the beds.

Visitors must not bring any food for patients unless specially authorized. They must not be accompanied by animals (cats, dogs, etc.). They are allowed to bring in cut flowers but not pot plants.

Visitors should be properly informed of the rules; visitors to infected patients should be provided with appropriate equipment. Such visits should be supervised by the nursing staff.

5.2 Special regulations

Some areas of the hospital will have rules that are either less strict or more strict, as required.

(1) Paediatric department

In most hospitals there are no restrictions on visits by mothers. This practice gives the child a feeling of comfort and security; it may also free the nursing staff from a number of routine tasks such as feeding, changing the bed and clothing, and keeping the child amused.

In some hospitals beds are supplied so that mothers can stay with their children full-time. This practice may be useful or even desirable, but the mothers need to be given proper training so that they will observe the constraints of hospital hygiene.

All the normal precautions remain applicable to other visitors.

(2) Department for newborn infants

No visitors are allowed into the nurseries; they must be separated from the babies by a glass partition.

In the maternity unit, if the baby is kept in the mother's room, visitors should be limited to one person at a time. Only the father and mother should be allowed to touch the baby, as other contacts might increase the risk of infection. When the baby is in a glass cubicle visitors may be allowed without restriction into the mother's room during visiting hours.

(3) Department for burn injuries and intensive care

Only one visitor is allowed at a time and visits should not last longer than a few minutes.

The visitor should be kept under close observation by the nursing staff and all direct contact with the patient must be avoided. The wearing of a gown and mask is advisable unless the visitor is behind a glass panel. The patient and visitor should be informed of the potential risk of infection and of the requirements for medical asepsis.

The number of visitors to patients who are particularly susceptible to infection (e.g., transplant patients, cancer patients undergoing chemotherapy) should be similarly limited.

If a member of the family takes part in providing care, he should be given appropriate instruction by the nursing staff concerning his behaviour in relation to hospital hygiene.

6. RESPONSIBILITIES FOR THE CONTROL OF INFECTION

Both individuals and departments must be assigned special responsibilities for the prevention and surveillance of hospital infections.

6.1 Role of the hospital management

The administration and/or medical management of the hospital play an important part in the control of hospital infection. They are responsible for:

(a) encouraging the education and training of all the staff through programmes on the prevention of infection and on disinfection and sterilization techniques;

(b) delegating the technical aspects of hospital hygiene to specific categories of staff:

- nursing service
- cleaning service
- technical service
- appropriate bacteriology laboratory;

(c) setting up a Hospital Hygiene Committee which can take over some of the tasks and coordinate action;

(d) drawing up rules for visitors;

(e) ensuring the efficient operation of the mechanism for the full and swift notification of any hospital infection;

(f) drawing up the budget for financing a programme for monitoring infections and applying the most appropriate methods for preventing infections;

(g) transmitting the following descriptions to each service, thus establishing the services' minimum responsibilities for the prevention of infections.

6.2 Role of physicians

Physicians have special responsibilities for the prevention and control of hospital infections:

- by looking after patients;
- by setting an example in the practice of the rules of hygiene;
- by serving on the Hospital Hygiene Committee.

More specifically, physicians are responsible for:

(a) protecting their patients from other infected patients and from hospital staff who may be infected. In other words, physicians are responsible for preventing the transfer of an infection from one patient to another, or to the hospital staff, and for preventing any of their patients being contaminated by another patient;

(b) complying with the practices and techniques recommended by the Hospital Hygiene Committee;

- (c) requesting the necessary analyses for identifying the micro-organisms involved when an infection is present or suspected;
- (d) notifying cases of hospital-acquired infection to the hygiene officer (physician or nurse specializing in hospital hygiene) and informing him of the admission of any infected patients;
- (e) complying with the recommendations of the Hospital Hygiene Committee regarding the use of antibiotics;
- (f) advising patients, parents of patients and the staff on techniques for preventing the transmission of infection;
- (g) instituting appropriate treatment for any infection that may occur in themselves, taking steps to prevent such infection being transmitted to other people and especially to patients.

6.3 Role of the microbiologist

The microbiologist is responsible for:

- (a) making microbiological diagnoses of patients and staff, paying special attention to the identification of carriers of pathogenic micro-organisms;
- (b) applying where necessary, if no laboratory specializing in hospital epidemiology is available, special methods for checking sterilization, disinfection and the environment;
- (c) transmitting the results of these analyses to the Hospital Hygiene Committee or the hygiene officer;
- (d) making a critical study of the results of antibiotic sensitivity tests in order to show the appearance of any resistant micro-organisms and provide information on the use of antibiotics (in collaboration with the pharmacist);
- (e) typing certain hospital micro-organisms for epidemiological surveys. Sometimes the microbiology laboratory agrees to keep the results for the Hospital Hygiene Committee. If required these results may be centralized by the hygiene officer, by the hospital hygiene nurse, or by a member of the Hospital Hygiene Committee;
- (f) applying safety measures to prevent the contamination of laboratory personnel.

6.4 Role of the hospital pharmacist

The hospital pharmacist is responsible for:

- (a) obtaining, storing and distributing medicinal preparations in such a way that infectious agents are not transmitted to patients;
- (b) dispensing anti-infectious drugs and holding all the relevant documentation (regarding potency, incompatibility, conditions of deterioration);
- (c) obtaining and storing vaccines or sera and making them available in emergencies;
- (d) keeping an inventory of antibiotics distributed to the medical departments;
- (e) holding the following information on disinfectants, antiseptics and other anti-infectious agents:
 - active properties in relation to concentration, temperature, length of action, antibiotic spectrum;

- toxic properties with a sensitizing or irritant action on the skin and mucosa;
- substances that are incompatible with them or reduce their potency;
- physical conditions which unfavourably affect potency during storage: temperature, light humidity;
- harmful effects on materials.

Moreover, by virtue of his training in both clinical and biological disciplines, the hospital pharmacist is often able to:

(f) contribute to decisions on the efficient and standardized use of antiseptics, disinfectants and products used for washing and disinfecting the hands;

(g) contribute to the criteria for selecting and checking the quality of disposable equipment, particularly equipment presented as "sterile";

(h) take part in the quality control of the techniques used to sterilize equipment in the hospital:

- selection of sterilization equipment (type of appliances);
- regular physicochemical and bacteriological testing of this equipment.

6.5 Role of nursing staff

Implementation of the practical aspects of the control and surveillance of infection is largely a matter for the nursing staff. Nurses should be familiar with all the techniques needed for preventing and avoiding the spread of infection. As they are the only people in the hospital who are close to the patient at all hours of the day and night, they can ensure continuous prevention of infection.

The head of the nursing service is responsible for:

- (a) taking part in the discussions of the Hospital Hygiene Committee;
- (b) promoting the development and improvement of nursing techniques and submitting to the Hospital Hygiene Committee a continuous review of all aseptic nursing techniques, getting rid of any unnecessary or out-of-date procedure;
- (c) developing training programmes for all new members of the nursing staff;
- (d) supervising the implementation of techniques for the prevention of infections in specialized sectors such as the operating suite, intensive care unit, maternity unit and the department for newborn infants;
- (e) checking regularly that the hospital hygiene instructions are observed by the nursing staff.

The nurse in charge of a ward is responsible for:

- (a) maintaining hygiene in the ward. She should therefore have a very thorough knowledge of the hospital hygiene programme and ensure that it is correctly applied;
- (b) keeping an extremely close watch on asepsis techniques, including hand-washing and isolation techniques;
- (c) reporting promptly to the physician-in-charge any sign of infection - fever, shivering, shock, pus, diarrhoea - in the patients for whom she is responsible;

(d) if no medical advice is available, undertaking the temporary isolation of a patient and taking culture specimens from any patient showing signs of a communicable disease;

(e) protecting the patients in her ward against infections from visitors, the hospital staff, other patients, or equipment used for diagnosis or treatment;

(f) checking at regular intervals (yearly) whether the items supplied to the unit (linen, drugs, nursing equipment, etc.) are adequately distributed.

6.6 Role of the central sterilization service

The central sterilization service occupies a key position in the running of the modern hospital. Responsibility for it should therefore be assigned to a physician designated by name. Responsibility for its day-to-day management can be entrusted to a nurse who holds qualifications equivalent to those of a matron and has a thorough knowledge of surgical instruments and experience of personnel management.

On the basis of experience so far, a central sterilization department can serve all hospital sectors, including the operating suite.

The responsibilities of the central sterilization service are to clean, decontaminate, test, prepare for use, sterilize, and store aseptically all the equipment and equipment kits intended for all hospital sectors.

In order to do this it should lay down in collaboration with the Hospital Hygiene Committee:

- instructions for cleaning and decontamination of:
 - normally dirty equipment;
 - infected equipment, with variations depending on the nature of the contaminating agent (viral hepatitis);
- wrapping procedures, according to the type of sterilization;
- sterilization methods, according to the type of equipment;
- sterilization conditions (temperature, duration, pressure, humidity, etc.).

The head of this service should:

(a) see to the application of all methods - physical, chemical, and bacteriological - for checking the various types of sterilization equipment;

(b) see that technical maintenance of the equipment is carried out every six months;

(c) report any defect and, depending on the circumstances and the internal organization, call upon the hygiene officer, the microbiologist, the hospital pharmacist or the technical service;

(d) collate the records of each autoclave run and enter them in a register, which should be kept for two years;

(e) collect or have collected, at regular intervals, all sterile units whose validity has expired on account of the way they are wrapped (fabric);

(f) keep in constant touch with the Hospital Hygiene Committee, the nursing service, the operating suite, the hospital transport service, the pharmacy service and the technical service;

(g) carry out tests on the resistance of equipment to the disinfection and sterilization procedures.

6.7 Role of the catering service and kitchens

In order to carry out his responsibilities properly, the head of the catering service should have some knowledge of bacteriology and food hygiene on the one hand and of staff training, the storage and preparation of foodstuffs, job analysis, and the characteristics and applications of the equipment on the other hand.

If he does not have this knowledge he should be able to call on consultants or members of the medical profession.

He is responsible for:

(a) defining the criteria for the purchase of foodstuffs, equipment and cleaning procedures so as to maintain a high level of hygiene;

(b) ensuring that the equipment used and all working and storage areas are kept clean;

(c) issuing written rules and instructions for hand-washing, clothing, staff discipline and daily disinfection duties;

(d) ensuring that the methods used for storing, preparing and distributing food will avoid contamination by micro-organisms;

(e) issuing written instructions for the cleaning of crockery and cutlery after use by patients and staff. Methods of distributing meals to isolation wards should be worked out in collaboration with the Hospital Hygiene Committee and the nursing staff;

(f) laying down methods for the storage, handling and disposal of wastes;

(g) establishing programmes for training staff to prepare food and maintain cleanliness, in accordance with the instructions laid down by the Hospital Hygiene Committee.

Many employees of the catering service have little or no knowledge of the necessary rules of hygiene. It is therefore essential to arrange a training programme for all new members of the staff. This programme should stress personal hygiene, the importance of washing the hands (particularly on starting work and after going to the toilet), routine medical examination, the notification of any infection (particularly infections of the skin, digestive tract and respiratory tract), and the recognition of diseases and physical conditions that rule out any contact with foodstuffs.

It is important to explain the causes of contamination of foodstuffs and ways of preventing them, including the relationship between temperature and microbial development, and to give the staff a valid explanation of any prohibitions.

6.8 Role of the linen and laundry service

The linen service is responsible for:

(a) establishing the characteristics of the various fabrics used in each sector of the hospital, defining the types of working clothes to be worn in each specific sector and by each group of staff, and assessing the quantities needed in the light of the changes of clothing required by good hygienic practices;

(b) working out methods for the distribution of working clothes and, if necessary, taking charge of the changing rooms;

- (c) issuing instructions for the collection of dirty linen (frequency, method of wrapping) and ways of transporting it;
- (d) establishing methods for the cleaning and disinfection of bedding (mattresses, pillows, etc.);
- (e) defining, where necessary, the method for disinfecting infected linen, either before it is taken to the laundry or in the laundry;
- (f) determining the frequency for the washing of curtains, screening curtains between beds, etc.;
- (g) outlining instructions for the absolute protection of clean linen against any contamination during transport from the laundry to the place of use;
- (h) laying down criteria for the choice of the laundry, if it is outside the hospital:
 - requirements concerning premises (separation of "clean" and "dirty" areas);
 - washing conditions (temperature, duration, etc.);
 - method and frequency of transport.

6.9 Role of the household cleaning service

The household cleaning service plays an essential part in the regular and routine cleaning of surfaces and the ambient medium. In collaboration with the Hospital Hygiene Committee it is responsible for:

- (a) classifying the different sectors of the hospital according to their decontamination requirements;
- (b) codifying the cleaning techniques appropriate to those requirements - procedure, frequency, agents used, etc. - for each type of room, from the most infected to the most aseptic, and ensuring that they are properly applied;
- (c) drawing up methods for the disposal of wastes (containers, frequency, etc.), from the treatment unit to the incinerator, ensuring that those wastes do not present a danger of contamination at any time;
- (d) ensuring that liquid soap and paper towel dispensers are replenished regularly;
- (e) informing the technical service of any imperfections noted in the building: cracks, defects in the sanitary or electrical equipment, etc.;
- (f) looking after flowers and plants;
- (g) initiating preventive treatment against vermin (insects, rodents);
- (h) arranging a training programme for all new staff members and for old employees, both periodically and whenever a new technique is introduced.

As in the case of the catering service, many employees in the domestic cleaning service have little or no knowledge of the necessary rules of hygiene. It is therefore essential to introduce a training programme for all new members of the staff. This programme should stress personal hygiene, the importance of frequent and careful washing of the hands, and the methods of cleaning: sequence of rooms, correct use of equipment, dilution of cleaning agents, etc.

The programme should draw attention to the need to notify any infection, especially infections of the skin, digestive tract and respiratory tract.

It is important to explain the causes of contamination of premises and ways of overcoming them, including the method of action of disinfectants, so as to give the staff valid reasons for the instructions laid down.

6.10 Role of the technical service

The technical service is responsible for:

- (a) establishing effective cooperation with the domestic cleaning service and the nursing staff in selecting equipment and ensuring the rapid repair of any defect;
- (b) carrying out inspections and regular maintenance of the plumbing, heating, refrigeration equipment, electrical fittings and air conditioning;
- (c) making regular checks on all steam outlet points and equipment such as autoclaves, antibacterial filters, etc.;
- (d) laying down procedures for emergency repairs in essential departments, by day and night;
- (e) ensuring environmental safety outside the hospital, e.g. waste water.

It should also perform special duties such as:

- participation in the choice of appliances if their maintenance requires technical assistance;
- inspection, cleaning and regular replacement of the filters of all appliances for treating the air and humidifiers;
- checking the autoclaves (temperature, pressure, vacuum, recording mechanism) and their regular maintenance (cleaning the inner chamber, emptying the tubes);
- checking the recording thermometers of refrigerators in pharmacy stores, laboratories, the blood bank and kitchens;
- regular inspection of all surfaces - walls, floors, ceilings - to ensure they are kept smooth and washable;
- repair of any opening or crack in partition walls or window frames;
- extremely careful maintenance of hydrotherapy appliances.

6.11 Role of the hospital hygiene service

Whatever its level of organization, the hospital hygiene service has the task of coordinating all the measures laid down so as to ensure that hospital hygiene forms a consistent whole.

The hospital hygiene service is responsible for:

- (a) organizing an epidemiological surveillance programme and a programme for supervising the use of anti-infectious drugs;
- (b) doing everything possible to adjust equipment, nursing techniques and the behaviour of the staff to the risks of infection;

(c) checking the efficacy of the methods of disinfection and sterilization and the efficacy of all the systems set up to improve hospital cleanliness, particularly by taking controlled bacteriological samples;

(d) drawing up teaching programmes for the medical, nursing and allied health personnel, not forgetting all the other categories of staff.

The hospital hygiene service may act as a referral point and provide assistance for smaller institutions.

The hospital hygiene service should take part in research on hospital hygiene at the local, national and even international levels.

7. TEACHING AT THE VARIOUS LEVELS

It is clear from the foregoing that teaching and continuous training are of particular importance for the prevention of infection.

Four staff categories requiring additional information may be distinguished:

- (1) the health professionals (physicians and allied health workers);
- (2) staff responsible for the "general" sectors;
- (3) all new members of the staff;
- (4) "specialists" in hospital hygiene.

7.1 Health "professionals"

Physicians and hospital pharmacists

As a rule, medical education pays little attention to the prevention of hospital infections. Every physician-to-be, in all countries of the world, has to undergo a training period in hospital, generally of at least one year. It would seem therefore that medical education ought to provide adequate training in the physician's behaviour in the hospital environment.

It is important that specialist studies in microbiology should include advanced work in epidemiology, public health and hospital hygiene because of the predominant role medical microbiologists can play in treatment establishments.

Nurses

Infectious diseases appear on the curriculum of nursing schools, but often this basic education includes little reference to the principles of hospital hygiene. The privileged position occupied by nursing staff in relation to hospital hygiene has been indicated above. The theory and practice of the prevention of infections should therefore be assigned their rightful place in nurses' training.

Specialist training courses (for operating theatre nurses, intensive care nurses, nurse-anaesthetists, etc.) should include additional material on hospital hygiene in these specific areas.

As the ward sisters and the matron have special responsibilities, the preparatory studies for these categories of staff should include the necessary additional material to enable them to carry out their duties concerning hospital hygiene.

Other health workers

Various other categories of staff in contact with patients now have increasing opportunities to play an effective part in preventing infections: dieticians, physiotherapists, laboratory assistants, etc. Their education should therefore include appropriate training in this area.

7.2 Staff responsible for the "general" sectors

The responsibilities defined above for the administrative directors and the heads of the catering, linen, household cleaning and technical services imply that all of them need to acquire knowledge, within their own sector, which is not normally provided by their basic training. They should therefore either obtain further information themselves in the sector concerning them, advised if necessary by "specialists" in hospital hygiene, or follow specific hospital training courses (which are comparatively rare) for these professions.

Such training must cover the aspects of hospital hygiene which will enable these senior members of the hospital staff to carry out their responsibilities in their own fields.

7.3 New employees

Most of the new employees in hospital institutions belong to one of two categories:

- nursing staff;
- unqualified staff trained as hospital orderlies, catering assistants or cleaners.

Not all the staff require the same type of training, so the programme needs to be adapted to each group and its specific motivation. One of the reasons for the failure of some educational programmes is that they were not adapted to the people concerned.

In all cases the programme should:

- provide an understanding of the basic principles of infection and the transmission of infection;
- provide an understanding of the dangers to patients caused by some types of personnel;
- convince each employee that he has responsibilities and a part to play in maintaining hospital hygiene;
- teach that an acquired infection may constitute a risk for the patients and other employees.

Every new member of the staff should be given an introductory talk on the methods used in the hospital. This should include a description of the hospital's responsibilities and the functions of each of its departments. In addition, it should introduce the principles and methods of hospital hygiene, developing each of the points mentioned above.

Special programmes should be provided for:

- qualified nursing staff;
- auxiliary nursing staff (orderlies);
- catering staff;
- household cleaning staff.

Besides the general programme, special training is needed for the staff working in the operating suite and in the obstetrics, paediatrics and intensive care units.

Within the various care units and departments a manual of working techniques must be available and regularly brought up to date.

The hospital must organize a continuous training programme for all personnel in contact with patients.

Regular meetings in the various hospital departments should be devoted to the description of working methods and new techniques for the prevention of infections.

The staff responsible for each hospital sector often notice employees carrying out procedures which could be dangerous and making mistakes in technique or in the use of equipment. They can correct such shortcomings by intervening discreetly at the time they occur, which represents extremely useful in-service training.

7.4 Hospital hygiene "specialists"

The number of hospital hygiene "specialists" is still comparatively limited in most countries. This category includes:

- the hospital hygiene physician;
- the hospital hygiene nurse;
- the hospital hygiene technician.

Each of these specialists has a specific role according to his basic training, although there may be slight variations from one country to another.

The hospital hygiene physician with advanced training in microbiology and epidemiology needs supplementary university training of 450-600 hours, and there should be one full-time physician of this category for every 1000 beds or for every 25 000-35 000 hospital admissions per year.

For the hospital hygiene nurse with wide hospital experience, about 300 hours of supplementary training is recommended (including 100-120 hours of practical training); depending on the country, one such nurse should be available full time for every 250-400 beds or, taking into account the average length of hospitalization, for every 9000-10 000 admissions per year.

The hospital hygiene technician has to deal with everything not immediately related to the patient. His training as a medical laboratory assistant will enable him to take bacteriological specimens or to arrange for them to be taken by someone from outside the hospital who comes to make an expert assessment. Conclusions and statistics need to be drawn up on the basis of the results of tests on the samples. All matters relating to the environment are under the supervision of the hospital hygiene technician. These duties could be carried out on a part-time basis in a small hospital. In a large hospital it is felt that one full-time post is needed for every 500 beds or so.

8. ISOLATION

Susceptibility to infection varies widely from patient to patient. In a hospital it is risky to make a patient with a communicable disease share a ward with a highly receptive patient such as a leukaemia patient, to put a patient who has undergone a heart operation together with a patient with multiple injuries who has become infected, to put a heart patient of advanced age with a pneumonia patient, or a chronic dialysis patient with another carrier of the Australia antigen.

Strict application of the proposed isolation techniques, which sever the routes of transmission of infection, should guarantee the safety of the hospital patients and the hospital staff.

8.1 Types and techniques of isolation

Five types of isolation are distinguished according to the mode of transmission of the infections concerned or the specific risk incurred by the patient.

A coloured card at the entrance to the isolation ward indicates immediately the type of isolation and hence the required procedures:

total isolation	TI	yellow card
respiratory isolation	RI	red card
enteric isolation	EI	brown card
skin and wound isolation	SI	olive-green card
protective isolation	PI	blue card

The isolation techniques for categories TI, RI, EI and SI are described in Table 5.

For other infections that are not so readily transferred or are less serious, some simple precautions are recommended. These concern patients whose:

secretions from the airways contain undesirable germs	RP
whose stools and urine contain undesirable germs	EP
whose skin lesions contain undesirable germs	SP

Protective isolation

This type of isolation is intended to protect a particularly vulnerable patient from undesirable micro-organisms. The degree of isolation, which ranges from a single room to a sterile unit, depends on the patient's defence status.

This type of isolation is applicable to:

- severe damage to the immunity mechanisms (constitutional or therapeutic);
- severe burns - burn injuries covering over 20% of the body surface (in conjunction with TI);
- chorioepithelioma;
- generalized bullous dermatitis;
- infantile eczema (atopy);
- organ transplants;
- total irradiation;
- leukaemia and other haemopathies with less than 1000 granulocytes per mm³;
- pancytopenias.

TABLE 5. ISOLATION SCHEDULE

	TOTAL TI	RESPIRATORY RI	ENTERIC EI	SKIN/WOUNDS SI
Isolation ward	Compulsory	Compulsory	Desirable	Desirable
Special gown	Compulsory	-	Compulsory if contact	Compulsory if contact
Mask	Compulsory	Compulsory	-	When performing dressings and if necessary making beds
Goggles	Compulsory (rabies: compulsory for non-immune subjects)	-	-	-
Hand-washing	Compulsory on entering and leaving	Compulsory after putting on and taking off mask	On leaving	Compulsory after putting on and taking off mask
Gloves	Compulsory (two pairs if in contact with patients)	-	Compulsory if in direct contact with patients or objects	Compulsory if in direct contact with patients or objects, two pairs if performing dressings
Footwear protectors	Compulsory	-	-	-
Cap	Compulsory	-	-	-
Sphygmomanometer, stethoscope	Stay in the ward	-	Stay in the ward	Stay in the ward if dirty
Needles and syringes, medical instruments	Are removed in a resistant container, double-wrapped	-	Are removed in a resistant container, double-wrapped	Are removed in a resistant container, double-wrapped
Dressings and fabrics	Double impervious wrapping - incineration (failing that: autoclave)	Double impervious wrapping - incineration (failing that: autoclave)	Double impervious wrapping - incineration (failing that: autoclave)	Double impervious wrapping - incineration (failing that: autoclave)
Excreta	Incinerate or disinfect	-	Incinerate or disinfect	-
Nasopharyngeal secretions	Incinerate or disinfect	Incinerate or disinfect	-	-
Washing water	Disinfect	-	Disinfect if not linked to purification system	-
Thermometer	Stays in the ward, disinfect on departure	-	Stays in the ward, disinfect on departure	Stays in the ward, disinfect on departure
Linen	Removal under double impervious wrapping: autoclave or disinfect	-	Removal under double wrapping, disinfect	Removal under double wrapping, disinfect
Crockery	Stays in the ward or removed under double wrapping if autoclaving is possible	-	Disinfection in the ward or removal under double wrapping	-
Food wastes	Incineration	-	Incineration	-
Clothing and personal effects	Disinfection with formal	-	-	-
Laboratory samples	Double wrapping and labelling	Double wrapping and labelling for sputum samples	Double wrapping and labelling	-
Outgoing correspondence	Press with hot iron until paper becomes slightly yellow	-	-	-

TABLE 5. ISOLATION SCHEDULE (continued)

	TOTAL TI	RESPIRATORY RI	ENTERIC EI	SKIN/WOUNDS SI
Books, magazines, toys, money	Taken out double-wrapped and treated with formol	-	If dirty, taken out double-wrapped and treated with formol	If dirty, taken out double-wrapped and treated with formol
Patients' records	Kept outside the ward	-	-	-
Visitors	Stay outside - if they enter, dress as hospital staff	Visitors immunized or masked	Visitors must not touch the bed or the patient (supervision)	Visitors must not touch the bed or the patient (supervision)
Monitoring equipment, respirators	Stay in the ward or removed under double wrapping and disinfected	-	-	-
Transport of patient	Plastic bag in which patient is placed	Mask for patient	Drawsheet - disinfected afterwards	Fabric protection of the sector - drawsheet to be disinfected afterwards
Cleaning equipment	Equipment kept in the room	If daily disinfection is effective, no further precautions	Equipment kept in the room	If daily disinfection is effective, no further precautions
Terminal disinfection	Formol	Chemical/mechanical disinfection or formol for overt tuberculosis	Chemical/mechanical disinfection	Chemical/mechanical disinfection

Precautions

(1) Respiratory precautions - RP

These concern patients whose airways secretions contain undesirable micro-organisms.

Their objective is to prevent cross-infection by micro-organisms which can be transmitted by direct contact with nasopharyngeal secretions.

The precautions to be taken are as follows:

- the patient should cough and spit into disposable handkerchiefs held in front of the mouth;
- the handkerchiefs should be thrown into an impervious bag attached to the bedside table;
- this bag, properly closed, should be emptied at least once a day together with the rubbish and incinerated;
- the staff may wear a mask.

(2) Enteric precautions - EP

These concern patients whose stools and/or urine contain undesirable micro-organisms.

Their objective is to prevent cross-infection by micro-organisms that can be transferred by direct contact with the stools or urine or with contaminated objects.

The precautions to be taken are as follows:

- washing of the hands before and after contact with the patient;
- the patient should wash his hands after defecation;
- disposable non-sterile gloves should be worn for handling objects contaminated with stools or urine.

Only staff who have been vaccinated should come into contact with poliomyelitis patients during the acute phase of the disease.

(3) Skin precautions - SP

These concern patients whose skin lesions contain undesirable micro-organisms.

Their objective is to prevent cross-infection by micro-organisms that can be transmitted by direct contact with the wound or contaminated objects, in diseases where the risk is minimal but present.

The precautions to be taken are as follows:

- washing of the hands before and after contact with the patient;
- aseptic technique for dressings;
- double wrapping of soiled dressings;
- immediate decontamination of soiled instruments.

8.2 Alphabetical list of conditions requiring isolation

A.	Actinomycosis, overt	SP
	Anthrax	TI
	Atopy	PI
B.	Burns, infected, covering over 20% of body surface	PI + TI
	Burns, severe, non-infected	PI
C.	Chickenpox	RI
	Cholera	EI
	Chorioepithelioma	PI
	Colostomy	SP
	Conjunctivitis, bacterial, acute	SP
D.	Decubitus ulcer, extensive or multiple, in necrotic phase	TI
	Dermatitis, bullous, generalized	PI
	Dermatitis, suppurative, acute, infected	SI
	Dermatosis, infected	TI
	Diphtheria	RI
	Drainage of infected cavities	SI
E.	Eczema, infantile (atopy)	PI
	Eczema, suppurative	TI
	Empyema	SI
	Enterocolitis, staphylococcal	TI
	Erysipelas	TI
F.	Favus	SI
	Food poisoning, bacterial	EP
	Furuncle	SI
	Furunculosis, generalized	TI
G.	Gastroenteritis, infantile, due to <u>E. coli</u>	EI
H.	Haemopathy, malignant	PI
	Hepatitis A	EI
	Hepatitis A, simple	EP
	Herpes, congenital	TI
I.	Impetigo, depending on extent	TI or SP
	Infection of soft parts (skin, muscles) (depending on micro-organism)	TI or SI
	Influenza	RP
	Irradiation, total	PI
K.	Keratoconjunctivitis, acute	SP

I.	Leprosy, lepromatous	SI
	Leptospirosis	EP
	Leukaemia, remission induction therapy	PI
	Lung abscess, non-staphylococcal	RP
	Lymphogranuloma venereum	SP
M.	Measles	RI
	Meningitis, lymphocytic, benign	RP
	Meningitis, meningococcal	RI
	Meningococcaemia	RI
	Mumps	RI
N.	Nocardiosis, overt	SP
O.	Ophthalmia, gonococcal, of newborn	SP
	Organ transplant	PI
P.	Pancytopenia	PI
	Panophthalmitis	SI
	Paratyphoid fever	EI
	Peritonitis, suppurative	SI
	Plague, pneumonic	TI
	Pneumonia, atypical	RP
	Pneumonia, bacterial, caused by staphylococci, <u>Pseudomonas aeruginosa</u> or enterobacteria	TI
	Pneumonia, pneumococcal	RP
	Poliomyelitis	EP
	Pyoderma, inextensive	SP
R.	Rabies	TI
	Respiratory virus infection	RP
	Rubella	RI
	Rubella, congenital	TI
S.	Salmonella infection	EI
	Severe damage to immunity mechanisms	PI
	Shigella infection	EI
	Skin infection, severe and extensive	TI or SI
	Smallpox	TI
	Soft chancre	SP
	Staphylococcal infection, cutaneous, extensive	TI
	Staphylococcal infection, cutaneous, inextensive	SI
	Streptococcal infection, cutaneous, extensive	TI
	Streptococcal infection, cutaneous, inextensive	SI
	Streptococcal sore throat	RP
	Syphilis (up to administration of 2.4 million I.U. penicillin)	SP

T.	Tinea (<u>Trichophyton</u>)	SI
	Tracheotomy patient, hospitalized	RI
	Tuberculosis, extrapulmonary, overt	SP
	Tuberculosis, miliary	TI
	Tuberculosis, pulmonary, with positive sputum tests	RI
	Typhoid fever	EI
	Typhoid fever, treated	EP
U.	Urinary infection	EP
V.	Vaccinia, generalized	TI
	Viral haemorrhagic fever (Lassa, Marburg, Ebola)	TI
W.	Whooping-cough, infantile	TI
	Wounds infected by <u>Pseudomonas aeruginosa</u> , staphylococci, streptococci and enterobacteria	SI

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